Francis Xavier Engineering College

(An Autonomous Institution)
Tirunelveli 627 003
Department of Electrical and Electronics Engineering

Curriculum and Syllabi – R 2021-UG

CHOICE BASED CREDIT SYSTEM AND OBE

Vision of the Department

To be a Centre of Excellence for Technology transformation in the field of Electrical and Electronics Engineering

Mission of the Department

- To empower the vibrant young leaders with technical skills and knowledge in the field of technology
- To facilitate the industries to adopt effective solutions in the field of Electrical and Electronics Engineering through consultancy
- To transform technology for rural needs and ethical values to lead and serve the society.

Table of Contents

Programme Educational Outcomes (PEOs)

PEO 1 – Professional Development: Graduates of the program will Engage in designing, manufacturing, testing, operating, and or maintaining systems in the field of electrical and electronic engineering and allied engineering industries.
PEO 2 – Social Responsibility: Graduates of the program will Solve problems of social relevance applying the knowledge of electrical and electronics engineering and or pursue higher education and research.
PEO 3 – Team Work and Leadership: Graduates of the program will Work effectively as individuals and as team members in multidisciplinary projects.
PEO 4 – Lifelong Learning & Virtues: Graduates of the program will Engage in lifelong learning, career enhancement and adopt to changing professional and societal needs.

Programme Specific Objectives (PSOs)

PSO 1 – To design and develop environmental friendly electrical and electronics products.
PSO 2 – To design and analyze system that efficiently generates, transmits, distribute and utilize electrical power.

Programme Outcomes (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping with PO Vs PEO, PSO

PO	PEO1	PEO2	PEO3	PEO4
1	3			2
2	3	3	3	
3	3	3		2
4	3	3		1
5			2	3
6	1	3		3
7		2		3
8		3		1
9			3	2
10	1	3	3	3
11			3	3
12			2	3
PSO1	2	2	3	
PSO2	3	2		2

FRANCIS XAVIER ENGINEERING COLLEGE

B.E. – EEE REGULATIONS 2021

S.No	Category	Credits Per Semester								Total Credits	Credit sin %
		I	II	III	IV	V	VI	VI I	VIII		
1	HSSM	4	3	3				3		13	7.78
2	BS	12	4	4						20	11.97
3	ES	9	9				3			21	12.57
4	PC		5	16	20	13	4	7		65	38.92
5	PE					6	6	6		18	10.78
6	OE					3	3	6		12	7.19
7	EEC			1	1	1	5		10	18	10.78
Total		25	21	24	21	23	21	22	10	167	**100**

Choice Based Credit System and Outcome Based Education

SUMMARY OF CREDIT DISTRIBUTION

Minimum Number of Credits to be acquired by regular students: 167

Minimum Number of Credits to be acquired by Lateral students: 121

HSSM - Humanities and Social Sciences including Management

BS - Basic Science

ES - Engineering Sciences

PC - Professional Core

PE - Professional Elective

OE – Open Elective/Programme Specific Elective for Expandable Scope

EEC - Employability Enhancement Course

FRANCIS XAVIER ENGINEERING COLLEGE

B.E. – EEE REGULATIONS 2021

Choice Based Credit System and Outcome Based Education

I-VIII Semester Curriculum and Syllabi

SEMESTER I

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MA1201	Matrices and Advanced Calculus	BS	4	3	1	0	4
2	21PH1301	Physics For Engineers	BS	3	3	0	0	3
3	21CY1401	Engineering Chemistry	BS	3	3	0	0	3
4	21CS1501	Problem Solving and Logical Thinking Using C	ES	3	3	0	0	3
5	21HS1103	Tamil Heritage	HSSM	3	2	0	0	1
Theory cum Practical Courses								
1	21HS1101	English for Professional Communication	HSSM	**3**	**2**	**0**	**2**	**3**
2	21ME1513	Computer Aided Engineering Graphics	ES	5	3	0	2	4
Practical Courses								
1	21PY1311	Physics and Chemistry Laboratory	BS	4	0	0	4	2
2	21CS1511	Programming Practice Laboratory using C	ES	4	0	0	4	2
			Total	**32**	**19**	**1**	**12**	**25**

SEMESTER II

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21HS2101	English for Technical Communication	HSSM	2	2	0	0	2
2	21MA2201	Partial Differential Equation and Applications of Fourier Series	BS	4	3	1	0	4
3	21ME1502	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3

4	21EE2601	Electric Circuits and Network Analysis	PC	3	3	0	0	3
5	21HS2103	Technology in Tamil Culture	HSSM	3	2	0	0	1
Theory cum Practical Courses								
1	21CS2501	Introduction to Computing Using Python	ES	4	3	0	2	4
Practical Courses								
1	21GE1512	Engineering Workshop	ES	4	0	0	4	2
2	21EE2611	Electrical Circuit Analysis Laboratory	PC	4	0	0	4	2
			Total	**27**	**16**	**1**	**10**	**21**

SEMESTER III

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21HS3101	Ethics and Values	HSSM	3	3	0	0	3
2	21MA3204	Transforms Techniques and Numerical Methods	BS	4	3	1	0	4
3	21EE3601	Analog and Integrated Circuits	PC	3	3	0	0	3
4	21EE3602	DC Machines and Transformers	PC	3	3	0	0	3
5	21EE3603	Fundamentals of Applied Electromagnetics	PC	3	3	0	0	3
6	21EE3604	Signals and Systems	PC	3	3	0	0	3
Practical Courses								
1	21EE3611	Analog and Integrated Circuit Design Laboratory	PC	4	0	0	4	2
2	21EE3612	DC Machines and Transformers Laboratory	PC	4	0	0	4	2
3	21PT3901	Soft Skills- Aptitude I	EEC	2	1	0	0	1
			Total	**29**	**19**	**1**	**8**	**24**

SEMESTER IV

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EE4601	Measurements and Modern Instruments	PC	3	3	0	0	3
2	21EE4602	Control Theory	PC	3	3	0	0	3
3	21EE4603	AC Machines	PC	4	3	1	0	4
4	21EE4604	Transmission and Distribution in Power Systems	PC	3	3	0	0	3
Theory cum Practical Courses								
1	21EE4605	Digital Electronics	PC	4	2	0	2	3
Mandatory Course								
1	21GE4M01	Indian Constitution and Cultural Heritage	MC	2	2	0	0	0
Practical Courses								
1	21EE4611	Control and Instrumentation Laboratory	PC	4	0	0	4	2
2	21EE4612	AC Machines Laboratory	PC	4	0	0	4	2
3	21PT3902	Soft Skills-Verbal Ability	EEC	2	0	0	2	1
			Total	**29**	**16**	**1**	**12**	**21**

SEMESTER V

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EE5601	Microcontrollers and its Applications	PC	3	3	0	0	3
2	21EE5602	Power Electronics andDrives	PC	3	3	0	0	3
3	21EE5603	Power Generation systems	PC	3	3	0	0	3
4		Professional Elective – I	PE	3	3	0	0	3

5		Professional Elective – II	PE	3	3	0	0	3
6		Open Elective – I	OE	3	3	0	0	3
Practical Courses								
1	21EE5611	Power Electronics Laboratory	PC	4	0	0	4	2
2	21EE5612	Microcontrollers Laboratory	PC	4	0	0	4	2
3	21PT3903	Soft Skills- Aptitude II	EEC	2	0	0	2	1
			Total	**28**	**18**	**0**	**10**	**23**

SEMESTER VI

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EE6601	Power System Analysis	PC	4	3	1	0	4
2		Professional Elective – III	PE	3	3	0	0	3
3		Professional Elective – IV	PE	3	3	0	0	3
4		Open Elective – II	OE	3	3	0	0	3
Theory cum Practical Courses								
1	21EE6501	Embedded System Design and Development	ES	4	2	0	2	3
Mandatory Course								
1	21GE2M02	Environmental and Sustainable Engineering	MC	2	2	0	0	0
Practical Courses								
1	21PT3904	Soft Skills-Reasoning	EEC	2	0	0	2	1
2	21EE6911	Comprehension	EEC	4	0	0	4	2
3	21EE6912	Mini Project/ Internship	EEC	4	0	0	4	2
			Total	**29**	**17**	**1**	**12**	**21**

SEMESTER VII

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21GE7101	Total Quality Management	HSS	3	3	0	0	3
2	21EE7601	Renewable Energy Systems	PC	3	3	0	0	3
3		Professional Elective-V	PE	3	3	0	0	3
4		Professional Elective-VI	PE	3	3	0	0	3
5		Open Elective – III	OE	3	3	0	0	3
6		Open Elective – IV	OE	3	3	0	0	3
Practical Courses								
1	21EE7611	Power System Simulation Laboratory	PC	4	0	0	4	2
2	21EE7612	Renewable Energy Systems Laboratory	PC	4	0	0	4	2
			Total	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Practical Courses								
1	21EE8901	Project Work	EEC	20	0	0	20	10
			Total	**20**	**0**	**0**	**20**	**10**

Minimum Number of Credits to be Acquired:167

Humanities and Social Sciences Including Management

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21HS2101	English For Technical Communication	HSSM	2	2	0	0	2
2	21HS3101	Ethics and Values	HSSM	3	3	0	0	3
3	21GE7101	Principles of Management	HSSM	3	3	0	0	3
4	21HS1103	Tamil Heritage	HSSM	3	2	0	0	1
5	21HS2103	Technology in Tamil Culture	HSSM	3	2	0	0	1
Theory cum Practical Courses								
1	21HS1101	English for Professional Communication	HSSM	3	2	0	2	3

List Basic Science Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MA1201	Matrices and Advance Calculus	BS	4	3	1	0	4
2	21PH1301	Physics For Engineers	BS	3	3	0	0	3
3	21CY1401	Engineering Chemistry	BS	3	3	0	0	3
4	21MA2201	Partial Differential Equation and Applications of Fourier Series	BS	4	3	1	0	4
5	21MA3204	Transforms Techniques and Numerical Methods	BS	4	3	1	0	4
Theory cum Practical Courses								
1	21PY1311	Physics and Chemistry laboratory	BS	4	0	0	4	2

List of Engineering Science Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21ME1502	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3
2	21CS1501	Problem Solving and Logical Thinking Using C	ES	3	3	0	0	3
Theory cum Practical Courses								
1	21EE6501	Embedded System Design and Development	ES	4	2	0	2	3
2	21CS2501	Introduction to Computing Using Python	ES	4	3	0	2	4
3	21ME1513	Computer Aided Engineering Graphics	ES	5	3	0	2	4
Practical Courses								
1	21CS1511	Programming Practice Laboratory Using C	ES	4	0	0	4	2
2	21GE1512	Engineering Workshop	ES	4	0	0	4	2

List of Employability Enhancement Course

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21PT3901	Soft Skills - Aptitude I	EEC	2	1	0	0	1
2	21PT3902	Soft Skills -Verbal Ability	EEC	2	0	0	2	1
3	21PT3903	Soft Skills - Aptitude II	EEC	2	0	0	2	1
4	21PT3904	Soft Skills -Reasoning	EEC	2	0	0	2	1
5	21EE6911	Comprehension	EEC	4	0	0	4	2
6	21EE6912	Mini Project/ Internship	EEC	4	0	0	4	2
7	21EE8901	Project Work	EEC	20	0	0	20	10

List of Professional Elective Courses

S.No	Course Code	Course Name	Semester	L	T	P	C	Stream/ Domain
Professional Elective I								
1	21EE5701	Design of Electrical Machines	5	3	0	0	3	Power systems
2	21EE5702	Modern Control Theory	5	3	0	0	3	Instrumentation and Control
3	21EE5703	Digital Signal Processingand its Applications	5	3	0	0	3	Embedded and IoT
4	21EE5704	Virtual Instrumentation	5	3	0	0	3	Instrumentation and Control
5	21EE5705	Artificial Intelligence andExpert System	5	3	0	0	3	Embedded and IoT
6	21EE5706	Internet of Things and its Applications	5	3	0	0	3	Embedded and IoT
7	21EE5101	Applied Industrial IoT (Industrial Supported course)	5	3	0	0	3	Embedded and IoT
Professional Elective II								
1	21EE5707	Power System transients	5	3	0	0	3	Power systems
2	21EE5708	Protection and switchgear	5	3	0	0	3	Power systems
3	21EE5709	Communication Engineering	5	3	0	0	3	Embedded and IoT
4	21EE5710	CMOS Analog IC Design	5	3	0	0	3	Embedded and IoT
5	21EE5711	Neural Networks and Fuzzy Logic Control	5	3	0	0	3	Embedded and IoT
6	21EE5712	Biomedical Engineering	5	3	0	0	3	Instrumentation and Control
Professional Elective III								
1	21EE6701	Industrial Drives and control	6	3	0	0	3	Industrial Drives and Electric Vehicles
2	21EE6702	High Voltage Direct Current Transmission	6	3	0	0	3	High Voltage

3	21EE6703	Fuel Cell and Hydrogen Energy	6	3	0	0	3	Industrial Drives and Electric Vehicles
4	21EE6704	EHVAC Transmission	6	3	0	0	3	High Voltage
5	21EE6705	Energy Conservation and Auditing	6	3	0	0	3	Industrial Drives
6	21EE6706	Electrical Substation Engineering	6	3	0	0	3	High Voltage
Professional Elective IV								
1	21EE6707	Design of SMPS and UPS	6	3	0	0	3	Industrial Drives and Electric Vehicles
2	21EE6708	Design of Electrical Installations	6	3	0	0	3	High Voltage
3	21EE6709	Smart Grid Technologies	6	3	0	0	3	Embedded and IoT
4	21EE6710	Electrical Safety and Quality Assurance	6	3	0	0	3	Power systems
5	21EE6711	Intelligent Systems and Control	6	3	0	0	3	Embedded and IoT
6	21EE6712	Low Power VLSI Design	6	3	0	0	3	Embedded and IoT
7	21EE6713	Extra low voltage system design for buildings (Industrial Supported course)	6	3	0	0	3	Power systems
8	21EE6714	Smart grid technologies (Industrial Supportedcourse)	6	3	0	0	3	Embedded and IoT
9	21EE6715	FPGA design for Industrial Applications(VLSI) (Industrial Supported course)	6	3	0	0	3	Embedded and IoT
Professional Elective V								
1	21EE7710	Modern Power Converters	7	3	0	0	3	Industrial Drives and Electric Vehicles
2	21EE7711	Power Quality	7	3	0	0	3	Power systems
3	21EE7712	Advanced Power Semiconductor Devicesand Protection	7	3	0	0	3	Industrial Drives and Electric Vehicles

4	21EE7713	Microcontroller Based System Design	7	3	0	0	3	Embedded and IoT
5	21EE7714	Wind Energy Conversion Systems	7	3	0	0	3	Industrial Drives and Electric Vehicles
6	21EE7715	Power Electronics for Renewable Energy Systems	7	3	0	0	3	Industrial Drives and Electric Vehicles
7	21EE7716	Renewable energy and Power evacuation (Industrial Supported course)	7	3	0	0	3	Industrial Drives and Electric Vehicles
Professional Elective VI								
1	21EE8701	Generation, Utilization and conservation of electrical Energy	7	3	0	0	3	Power systems
2	21EE8702	Power System Operation and Control	7	3	0	0	3	Power systems
3	21EE8703	High Voltage Engineering	7	3	0	0	3	High Voltage
4	21EE8704	Industrial Automation and Control	7	3	0	0	3	Industrial Drives and Electric Vehicles
5	21EE8705	Special Electrical Machines and Controllers	7	3	0	0	3	Industrial Drives and Electric Vehicles
6	21EE8706	Electrical and Hybrid Electric Vehicles	7	3	0	0	3	Industrial Drives and Electric Vehicles
7	21EE8707	Cyber physical systems for Industrial applications (Industrial Supported course)	7	3	0	0	3	Embedded and IoT

List of Open Electives Courses

S.No	Course Code	Course Name	Semester	L	T	P	C	Offered By
Open Elective I								
1	21EE5801	Biomedical Instrumentation	5	3	0	0	3	EEE
2	21EE5802	Sensors and Transducers	5	3	0	0	3	EEE
3	21EE5803	Principles of Robotics	5	3	0	0	3	EEE

4	21EE5804	Micro Electro Mechanical Systems	5	3	0	0	3	EEE
5	21EE5805	Automotive Electrical and Electronics System	5	3	0	0	3	EEE
6	21EE5806	PCB Design and its Fabrication	5	3	0	0	3	EEE
Open Elective II								
1	21EE6801	Energy Conservation and Auditing	6	3	0	0	3	EEE
2	21EE6802	Fundamentals and Modelling of Solar PV Systems	6	3	0	0	3	EEE
3	21EE6803	Generation of Electrical energy	6	3	0	0	3	EEE
4	21EE6804	PLC and SCADA	6	3	0	0	3	EEE
5	21EE6805	Power Electronics for Renewable Energy Systems	6	3	0	0	3	EEE
6	21EE6806	Fibre Optic and Laser Instrumentation	6	3	0	0	3	EEE
Open Elective III								
1	21EE7801	Electrical Equipment safety	7	3	0	0	3	EEE
2	21EE7802	Measurement and Instrumentation System	7	3	0	0	3	EEE
3	21EE7803	Control Engineering	7	3	0	0	3	EEE
4	21EE7804	Electrical Machines	7	3	0	0	3	EEE
5	21EE7806	Electric Vehicles and Control	7	3	0	0	3	EEE
Open Elective IV								
1	21EE8801	Wind Energy Conversion Systems	8	3	0	0	3	EEE
2	21EE8802	Electrical Safety	8	3	0	0	3	EEE

3	21EE8803	Energy Storage Systems	8	3	0	0	3	EEE
4	21EE8804	Industrial Drives and control	8	3	0	0	3	EEE
5	21EE8806	Electrical Wiring Estimation and Costing	8	3	0	0	3	EEE

Note: The Prerequisite for the courses offered in Open Elective II shall be of any courses offered as Open elective I

List of Minor/Specialization Honour Degree Courses

Robotics in Industrial Automation

S.No	Course Code	Course Name	Semester	L	T	P	C
1	21EE4S01	Industry 4.0	4	3	0	0	3
2	21EE5S01	Sensors and Actuators	5	3	0	0	3
3	21EE6S01	Artificial Intelligence for Robotics (Practical cum Theory)	6	2	0	4	4
4	21EE7S01	Digital Image Processing and Machine Vision (Practical cum Theory)	7	2	0	4	4
5	21EE8S01	Project	8	0	0	8	4

List of Value Added Courses

S.No	Course Code	Course Name	Category	L	T	P	C
1	21EE0V01	Embedded System Design using Arduino	VAC	0	0	4	2
2	21EE0V02	Raspberry Pi	VAC	0	0	4	2
3	21EE0V03	Solar Photo Voltaic System	VAC	0	0	4	2
4	21EE0V04	Lab VIEW	VAC	0	0	4	2
5	21EE0V05	Electronic testing	VAC	0	0	4	2
6	21EE0V06	Energy Auditing	VAC	0	0	4	2

7	21EE0V07	Electrical and Hybrid Vehicles	VAC	0	0	4	2

List of Value Added Skills

S.No	Course Code	Course Name	Semester	L	T	P	C
1	21SKL201	Applied Numerical Methods Using MATLAB	2	0	0	4	2
2	21SKL301	Multisim live	3	0	0	4	2
3	21SKL401	Sensor Interface with Controllers	4	0	0	4	2
4	21SKL501	Machine Learning for Electrical Engineers	5	0	0	4	2

Semester I

Theory Courses

21MA1201	MATRICES AND ADVANCED CALCULUS	L	T	P	C
		3	1	0	4

Preamble:

The course consists of topics in Matrices, Differential calculus, Integral calculus, Differential Equations and Vector calculus with applications to various engineering problems. This course will cover the following main topics: Cayley Hamilton Theorem, Linear differential equations of second order with constant coefficients, Methods of Variation parameter, Taylor's expansion of two variables, Maxima and Minima for two variables, Area and Volume in multiple integrals, Green's theorem and Gauss divergence theorem.

Prerequisites for the course:

Students should have basic knowledge about matrices, differentiation and integration

Objectives

1. To apply advanced matrix knowledge to Engineering problems
2. To familiarize with the applications of differential equations.
3. To familiarize with the functions of several variables
4. To have Knowledge in Multiple integrals
5. To improve their ability in Vector calculus.

UNIT I	MATRICES	9+3

Matrices - Characteristic equation – Eigen values and Eigen vectors of a symmetric and non symmetric matrix – Properties of Eigen values and Eigen vector – Cayley – Hamilton theorem and its applications

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Eigen values , Eigen Vectors and Cayley Hamilton Theorem and Add MATLAB and for application Add Power method to find Eigen value & Eigen vector

UNIT II	ORDINARY DIFFERENTIAL EQUATIONS	9+3

Differential Equations – Complementary Function – Particular Integral - Linear equations of second order with constant coefficients of types exponential, trigonometry, polynomial and its combination forms - Methods of Variation of parameter - Engineering Applications.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Linear differential equations of different types and Method of Variation parameters.

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	9+3

Function of two variables – Partial derivatives – Taylor's expansion for two variables – Maxima and Minima for two variables – Jacobians of two and three variables – Euler's theorem for homogeneous function.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Taylor's series, Jacobians, Maxima and Minima for two variables

UNIT IV	MULTIPLE INTEGRALS	9+3

Definite Integrals – Properties of definite integrals - Double integration in Cartesian coordinates – Area as a double integral in Cartesian coordinates – Triple integration in Cartesian coordinates – Volume as a Triple Integral

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Area , Triple integration and Volume

UNIT V	VECTOR CALCULUS	9+3

Vector dot product and Vector cross product - Gradient, divergence, curl – Solenoidal and irrotational fields –Unit normal vector - Angle between two surfaces - Directional derivatives – Green's theorem, Gauss divergence theorem (without proof) – Engineering Applications.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Angle between two surfaces, Green's theorem, Gauss divergence theorem.

Total Periods	**45 + 15 = 60 Periods**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
1. Descriptive Questions	1.Assignment 2. Online Quizzes	**1. Descriptive Questions**

Outcomes

Upon completion of the course, the students will be able to:

CO1: Find the eigen values, eigen vectors, inverse and the positive powers of a square matrix (Apply)

CO2: Identify the suitable method to solve second and higher order differential equations (Apply)

CO3: Find the maxima and minima for a given function with several variables, through by finding stationary points (Apply)

CO4: Compute area and volume using double and triple integration. (Apply)

CO5: Apply the concepts of Differentiation and Integration to Vectors. (Apply)

Text Books

1. B. S. Grewal, " Higher Engineering Mathematics", 43rd edition, 2017.
2. James Stewart, Calculus – Early Transcendals, 8th Edition, 2016.

Reference Books

1. A Textbook of Engineering Mathematics(Dr. A.P.J. Abdul Kalam Technical University, Lucknow) (For . Gautam Bhudh technical Universities ,Lucknow) January 2020
2. K. Ganesan, Sundarammal Kesavan, K. S. Ganapathy Subramanian & V. Srinivasan, "Calculus and Solid Geometry", Revised Edition, 2017

Web Resources

1. Eigen values and eigen vectors - https://youtu.be/h5urBuE4Xh Cayley Hamilton theorem -https://youtu.be/WROFJ15hk00
2. ODE - https://youtu.be/Im242eBqaxw
3. Functions of several variables -https://youtu.be/PA82F91e1vs
4. Integration - https://youtu.be/bVui07yHjzE, Multiple integrals - https://youtu.be/3BbrC9JcjOU
5. Volume as Triple integral - https://youtu.be/w_KiHgultbM
6. Vector calculus - https://youtu.be/v3ZC4Mo1fS0i
   Gauss divergence theorem https://youtu.be/U9LDcmKUGS0

CO Vs PO Mapping and CO Vs PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2												
4	3	2												
5	3	2												

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT-1	CAT-2	FAT-1	FAT-2	
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYSE	0	0	0	0	0
EVEALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

1- Low, 2- Medium, 3-High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) : (Apply)

1) Compute the eigen values and eigen vectors for the Symmetric matrix A = $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$

2) Find A^{-1} and A^4 using Cayley Hamilton Theorem for the matrix A= $\begin{bmatrix} 1 & -1 & 4 \\ 3 & 2 & -1 \\ 2 & 1 & -1 \end{bmatrix}$.

COURSE OUTCOME 2 (CO 2) : (Apply)

1) Solve $(D^2 - D + 1)y = sin\ sin\ 2x\ + e^{-4x}$

2) Solve $(D^2 + a^2)\ y = tan\ tan\ ax$ by using method of variation of parameters.

COURSE OUTCOME 3(CO 3) : (Apply)

1. Find the extreme values of the function $f(x, y)$= $x^3 + y^3 - 12x - 3y + 20$.
2. Calculate the maxima and minima of the function $f(x, y) = x^3y^2$ (1-x-y).

COURSE OUTCOME 4(CO 4) : (Apply)

1)Find the area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

2) Find $\int_0^a \int_0^b \int_0^c xyz\, dz\, dy\, dx$

COURSE OUTCOME 5(CO 5) : (Apply)

1. Find the directional derivative of $\emptyset = xy^2 + yz^3$at the point (2,-1,1) in the direction of $\vec{i} + 2\vec{j} + 2\vec{k}$.
2. Using Green's theorem , find $\int_c (x^2 - y^2)dx + 2xydy$ where C is the boundary of the rectangle in the XOY-plane bounded by the lines $x = 0, x = a, y = 0, y = b$.
3. Verify Gauss divergence theorem for $\vec{F} = 4xz\vec{i} - y^2\vec{j} + yz\vec{k}$ over the cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0$ and $z = 1$.

21PH1301	PHYSICS FOR ENGINEERS (Common to AI&DS, CSE, CSBS, IT, ECE & EEE)	L	T	P	C
		3	0	0	3

Preamble

The aim of this course is to impart fundamental knowledge in materials which are essential in understanding and explaining engineering devices.

Prerequisites for the course

Basic theoretical concepts of Physics in XI and XII.

Objectives

1. To impart knowledge about electrical properties of materials.
2. To instill knowledge on physics of Semiconductor and device applications.
3. To enable the students to gain knowledge on magnetic properties.
4. To establish a sound grasp of knowledge on different optical properties of materials ,optical displays and applications.
5. To inculcate an idea of significance of nano structures, quantum confinement and ensuring nano device applications .

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory – Expression for electrical conductivity – Thermal conductivity– Wiedemann -Franz law –Merits and Demerits – Quantum theory - Fermi- Dirac statistics – Density of energy states.

UNIT II	**SEMICONDUCTORS PHYSICS**	**9**
Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors –Extrinsic semiconductors – N-type & P-type semiconductors (Qualitative)– variation of Fermi level with temperature and impurity concentration – Hall effect and devices.-Ohmic contacts-Schottky diode.		
UNIT III	**MAGNETIC PROPERTIES OF MATERIALS AND ITS DEVICE**	**9**
Magnetism in materials – magnetic field and induction – magnetization – magnetic permeability and susceptibility– Classification of Magnetic materials– Domain Theory - M versus H behavior - Hard and Soft magnetic materials–examples and uses–Magnetic Principle in computer data storage - Magnetic Resonance Imaging. - quantum interference devices-GMR devices		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS AND ITS DEVICES**	**9**
Classification of Optical Materials–carrier generation and recombination processes– Absorption, Emission and Scattering of light in metals, Insulators and Semiconductors –Light detectors- Solar cell–LED–Organic LED–Laser Diodes– Optical Data Storage Techniques.		
UNIT V	**NANOMATERIALS AND ITS DEVICES**	**9**
Quantum Confinement Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure –Band gap of nanomaterials –Tunneling: Single electron phenomena and single electron transistor- Quantum dot Laser- Carbon Nanotubes - Properties and Applications		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive	1. Assignment 2. Online Quizzes 3. Problem-Solving Activities	Descriptive

Outcomes

Upon completion of the course, the students will be able to :

CO 1	Expound the basics of classical and quantum electron theories. **Understand**
CO 2	Acquire knowledge on basic semiconductor physics and its application in various devices. **Understand**
CO 3	Identify the properties of magnetic materials and their applications in data storage. **Understand**

CO 4	Understand the functions of optical materials for Optoelectronics. **Understand**
CO 5	Interpret quantum theory concepts & study the density of states for various Quantum Confinements. **Apply**

Text Books

1. Dr. P. Mani,"Physics for Information Science",SreeDhanam Publisher, 2017
2. Senthilkumar G, Murugavel S, "Physics for Information Science",VRB Publication, 2017-2018

Reference Books

1. Srinivasan.P, "Physics for Electronics Engineering". Vishnu Prints Media, 1st edition Jan 2018
2. Kasap, S.O., Principle of Electronic Materials and devices, Tata Mc-Graw Hill Education, 20 th reprint 2019.
3. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.
4. S. Salivahanan,A. Rajalakshmi"Physics for Electronics Engineering and Information Science"- Tata Mc-Graw Hill Education,29 January 2018.

Web Resources

1. UNIT 1 -https://www.britannica.com/science/Fermi-Dirac-statistics
2. UNIT 2&4 -https://onlinecourses.nptel.ac.in/noc23_mm02/preview
3. UNIT 2- http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1
4. UNIT 3- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934330/
5. UNIT 1 TO 5- https://easyengineering.net/ph8253-physics-for-electronics-engineering/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2					1					1		
2	2	2					1					1		
3	2	2					1					1		
4	2	2					1					1		
5	2	2	1				1					1		

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDERSTAND	50	50	20	20	40
APPLY	40	40	20	20	50
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	**100**	**50**	**50**	**100**

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Expound the basics of classical and quantum electron theories.(Understand)

1. The thermal conductivity of copper at 300 K is 470.4 $Wm^{-1}K^{-1}$.Calculate theelectrical conductivity of copper at 300 K. (Lorentz number = 2.45×10^{-8})
2. On the basis of classical free electron theory derive an expression for the electricalconductivity.
3. Explain fermi dirac distribution for electrons in a metal and discuss the effect oftemperature on fermi function.

COURSE OUTCOME 2: Acquire knowledge on basic semiconductor physics and itsapplication in various devices. (Understand)

1. Derive an expression for the number of electrons in the conduction band of anintrinsic semiconductor.
2. Show that for a n-type semiconductor the hall Coefficient is given by $RR=+\frac{1}{ne}$. Describe an experimental setup to measure the Hall voltage.

COURSE OUTCOME 3: Identify the properties of magnetic materials and their applications indata storage. (Understand)

1. Distinguish between dia, para,ferro,antiferro and ferrimagnetic materials
2. Write short notes on magnetic recording materials and discuss any one in detail.

COURSE OUTCOME 4: Understand the functions of optical materials for Optoelectronics.(Understand)

1. An LED emits green light of wavelength (λ) = 5511.11 A^0. Find out the value of E_g.
2. Explain the theory and working of LEDs. What are the different types of LED? Explainthe advantages.
3. Explain the construction and working of solar cells.

COURSE OUTCOME 5: Interpret quantum theory concepts & study the density of states forvarious Quantum confinements. (Apply)

1. Using the concept of DOS (Density of State) expound the different quantumconfinements.
2. Using the single electron transistor interrupts the phenomena of a single electron.
3. Show the variation using the density of states in nanostructures for differentdimensions.

21CY1401	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

Preamble

To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like electrochemistry, corrosion prevention methods, significance of alloys, benefits of renewable energy sources, engineering materials, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of engineering chemistry.

Prerequisites for the course

Basic theoretical concepts of Chemistry in higher secondary level.

Objectives

1. To inculcate sound understanding of water quality parameters and water treatment techniques.
2. To make the students familiar with the principles of electrochemistry and corrosion.
3. To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
4. To have a thorough understanding on the principles and generation of energy in

batteries, nuclear reactors, solar cells, windmills, fuel cells and supercapacitors .

5. To make the students learn the basics of polymer chemistry, composites and nanomaterials.

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness of water by EDTA –Municipal water treatment- Boiler troubles (scale and sludge) – Treatment of boiler feed water – Internal treatment (phosphate and calgon conditioning)-External treatment – Ion exchange process- Desalination of brackish water - Reverse Osmosis.		
UNIT II	**ELECTROCHEMISTRY AND CORROSION**	**9**
Electrodes- types, Cells- types, Construction (Daniel cell) - Electrode potential- Photo electrochemical cell-working and applications – Nernst equation and its applications- Emf series & its applications. Corrosion- Causes- Types- Chemical, Electrochemical corrosion (galvanic, differential aeration), Corrosion control – Material selection and design aspects – Electrochemical protection – Sacrificial Anode cathodic Protection method.		
UNIT III	**PHASE RULE AND ALLOYS**	**9**
Phase rule: Introduction, definition of terms with examples, One component system -Water system - Reduced Phase rule - Two component systems - Lead-Silver system – Pattinson's process. Alloys: Introduction- Properties of alloys- Significance of alloying, Nichrome and Stainless steel (18/8) – Heat treatment of steel - Annealing - Tempering - Normalising - Hardening and Quenching - Surface hardening methods - Carburising - Nitriding.		
UNIT IV	**ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear fission - Nuclear fusion - Differences between nuclear fission and fusion - Nuclear chain reactions - Nuclear energy - Light Water Nuclear Power Plant - Solar energy conversion - Solar cells - Wind energy. Batteries & Fuel cells: Types of batteries – Primary battery (dry cell) Secondary battery (lead acid battery) Lithium ion battery – Electric Vehicles – working principles, Fuel cells – H_2-O_2 fuel cell and microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
UNIT V	**ENGINEERING MATERIALS**	**9**
Polymers: Classification of Polymers – Preparation, properties and uses of Teflon and Nylon 6,6- Benefits and Applications. Composites: Introduction: Definition & Need for composites; Properties and applications of Polymer matrix composites and hybrid composites. Nanomaterials: Types of nanomaterials;properties and uses of nanoparticle, nanocluster, nano rod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, chemical vapour deposition and electrochemical deposition methods. Applications of nanomaterials in medicine, agriculture, energy and electronics.		

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	ASSIGNMENT & ONLINE QUIZZES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Infer the quality of water parameters from quality parameter data and proposesuitable methodologies to treat water. (Remember)
2	Identify and apply the basic principles of electrochemistry and corrosion.(Understand)
3	Identify suitable alloys for material analysis. (Remember)
4	Identify different forms of energy resources and apply them in suitable energysectors. (Apply)
5	Recognise and apply basic knowledge on polymers and nanomaterial's to futuristic material fabrication needs. (Understand)

Text Books

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2018
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai PublishingCompany (P) LTD, New Delhi, 2018

Reference Books

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.

Web Resources

1. NPTEL Coursehttps://www.digimat.in/nptel/courses/video/121106014/L01.html

2. Mod-06 Lec-36 Fundamentals of Electrochemical Techniques

https://www.youtube.com/watch?v=l2ENx_Y0dNU

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2				2						2		
2	2	2				2						2		
3	2	2										2		
4	2	2										2		
5	2	2										2		

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	30	30	10	10	30
UNDERSTAND	30	30	10	10	30
APPLY	20	20	5	5	20
ANALYZE	20	20	0	0	20
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to demonstrate the knowledge of water and their quality used in different industries. (Remember)

1. How is the exhausted resin regenerated in an ion exchanger?
2. Suggest your valuable ideas to protect the boiler from corrosion.

COURSE OUTCOME 2: Students will be able to identify and apply the basic principles of electrochemistry and corrosion. (Understand)

1. Compare the mechanisms involved in electrochemical cells and electrolytic cells.

2. How corrosion is prevented by sacrificial anode cathodic protection methods.

COURSE OUTCOME 3: Students will be able to identify suitable alloys for material analysis. (Remember)

1. Illustrate phase, component and degree of freedom with example
2. Will stainless steel rust? Justify.

COURSE OUTCOME 4: Students will be able to identify different forms of energy resources and apply them in suitable energy sectors. (Apply)

1. Is it safe to utilize wind energy for domestic purposes? How are commercial wind farms developed and how can I get a wind farm on my property?
2. Critically analyze nuclear power technology in terms of environmental and health safety. Draw a general layout of the Light water nuclear reactor and explain its components.

COURSE OUTCOME 5: Students will be able to recognise and apply basic knowledge on polymers and nanomaterial's to futuristic material fabrication needs. (Understand

1. What do you feel the repercussions are for extended life through utilization of nanotechnology
2. Give an account of the preparation properties and uses of Teflon and nylon 6,6.

21CS1501	PROBLEM SOLVING AND LOGICAL THINKING USING C	L	T	P	C
		3	0	0	3

Preamble

This course aims to provide the students with a foundation in computer programming. The focus is to develop the basic problem solving skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems.This will enable the students to develop modular applications related to the field of engineering.

Prerequisites for the course

- NIL

Objectives

1. To learn the basic constructs of C Programming.
2. To learn arrays and strings concepts of C Programming.
3. To learn functions in C and use pointers for storing data in the main memory efficiently.
4. To learn structures and union concepts of C Programming
5. To learn file processing functions and further develop applications in C

UNIT I	INTRODUCTION TO PROBLEM SOLVING AND BASICS OF C PROGRAMMING	10

Introduction to Computer Software-Generations of programming languages- problem solving and logical thinking- Algorithm- Flowcharts - practical examples- Characteristics of C-uses of C-Structure of a 'C' program – Files used in C programs- Compiling and executing C programs - C Tokens- Character Sets in C- Keywords- Identifiers- Using comments in C

SUGGESTED ACTIVITIES

- Discussion on Logical and Algorithmic thinking
- Demonstration of concepts using Algorithms and Flowcharts

SUGGESTED EVALUATION METHODS

- Write basic programs in C based on algorithm and flowchart
- Quiz on problem solving and basics of C programming

UNIT II	DECISION CONTROL STATEMENTS AND ARRAYS	10

Data Types- Variables- Constants- Managing Input and Output operations in C- Operators and Expressions- Type Conversion- Type casting- Decision Making: Branching and Iterative statements- Nested Loops-break and continue statements- Arrays: Declaration, Initialization- Operations- One dimensional Arrays- Two Dimensional Arrays- Multidimensional Arrays.

SUGGESTED ACTIVITIES

- Demonstrate the use of data types and operators
- Comparison study on the types of decision making and looping statements
- Comparison study with examples on the types of arrays

SUGGESTED EVALUATION METHODS

- Demonstration of programs using Nested if and Nested loops
- Demonstration of programs using arrays and its operations
- Quiz on data types, operators, statements, loops and arrays

UNIT III	FUNCTIONS, STRINGS AND POINTERS	10

Functions: Declaration and prototyping- Definition- Types- Call and Return statement- Parameter passing methods- Recursion and types. Strings: String operations- Arrays of Strings –Pointers: Declaration- Definition- Pointer Arithmetic- Null pointers- Pointers and Arrays- Pointers and Functions- Pointers and Strings- Pointers to Pointers, Dynamic Memory Allocation

SUGGESTED ACTIVITIES

- Discussion on array of pointers, function pointers and array of function pointers
- Comparison study on the types of dynamic memory allocation
- Solve problems on pointers to arrays,pointers to functions and pointers to pointers

SUGGESTED EVALUATION METHODS

- Demonstration of programs usingpre defined, user defined and recursive functions
- Demonstration of programs using String manipulation functions
- Quiz on basics of functions, strings and pointers

UNIT IV	STRUCTURE, UNION AND ENUMERATED DATA TYPES	8

Structure: Declaration and Initialization- Nested Structures- Array of Structures- Structures and functions- pointers to structures- Self-referential structures. Unions: Declaration and Initialization- Arrays of union variables- unions inside structures- Enumerated data types

SUGGESTED ACTIVITIES

- Discussion and comparison of Structures and Unions
- Solve problems by using nested structures and union inside structures

SUGGESTED EVALUATION METHODS

- Demonstration of programs using pointers to structures and self referential structures
- Demonstration of programs using enumerated data types and its operations

UNIT V	FILE PROCESSING AND PRE PROCESSOR DIRECTIVES	7

Introduction to Files – Using Files in C- Read data from files- Write data to files- Error Handling during file operations- Command line arguments- Random file functions- Pre processor Directives: Introduction-Types- Unconditional directives- Conditional Directives- examples

SUGGESTED ACTIVITIES

- Assignment on modes of operations using files in C
- Discussion on types of pre-processor directives

SUGGESTED EVALUATION METHODS

- Demonstration of programs using file operations
- Demonstration of programs using pre-processor directives

Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
1. DESCRIPTIVE QUESTIONS 2. PROGRAMING AND PROBLEM SOLVING QUESTIONS	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	1.DESCRIPTIVE QUESTIONS 2. PROGRAMING AND PROBLEM SOLVING QUESTIONS

Course Outcomes

Upon completion of the course, the students will be able to:

CO1 Apply algorithmic thinking to understand, define and solve problems (Apply)
CO2 Write simple programs in C using basic constructs, loops and arrays (Apply)
CO3 Use strings, functions and pointers in C to solve complex problems (Apply)
CO4 Write programs in C using structures and union to store different data (Apply)
CO5 Apply file operations and advanced features to develop real time solutions (Apply)

Text Books

1. Reema Thareja, "Programming in C",, Second edition, 2016
2. Beecher K. Computational Thinking: A beginner's guide to Problem-solving and Programming. BCS Learning & Development Limited, 2017.

Reference Books

1. Byron Gottfried "Programming With C" Fourth Edition, McGrawHill, 2018.
2. Yashvant P. Kanetkar. "Let Us C", BPB Publications, 2016.

Web Resources

1. https://www.programiz.com/c-programming
2. https://nptel.ac.in/courses/106105171/
3. https://www.javatpoint.com/c-programming-language-tutorial
4. https://www.tutorialspoint.com/cprogramming/index.htm
5. https://www.w3schools.com/c/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3			2							1	
2	3	3	3			2							1	
3	3	3	3			2							2	
4	3	3	3			2							2	
5	3	3	3			2							3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	10	5	5	10
UNDERSTAND	40	20	10	10	20
APPLY	40	50	5	5	50
ANALYZE		20	5	5	20
EVALUATE					
CREATE					

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): (Apply)

Write algorithm and draw flowchart

1. To count the even numbers between 1 and 200 and print the sum
2. To calculate the simple interest and compound interest
3. To calculate sum of the digits of a number and check if “sum” is an Armstrong number

Course Outcome 2 (CO2): (Apply)

1. Write a program to print the grade of a student based on his marks using switch case.
2. Write a program to print the following pattern

1
22
333
4444
55555

3. Write a program to input the elements of a two dimensional array. Then from this array make two arrays: one that stores all the odd elements of the array and other that stores all the even elements of the array

Course Outcome 3 (CO3): (Apply)

1. Write a program using function to calculate 'x' to the power of 'y' where 'y' can be positive or negative.
2. Write a program to read a paragraph. Then count the number of words, number of lines, number of vowels and number of sentences in it
3. Find the output of the following:

```
main(){
char *str="ABCDEFGH";
(*str++);        // what will happen if str++; is given here??
printf("%s",str);    }
```

Course Outcome 4 (CO4): (Apply)

1. What will be the output of the C program?

```
#include<stdio.h>
int main() {
enum numbers
{
n1 = 1.5, n2 = 0, n3, n4, n5, n6
};
printf("%d %d\n", n1, n2);
}
```

2. How many bytes in memory taken by the following C structure?

```
#include <stdio.h>
struct test {
 int k;
char c;
};
```

Course Outcome 5 (CO5): (Apply)

1. Write a program to create a file and store 20 names in it. Write a program to read the names in the file in the reverse order without reopening the file
2. Write a program that reads the file name and text of 20 words as command line arguments.
   Write the text into a file whose name is given as the file name.

<table>
<tr><td rowspan="2">21HS1103</td><td rowspan="2">TAMIL HERITAGE</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="6">Preamble: This course is offered to equip students to create awareness of the contribution of Tamil people to Indian culture by highlighting the characteristics of Tamil language and literature and exhibiting Tamil culture through traditional arts such as performing arts and finearts.</td></tr>
<tr><td colspan="6">Prerequisites for the course:
The prerequisite knowledge required to study this course is basic knowledge in English andTamil Heritage.</td></tr>
<tr><td>UNIT I</td><td colspan="4">LANGUAGE AND LITERATURE</td><td>6</td></tr>
<tr><td colspan="6">Language Families in India-Dravidian Languages –Tamil as Classical Language –Classical Literature in Tamil – Secular Nature of Sangam Literature –Distributive Justice in Sangam Literature Management Principles in Thirukural - Tamil Land Bakthi Literature Azhwars and Nayanmars-Forms of minor Poetry development of Modern literature in Tamil-Contribution of Bharathiyar and Bharathidhasan.</td></tr>
<tr><td>UNIT II</td><td colspan="4">HERITAGE-ROCK ART PAINTINGS TO MODERN ART–SCULPTURE</td><td>6</td></tr>
<tr><td colspan="6">Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making- Massive Terracotta sculptures, Village Deities, Thiruvalluvar Statue at Kanyakumari,</td></tr>
<tr><td>UNIT III</td><td colspan="4">FOLK AND MARTIAL ARTS</td><td>6</td></tr>
<tr><td colspan="6">Therukoothu, Karakattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry,Silambattam, Valari, Tiger dance-Sports and Games of Tamils.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">THINAI CONCEPT OF TAMILS</td><td>6</td></tr>
<tr><td colspan="6">Flora and Fauna of Tamils & Agam and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age-Export and Import during Sangam Age-Overseas Conquest of Cholas.</td></tr>
<tr><td>UNIT V</td><td colspan="4">CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</td><td>6</td></tr>
<tr><td colspan="6">Contribution of Tamils to Indian Freedom Struggle-The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine–Inscriptions & Manuscripts–Print History of Tamil Books.</td></tr>
<tr><td colspan="5">Total Periods</td><td>30</td></tr>
</table>

Course Outcomes:

CO1	To widen the knowledge on the characteristics of Tamil language and literature.
CO2	To explore the traditional Tamil fine arts and its techniques of Tamil Heritage.
CO3	To evaluate the various types of performing arts and their cultural context.
CO4	To get an insight on the lifestyle and living techniques of Tamil ancestors.
CO5	To recognise and perceive the role played by Tamils in the unity and development ofIndia.

CO PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1
1								1	2	3	1	3	1
2								1	3	2	3		1
3								1	3	2	1		1
4								3	2	2			3
5								2	3	3			2

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL–(in print)

2. Social Life of the Tamils- The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

5. Keeladi-'Sangam City Civilization on the banks of river Vaigai'(Jointly Published by:Department of Archaeology &TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)

6. Studies in the History of India with Special Reference to TamilNadu (Dr.K.K.Pillay) (Published by: The Author)

7. Porunai Civilization(Jointly Published by:Department of Archaeology &TamilNadu Text Book and Educational Services Corporation,Tamil Nadu)

8. Journey of Civilization Industo Vaigai(R.Balakrishnan)(Published by:RMRL)– Reference Book.

21HS1101	ENGLISH FOR PROFESSIONAL COMMUNICATION	L	T	P	C
		2	0	2	3

Preamble

This course is offered to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisites for the course

- The prerequisite knowledge required to study this Course is the basic knowledge in English Language.

Objectives

1. To develop listening skills, and enhance the ability of comprehending.
2. To communicate confidently in varied real life situations.
3. To widen the basic reading skills of the first year Engineering and Technology students.
4. To master vocabulary, sentence structure and to write articles.
5. To create emotional awareness.

Module I	SHARING BASIC INFORMATION	12

Listening - Listening to basic technical concepts, short formal and informal conversations; Speaking- Formal Self-Introduction – Etiquette – Phrases to be used highlighting the characteristics, strengths and weaknesses - Conversation Practice; Reading - short comprehension passages on fundamental concepts, principles, and ideas that helps to understand the need of Technology in a rapidly changing global environment; Writing - restructuring sentences from the jumbled words – creating coherence; Language development - Framing Yes/No questions, Question tag, Vocabulary development - formation of words– verb – Noun – Adjectives, Standard Abbreviations related to Engineering.

SUGGESTED ACTIVITIES	EVALUATION METHODS
i) Listening to Conversations/ technical concepts from suggested app/prescribed modules - Submission of 5 Recorded Conversations.	i) Listening & Speaking: Submitted Conversationwill be assessed for a) Language style as that of the sample audio. b) Pronunciation c) Intonation
ii) Introducing oneself to the audience in a professional way - Video Recording to be submitted.	ii) Introduction: Submitted Video Recording will be assessed for a) Communication Etiquette b) Language Style c) Sentence Construction
iii) Reading 3 Passages on Technology and answering questions through Google forms.	

iv) Rearranging Jumbled words – Exercises v) Teaching of Grammar Contents	Activities iii to v will be assessed through Google form tests/ written tests.

Module II	**SHARING TECHNICAL INFORMATION**	**12**

Listening - Listening to technical lectures by native speakers; Speaking - introducing a device/gadget to the audience – giving importance to its specifications, descriptions, merits and demerits; Reading - extensive reading – short narratives and news items from newspapers related to technology; Writing - sentence structure – short passages / reviews on any gadget – describing an electronic/ mechanical gadget, importance of punctuation, organizing paragraphs; Language development - framing 'Wh' Questions, writing a complete sentence using the fragments given; Vocabulary development- prefix and suffix.

SUGGESTED ACTIVITIES	EVALUATION METHODS
i) Listening to Technical Lectures - Suggested Youtube channels a) Learn Engineering b) Jared Owen c) Interesting Engineering d) Practical Engineering	) Listening skills will be tested through a) MCQs - Google Forms - 3 Sets b) Quiz - Polling - 2 set
ii) Speaking / Submitting video recording / classroom presentation about an electronic/electrical/ a mechanical gadget giving importance to its specifications, descriptions, merits and demerits.	ii)Speaking: Submitted Video Recording/Presentation during class hours willbe assessed for a) Language Style & Fluency b) Creation of Google Slides / Canva Slides c) Content delivery
iii) Reading articles from Newspaper/ Google News / Times Now / and other TechNews Sites iv) Writing reviews of a product v) Teaching of Grammar Contents	Activities iii to v will be assessed through Google form tests/ written tests.

Module III	**UNDERSTANDING TECHNOLOGY**	**12**

Listening - listening to technical talks on emerging trends and filling in the blanks – cloze test; Speaking - asking for opinions about technical gadgets – presentation of reviews on electronic/electrical/mechanical/software products; Reading - Reading Comprehension – technical passages – Articles from journals; Writing - rearranging jumbled sentences, writing short essays; Language development - Direct Speech and Indirect Speech – Framing Indirect – Questions - Prepositions – Articles; Vocabulary development – Select Single Word Substitutes used in Engineering.

SUGGESTED ACTIVITIES	EVALUATION METHODS
i) Listening to Technical talks on emerging trends - Suggested YouTube channels	i) Listening skills will be tested through a) Cloze Test - 2 Sets

a) Bernard Marr b) Concerning Reality c) Ideas and Inspiration ii) Speaking / Submitting video recording / classroom presentation on giving reviews about a product. iii) Reading articles -Extracts from reputed journals. iv) Writing essays and rearranging Jumbled Sentences. v) Teaching of Grammar Contents	ii)Speaking: Submitted Video Recording/Classroom presentation will beassessed for a) Inquisitiveness b) Analytical skills c) Presentation Skills Activities iii to v will be assessed through Google form tests/ written tests.

Module IV	STATING PROBLEMS AND EXPRESSING SOLUTIONS	12

Listening- listening to talks relating to technology and noting down the merits and demerits; Speaking - stating a problem and expressing solutions giving more focus on pronunciation of words and sentence structure; Reading - comprehending Articles from Magazines – Identify the problem statement and note down solution statements; Writing - Identifying problems – Writing problem statement, Analyzing the situation – Gathering information related to the problem stated – Identifying solution criteria – Choosing the best solution – Implementing a solution – writing solution content - Measuring solution success – Report preparation – White paper writing – Release/launch notes; Language development- Tenses; Vocabulary development- Synonyms, Antonyms, Phrasal Verbs.

SUGGESTED ACTIVITIES	EVALUATION METHODS
i) Listening to talks related to Technology - Suggested YouTube channels a) Auto Car India b) Lesics c) Student Energy ii) Speaking / Submitting video recording / Classroom presentation on Technical issues faced in a gadget and expressing suitable solutions. iii) Reading articles -Extracts from reputed journals and identify problem statements	i) Listening skills will be tested through a) Note making - 2 Sets ii)Speaking: Submitted Video Recording / Classroom Presentation will be assessed for a) Expression of Innovative Ideas and Solution b) Sentence Structure

and solution statements. iv) Writing - Identifying problems – Writing problem statement, Analyzing the situation – Gathering information related to the problem stated – Identifying solution criteria – Choosing the best solution – Implementing a solution – writing solution content - Measuring solution success – Report preparation – White paper writing – Release/launch notes v) Teaching of Grammar Contents	Activities iii to v will be assessed through Google form tests/ written tests/ written exercises.

Module V	EMOTIONAL AWARENESS AND MANAGEMENT	7

Listening - Listening Types - Appreciative listening – Critical Listening – Relationship Listening; Speaking - presentation on the importance of Emotional Intelligence; Reading- Reading Articles on High Level Cognition - Cognitive Control – Decision Making – Social Behaviour – Emotion – Language and Consciousness; Writing - Articulate emotions using the right language - Balance optimism and pessimism to effectively impact others; Language development - modal verbs; Vocabulary Development - Fixed and Semi-Fixed Expressions.

SUGGESTED ACTIVITIES	EVALUATION METHODS
i) Watching videos on types of Listening ii) Presentation on Emotional Intelligence iii) Reading Articles on High Level Cognition iv) Writing - Articulate emotions using the right language - Balance optimism and pessimism to effectively impact others v) Teaching of Grammar Contents	i) Listening skills will be tested through a) Google form test- 2 Sets ii) Speaking: Submitted Video Recording / Classroom Presentation will be assessed for a) Emotional awareness b) Communication Skills

S.No	List of Exercises	CO
1.	Conversation Recording using the suggested app	CO 1
2.	Self Introduction Video	CO 1
3.	Listening Test - Google Form	CO 2
4.	Presentation on the working principle of a gadget	CO 2
5.	Listening - Cloze Test	CO 3
6.	Reviewing a Product - Video Submission	CO 3
7.	Listening and Note Making	CO 4
8.	Talk on technical issues in a gadget and express suitable Solutions	CO 4
9.	Types of Listening - Google Form	CO 5

10.	Presentation on Emotional Intelligence	CO 5
Total Periods		30 Theory +30 Lab

Laboratory Requirements for a batch of 60 Students

Software: Globarena

1. Teacher console and 30 systems for students.
2. English Language Lab Software
3. Career Lab Software

Suggestive Assessment Methods

1) Listening and answering questions - MCQ - Cloze Test - Note Making
2) Speaking - App/Software based testing
3) Reading - analyze the passage given - understand the concept and answer Questions - On-line Based
4) Written Tests

Continuous Assessment Test (30 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (50 Marks)
Written Examination	Completion of Suggested Exercises	Written Examination

Course Outcomes

Upon completion of the course, the students will be able to:

CO 1	Enumerate basic information using communication etiquette on par withinternational communication standards.
CO 2	Interpret fundamental technical concepts in English language giving importance tosyntax.
CO 3	Evaluate advanced varied technical concepts in the current scenario and emergingtrends to invent new concepts.
CO 4	Write solutions for problems identified using the exact vocabulary and structurewithout grammatical errors as expected by the corporate world.
CO 5	Manage and respond to self, others' emotions using skills of Self Awareness, Self Management, Self Motivation, Empathy & Social Relations to be an Emotionally Intelligent Human Being.

Text Books

1. Butterfield, Jeff. Soft Skills for Every one. Cengage Learning: New Delhi, 2017.
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. CambridgeUniversity Press: New Delhi, 2016.

Reference Books

1. B Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
2. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges.

Web Resources

1. Self Introduction: https://youtu.be/Osa53-RYBk4
2. Working Principle of a Gadget: https://www.youtube.com/channel/UC6qf8AGvAGixZXWdxapvCqw
3. Product Review: https://youtu.be/ByhA05x7CWI
4. Times of India: https://timesofindia.indiatimes.com/home/headlines
5. Listening to Technical talks:
   Auto Car India https://m.youtube.com/user/autocarindia1

   Lesics : https://www.youtube.com/channel/UCqZQJ4600a9wIfMPbYc60OQ Student

   Energy https://www.youtube.com/user/studentenergy?app=desktop
6. Types of Listening https://www.youtube.com/watch?v=22gzvSindTU&t=1s

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				2					1	1	2	2		
2									2	3				
3							2				2	2		
4										2	2	2		
5									2	3				

ASSESSMENT PATTERN

SUGGESTED COURSE LEVEL ASSESSMENT QUESTIONS:

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT – 1	CAT -2	FAT - 1	FAT - 2	
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE OUTCOME 1 (CO 1) : Enumerate basic information using communication etiquette onpar with international communication standards.

1) Listen to the talk on basic technical topics and answer the questions provided.

2) Introduce yourself in a professional way highlighting Characteristics, Strengths &Weaknesses.
3) Converse with your friend on any fundamental concepts in Technology.
4) Read the given technical passage and answer the questions provided.
5) Frame Yes/No Questions for the statements given.
6) Frame Question tags for the statements given.
7) Rearrange the jumbled words into a meaningful sentence.
8) Complete the sentence with the Noun form/ Verb Form/ Adjective form (as Directed) ofthe word given.
9) Give the expansion of the Abbreviations given.

COURSE OUTCOME 2 (CO 2) : Interpret fundamental technical concepts in English languagegiving importance to syntax.

1) Listen to the technical lecture and answer the questions provided.
2) Introduce a device or a gadget to the class giving importance to its specifications,description, merits and demerits.
3) Read the given passage / short narrative / article from a journal or newspaper to the class.
4) Write your review on any one of the gadgets you are using.
5) Frame "Wh" Questions for the statements given.
6) Punctuate the following statement given.
7) Complete the sentence using the fragments given.
8) Write a short passage on the given topic.
9) Fill in the blanks with the suitable prefix or suffix as directed.

COURSE OUTCOME 3 (CO 3) :Evaluate advanced varied technical concepts in the current scenarioand emerging trends to invent new concepts.

1) Listen to the technical talk on the emerging trends and complete the statements given. (Cloze Test)
2) Ask questions to get an opinion about technical gadgets / software / devices
3) Read the given article from a journal and provide your ideas for further developments.
4) Rearrange the following sentences in the proper chronological order.
5) Write a short essay on any one of the given technical topics highlighting the future scope of the product.
6) Rewrite the following into Indirect Speech.
7) Frame indirect questions for the questions given.
8) Fill in the blanks with the suitable articles.
9) Give the one word substitutes for the given statement.

COURSE OUTCOME 4 (CO 4) : Write solutions for problems identified using the exact vocabularyand structure without grammatical errors as expected by the corporate world.

1) Listen to the technical talks and write down the merits and demerits of the product discussed.
2) Watch the video, evaluate the concept and express your solutions to the problem.
3) Read the given article and note down the problems stated.

4) Write down solutions for the problems faced while using a product.
5) Draft a white paper writing for the given situation..
6) Write launch notes for a product.
7) Convert the given statement to another form of the tenses as directed.
8) Pick out the suitable synonym for the underlined word in order to minimize plagiarism.
9) Fill in the blank with the suitable phrasal verb.

COURSE OUTCOME 5 (CO 5) : Manage and respond to self, others' emotions using skills of Self Awareness, Self Management, Self Motivation, Empathy & Social Relations to be an Emotionally Intelligent Human Being.

1) Watch the video on Types of listening and answer the questions.
2) Make a presentation on the importance of Emotional Intelligence.
3) Read the given article on High level cognition and answer the questions.
4) Read the article on social behaviour and redraft it in your own style.
5) Comprehend the passage and give your inputs for decision making.
6) Watch the video and articulate your emotions using appropriate words.
7) Write a note on optimism and pessimism.
8) Fill in the blank with the suitable modal verb.
9) Pick out the suitable fixed/ semi-fixed expression to complete the given statement.

21ME1513	COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

Prerequisites for the course

- NIL

Preamble

Engineering drawing is an important tool for all Engineers and for many others professionals. It is the language of Engineers. Engineering Drawing communicates all needed information from the engineer who designed a part to the workers who will manufacture it.

Objectives

1. To understand the importance of the drawing in engineering applications
2. To improve their visualization skills so that they can apply these skill in developing new products
3. To expose them to existing standards related to technical drawings
4. To develop graphic skills for communication of concepts, ideas and design of engineering products
5. Train to practice engineering graphics through drafting software.

CONCEPTS AND CONVENTION(not for examination)		
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout of drawing sheets – Lettering and Dimensioning		
UNIT I	**PROJECTION OF POINTS AND LINES**	**9**
General Principles of orthographic projection – First Angle Projection, projection of points in four quadrants – Projection of straight lines located in the first quadrant – inclined to both planes		
UNIT II	**PROJECTION OF SOLIDS**	**10**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.		
UNIT III	**SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACES**	**10**
Sections of regular solids as per BIS conventions - Constructing sectional views of simple objects and components - Development of lateral surfaces of regular solids-Projection of truncated solids .		
UNIT IV	**ISOMETRIC PROJECTIONS**	**8**
Principles of isometric projection – isometric scale – isometric projections of simple solids,truncated prisms, pyramids, cylinders and cones.		
UNIT V	**PERSPECTIVE PROJECTIONS**	**8**
Perspective projection of prisms, pyramids and cylinders by visual ray method.		

S.No	List of Experiments	CO
1.	Introduction to drafting commands in AutoCAD. Creation of simple geometry and editing.	C112.1, C112.6
2.	Projection of simple Geometric objects and engineering components using AutoCAD	C112.2, C112.6
3.	Construction of simple objects and components sectional viewsusing AutoCAD	C112.3, C112.6
4.	Isometric projection of simple components-flange, cylinder, chimney, lamp shades, valve, Brackets using AutoCAD	C112.4, C112.6
5.	Creating a Perspective Projection of solids using AutoCAD	C112.5, C112.6
	Total Periods	**45 Theory + 15 Lab Hours**

Laboratory Requirements

SYSTEM REQUIREMENTS
(For a batch of 30 Students)

Hardware:

1. Intel i3 core due processor with 4GB ram with 500GB hard disk – 30 Nos.
2. Laser Printer – 1 No.

Software:

Drafting package – AutoCAD – Adequate license (Open source)

Suggestive Assessment Methods

CAT 1 (30Marks)	Model Lab (20 Marks)	End Semester Exams (50 Marks)
30	20	50

Outcomes

Upon completion of the course, the students will be able to:

CO1: Apply the principles of first angle projection in construction of points and lines.

CO2: Apply the principles of change of position method in projection of simple solids.

CO.3: Develop projections of sectioned solids and their developmental surface.

CO4: Develop isometric views from orthographic projections

CO.5: Construct the perspective projections of simple solids

CO6: Develop orthographic, isometric and perspective projection and development of surfaces using drafting software.

Text Books

1. Venugopal K. and Prabhu Raja V., "Engineering drawing + Autocad", New Age International (P) Limited (2022)

2. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2015)

Reference Books

1. Kumar M.S., "Engineering Graphics", D.D. Publications, (2015)

2. Parthasarathy N.S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, (2015)

3. Shah M.B. and Rana B.C., "Engineering Drawing", Pearson Education (2009)

4. N.D.Bhatt, "Engineering Graphics", Charotor Publishing House, 53RD Edition 2019

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets

2. IS 9609 (Parts 0 and 1) – 2001: Technical products Documentation – Lettering

3. IS 10714 (Part 20) – 2001 and SP 46 – 2003: Lines for technical drawings

4. IS 11669 – 1986 and SP 46 – 2003: Dimensioning of Technical Drawings

5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods

Web Recourses

1. http://nptel.ac.in/courses/112103019

2. https://archive.nptel.ac.in/courses/112/105/112105294/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
1	3	1	1	2									3	2
2	3	1	1	1	1								3	2
3	3	1	1	1	1								3	2
4	2	2	1	1	1								3	1
5	2	2	1	1	1								3	2
6	2	2	2	2	2								3	3

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	MODEL	END SEM EXAM
REMEMBER				
UNDERSTAND				
APPLY	15	15	20	50
ANALYZE				
EVALUATE				
CREATE				

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Apply the principles of first angle projection in construction of points and lines. (Apply)

1. Draw the projections of the following points on a common reference line. (Apply) A,35 mm above HP and 25 mm in front of VP B,40 mm below HP and 15mm behind VP C,50 mm above HP and 25 mm behind VPD,45 mm below HP and 25 mm behind VPE, 30 mm behind VP and on HP

2. A line CD measuring 80 mm is inclined at an angle of 30° to HP and 45° to VP. The point C is 20 mm above HP and 30 mm in front of VP. Draw the projections of the straight line.(Apply)

COURSE OUTCOME 2: Apply the principles of change of position method in projectionsof solid problems and draw graphically

1. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30o to VP. Draw the projections of the solid. (A)

2. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30o to HP and 45o to VP. Draw the projections of the solid. (A)

COURSE OUTCOME 3: Develop projections of sectioned solids and their developmental surface.

1. A cylinder of base diameter 50mm and height 60mm rest on its base on HP. It is cut by a plane perpendicular to VP and inclined at 450 to HP. The cutting plane meets the axis at a distance 15mm from its top base. Draw the sectional plan and true shape of the section. (A)

2. A regular hexagonal pyramid side of base 30 mm and height 60 mm is vertically on its based on HP, such that two of its sides of the base are perpendicular to VP. It is cut by a plane inclined at 30° to HP and perpendicular to VP. The cutting plane bisects the axis of the pyramid. Obtain the development of the lateral surface of the truncated pyramid. (A)

COURSE OUTCOME 4: Develop isometric views from orthographic projections

1. A cylinder of base diameter 50mm and height 60mm rest on its base on HP. It is cut by a plane perpendicular to VP and inclined at 450 to HP. The cutting plane meets the axis at a distance 15mm from its top base. Draw the sectional plan and true shape of the section. (A)

2. A regular hexagonal pyramid side of base 30 mm and height 60 mm is vertically on its based on HP, such that two of its sides of the base are perpendicular to VP. It is cut by a plane inclined at 30° to HP and perpendicular to VP. The cutting plane bisects the axis of the pyramid. Obtain the development of the lateral surface of the truncated pyramid. (A)

COURSE OUTCOME 5: Construct the perspective projections of simple solid

1. Draw the perspective view of a square prism of base side 40mm and height 50mm. one vertical lateral face is parallel to PP and 30mm away from it. The station point is 80mm from PP, 80mm above the base and 60mm to the right of the axis of the prism. (APPLY)

2. A hexagonal pyramid of base side 25mm and axis length 50mm is resting on GP on its base with a side of base is parallel to and 20mm behind PP. The station point is 60mm above GP and 80mm in front of PP and lies in a central plane which is 50mm to the left of the axis of the pyramid. Draw the perspective view of a pyramid. (APPLY)

COURSE OUTCOME 6: Students will be able to Develop Orthographic, isometric and perspective projection and Development of surfaces using drafting software

1. A hexagonal pyramid of base side 30 mm axis length 60 mm is resting on HP on one of its base corners with its axis inclined at 35˚ to HP and parallel to VP. Draw its projections. (APPLY)

2. A cylinder of base diameter 50mm and axis length 50mm is placed horizontally on GP on its base. The axis of the cylinder is 35mm behind PP. The station point is 70mm in front of PP and 70mm above the GP and is 50mm to the left of the axis. Draw the perspective projection of the cylinder. (APPLY)

Practical Courses

21PY1311	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

Preamble

The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and develop their practical applications in engineering materials by using the principles in the right way to implement in modern technology.

Prerequisites

Basic practical concepts of Physics and Chemistry in higher secondary level.

Objectives (Physics)

- To understand the measurement techniques and usage of instruments in physics.
- To demonstrate competency and understanding of the basic concepts found in experimentalPhysics.
- To learn about the various electronic communication mechanisms and their usage in apractical manner.
- To make the students acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To develop an understanding about the range and uses of analytical methods in chemistry.

PHYSICS

S. No	List of Experiments	CO
1	Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.	**3**
2	Determination of band gap of a Semiconductor (Forbidden energy band gap kit).	**3**
3	Determination of planck's constant and work function using the principleof photoelectric effect	**1**
4	Determination of Wavelength, and particle size using Laser.	**2**
5	Determination of Numerical aperture and acceptance angle in an optical fiber.	**2**

6	Determination of Young's modulus of the material-Non Uniform bending method.	**1**
7	Determination of rigidity modulus – Torsion pendulum.	**1**
8	Determination of thermal conductivity of a bad conductor – Lee's Disc method.	**2**
9	Determination of velocity of sound and compressibility of liquid –Ultrasonic Interferometer.	**1**
10	Determination of wavelength of spectral lines using grating –Spectrometer.	**2**
CHEMISTRY (Any Five)		
1	Determination of total, temporary & permanent hardness of water by EDTA method.	**4**
2	Corrosion experiments – weight loss method.	**5**
3	Estimation of iron content of the given solution using potentiometer.	**5**
4	Conductometric titration of strong acid vs strong base.	**5**
5	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	**5**
6	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	**4**
7	Determination of strength of given hydrochloric acid using pH meter.	**5**
8	Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol- Gel method.	**5**
9	Estimation of sodium and potassium present in water using a flame photometer.	**5**
10	Determination of strength of acids in an acid mixture using conductivity meter.	**5**

List of Projects (PHYSICS)

S. No.	**List of Projects**	**Related Experiment**	**CO**
1	To study Infrared radiation emitted by different sources using phototransistors.	3	1
2	To study the variations, in current flowing in a circuit containing a LDR, because of a variation: (a) In the power of the incandescent lamp, used to 'illuminate' the LDR. (Keeping all the lamps at a fixed distance). (b) In the distance of an incandescent lamp, (of fixed power),	2	3

	used to 'illuminate' the LDR.		
3	Design a circuit for cool automatic timer controlled Light which controls vehicle traffic passing through the intersection of two or more roadways by giving a visual indication to drivers when to proceed, when to slow , and when to stop using LED and 4017 counter IC along with the 555 timer.	2	3
4	Design and implement a circuit which anyone can make at home to save their home from thefts using the light has high intensity, monochromatic, directional and coherent in nature.	4	2
5	Construct a household circuit consisting of three bulbs using a dual switching method.	1	3
6	Using ultrasonic sensor, design a ultrasonic distance finder using 8051	9	1
7	Design a water level indicator by connecting a Buzzer, resistor and transistor in series and connect this in parallel to LED.	2	3
List of Projects (CHEMISTRY)			
1	Water Analysis : Analysis of perennial Thamirabarani River water samples collected from various locations (before and after blending of industrial waste water). i) Determination of various physical and chemical parameters (Hardness, pH,TDS, Alkalinity) of different water samples. ii) From the result, give a detailed report about the water sample whether it is fit/unfit for domestic and industrial purposes.	1, 6	4
2.	Water Quality Monitoring : Analysis of ground water samples collected from various districts (Tirunelveli, Madurai, Tuticorin, Kanyakumari, Tenkasi etc.,). i) Determination of various physical and chemical parameters (Hardness, pH, TDS, Alkalinity) of different water samples. ii) From the result, give a detailed report about the water sample whether it is fit/unfit for domestic and industrial purposes.	1,6	4
3.	Household Plumbing Deterioration Monitoring : Study of Conductivity of domestic water (Home) by Arduino method to track the deterioration of household plumbing. i) From the observations give a detailed report about the existence of various ions in water.	4	5

	ii) Give an explanatory report on tracking the deterioration in household plumbing.		
4	Air quality monitoring : Study of air pollution in Nellai smart city in the early morning, noon and evening due to CO/CO2 emissions by Arduino method. i) From the observations give a detailed report about the impact of air pollution on human health. ii) Deduce an explanatory report on environmental impact due to CO/CO2 emissions.	4,10	5
5.	Food adulteration : Investigation of adulterants in various food stuffs (milk, chilli powder, turmeric powder, wheat flour, honey and ghee) by Chemical methods. i) Give a report on the presence of adulterants in the given food samples. ii) From the observations give a brief report about the impact of food adulteration on human health.	1	4
6.	Design of molecules (composites) by computationaltechniques.	4,10	5

Lab Assessment	
Lab Components Assessments **(50 Marks)**	**End Semester Exams** **(50 Marks)**

Outcomes(Physics)	
Upon completion of the course, the students will be able to:	
CO1	Understand measurement technology, usage of new instruments and real time applications in engineering studies.(Understand)
CO2	Operate different instruments and be capable of analysing the experimental results. (Analyse)
CO3	Applying basic knowledge to design various circuits (Apply)
CO4	Have knowledge and will be outfitted with hands-on knowledge in the quantitativechemical analysis of water quality related parameters. (Apply)
CO5	Gain knowledge and will be skilled in problem solving, critical thinking and analytical

	reasoning as applied to scientific problems. (Apply)

Reference Books (Physics)

- Physics Laboratory Manual, Department of Physics, Francis Xavier Engineering College, Tirunelveli.
- A Textbook of Engineering Physics Practical ,UNIVERSITY SCIENCE PRESS (An Imprint of Laxmi Publications Pvt. Ltd.)2nd edition.
- J.Mendham, R.C. Denney, J.D.Barnes, M.Thomas and B.Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (5th edition 2009).

Web Resources

Virtual Lab - https://bop-iitk.vlabs.ac.in/basics-of-physics/List%20of%20experiments.html
Young's Modulus- https://vlab.amrita.edu/?sub=1&brch=280&sim=550&cnt=1

Virtual Lab - https://www.vlab.co.in/ba-nptel-labs-physical-sciences
Numerical Aperture - https://vlab.amrita.edu/index.php?sub=1&brch=189&sim=343&cnt=1
Water Quality standards - https://www.youtube.com/watch?v=OlGllOZlIyI

Web Resources (Chemistry)

1. Water Quality standards -https://www.youtube.com/watch?v=OlGllOZlIyI

2.Corrosion experiments – weight loss method
https://www.youtube.com/watch?v=SMlgTWfdHb8

PHYSICS MAPPING

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1						1		1	1		
2	3	2	1						1		1	1		
3	3	2	1						1		1	1		
4	3	2	1						1		1	1		
5	3	2	1						1		1	1		

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: The students will be able to understand measurement technology, usage of new instruments and real time applications in engineering studies (Understand)

1. Find the Young's modulus of the material of a beam using Non-Uniform bending method. (Given : Thickness of the beam d = 6.35 mm)

COURSE OUTCOME 2: The students will be able to operate different instruments and be capable of analysing the experimental results (Analyse)

2.Using a given laser source and grating (i) determine the wavelength of the given laser light source and also using a given laser source and glass plate (ii) determine the average size of the particles of lycopodium powder by diffraction method.

3. Determine the thermal conductivity of a given bad conductor (Glass) using Lee's disc method. (Given: M= 800 X10-3 Kg, S = 370 JKg -1K-1).

COURSE OUTCOME 3: The students will be able to applying basic knowledge to design various circuits (Apply)

1. Design a circuit for finding unknown resistance and specific resistance of a given coil of wire.

2. Find the energy band gap of semiconductor diode.

COURSE OUTCOME 4: The students will be able to have knowledge and will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters. (Apply)

1. Estimate the amount of total hardness present in 250ml of the given water sample by EDTA method. You are provided with a standard hard water of strength 0.01N.What is the permissible limit of hardness in drinking water.

2. Calculate the amount of total alkalinity present in 500ml of the given water sample. You are provided with a standard NaOH solution of strength 0.01N. What is the permissible limit of alkalinity in drinking water?

COURSE OUTCOME 5: The students will be able to gain knowledge and will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.(Apply)

1. Determine the amount of NaOH present in 1000 ml of the given sample solution by pH metry. What is the pH of a blood sample?

2. Find the amount of HCl and CH3COOH present in 1000 ml of the given sample solution by Conductometry. Which Acid Is The Best Conductor Of Electricity?

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Determination of specific resistance of a given coil of wire – Carey Foster’s Bridge.	**1**
2	Determination of band gap of a Semiconductor (Forbidden energy band gap kit).	**1**
3	Determination of planck's constant and work functionusing the principle of photoelectric effect.	**1**
4	Determination of Wavelength, and particle size using Laser	**1**
5	Determination of Numerical aperture and acceptance anglein an optical fiber	**1**
6	Determination of Young’s modulus of the material-NonUniform bending method.	**1**
7	Determination of rigidity modulus – Torsion pendulum.	**1**
8	Determination of thermal conductivity of a bad conductor –Lee’s Disc method.	**1**
9	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	**1**
10	Determination of wavelength of spectral lines using grating – Spectrometer.	**1**

CHEMISTRY MAPPING

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1						1		1	1		
2	3	2	1						1		1	1		
3	3	2	1						1		1	1		
4	3	2	1						1		1	1		
5	3	2	1						1		1	1		

1-Low , 2- Medium, 3- High

COURSE CONTENT AND LECTURE SCHEDULE - CHEMISTRY

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Determination of total, temporary & permanent hardness of water by EDTA method.	1
2	Corrosion experiments – weight loss method	1
3	Estimation of iron content of the given solution using potentiometer	1
4	Conductometric titration of strong acid vs strong base	1
5	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer	1
6	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample	1
7	Determination of strength of given hydrochloric acid using pH meter.	1
8	Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol Gel method.	1

9	Estimation of sodium and potassium present in water using a flame photometer.	1
10	Determination of strength of acids in an acid mixture using conductivity meter.	1

21CS1511	**Programming Practice Laboratory using C**	**L**	**T**	**P**	**C**
		0	0	4	2

Preamble

The goal of the practice lab is to provide the students with foundation in computer programming to enhance the problem-solving skills related to the field of engineering. It enables the algorithmic approach among the students to solve real world problems thus providing the base to learn other new programming languages

Prerequisites for the course

- NIL

Objectives

- To develop C programs using conditional and looping statements
- To be able to use arrays and strings in C
- To build modular programs using functions in C
- To explicitly manage memory using pointers in C
- To develop applications in C using structures and files

S. No	List of Experiments	CO
1	Programs using simple statements	CO1
2	Programs using decision making statements	CO1
3	Programs using looping statements	CO1
4	Programs using one dimensional and two dimensional arrays	CO2
5	Programs using strings.	CO2
6	Programs using user defined functions and recursive functions	CO3
7	Programs using functions and pointers	CO3
8	Programs using structures and pointers	CO4

9	Programs using structures and unions	CO4	
10	Programs using file concept	CO4	
S.No.	List of Projects	Related Experiment	CO
1.	Vaccine Status Registration System	Ex. 1 to 10	CO5
2.	Toll Bill Management system	Ex. 1 to 10	CO5
3.	Voting Eligibility system	Ex. 1 to 10	CO5
4.	Cricket Scorecard Display system	Ex. 1 to 10	CO5
5.	Medical History Viewing System	Ex. 1 to 10	CO5
6.	Bus/ Flight Ticket Reservation System	Ex. 1 to 10	CO5
7.	Vehicle Parking Control System	Ex. 1 to 10	CO5
8.	Canteen Menu Management System	Ex. 1 to 10	CO5
9.	Grocery Checklist Management System	Ex. 1 to 10	CO5
10.	Diary Management System	Ex. 1 to 10	CO5
11.	Retail Shop Inventory Management System	Ex. 1 to 10	CO5
12.	Pharmacy Inventory System	Ex. 1 to 10	CO5
13.	Library Book Management System	Ex. 1 to 10	CO5
14.	Student Subject Selection System	Ex. 1 to 10	CO5
15.	Student Leave Application System	Ex. 1 to 10	CO5

Suggestive Assessment Methods

Lab Components Assessments (50 Marks)	End Semester Exams (50 Marks)
1. Exercises (Hacker rank score) 2. Project File (Progress Score) 3. Viva voce	1. Record note 2. Exercises 3. Viva voce

Course Outcomes

Upon completion of the course, the students will be able to:

CO1	Implement program using control statements

CO2	Implement arrays and perform string operations
CO3	Develop reusable modules, store data in main memory effectively using pointers
CO4	Form heterogeneous data using structures ,union and files
CO5	Build a project based on the required concepts learnt in C

Laboratory Requirements

- C compiler
- System with windows
- Internet

Reference Books

1. ReemaThareja,"ProgramminginC",OxfordUniversityPress,Secondedition,2016

Web Resources

1. https://www.hackerrank.com/
2. https://www.codechef.com/selflearning?itm_medium=navmenu&itm_campaign=learncp
3. https://www.hackerearth.com/practice/basic-programming/input-output/basics-of-input-output/tutorial/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3										1	
2	3	3	3										1	
3	3	3	3										2	
4	3	3	3										2	
5	2	2	2			1			2	2	2	1	3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMSCATEGORY	Model Exam	ENDSEMEXAM
REMEMBER		
UNDERSTAND		
APPLY	50	100
ANALYZE		
EVALUATE		
CREATE	50	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: (Blooms Category: Apply) (Problem Source: Code chef)

Problem Statement:

Pooja would like to withdraw X $US from an ATM. The cash machine will only accept the transaction if X is a multiple of 5, and Pooja's account balance has enough cash to perform the withdrawal transaction (including bank charges). For each successful withdrawal the bank charges 0.50 $US dollars. Calculate Pooja's account balance after an attempted transaction.

Input Constraints:

Positive integer 0 < X <= 2000 - the amount of cash which Pooja wishes to withdraw.

Nonnegative number 0<= Y <= 2000 with two digits of precision – To represent Pooja's initial account balance.

Output Constraints:

Output the account balance after the attempted transaction, given as a number with two digits of precision. If there is not enough money in the account to complete the transaction, output the current bank balance.

Example:

TYPE	INPUT	OUTPUT
Successful Transaction	30 120.00	89.50
Incorrect Withdrawal Amount (not multiple of 5)	42 120.00	120.00
Insufficient funds	300 120.00	120.00

COURSE OUTCOME 2: (Blooms Category: Apply) (Problem Source: Code chef)

Problem Statement:

Write a program that takes in a letter class ID of a ship and display the equivalent string class description of the given ID. Use the table below.

Class ID	Ship Class
B or b	Battle Ship
C or c	Cruiser
D or d	Destroyer
F or f	Frigate

Input Constraints:

The first line contains an integer T, the total number of test cases. Then T lines follow, each line contains a character. 1 ≤ T ≤ 1000

Output Constraints:

For each test case, display the Ship Class depending on ID, in a new line.

Example:

INPUT	OUTPUT
3 B C D	Battleship Cruiser Destroyer

COURSE OUTCOME 3: (Blooms Category: Apply) (Problem Source: Hacker rank)

Problem Statement:

Functions are a bunch of statements grouped together. A function is provided with zero or more arguments, and it executes the statements on it. Based on the return type, it either returns nothing (void) or something. For example, a function to read four variables and return the sum of them can be written as

```
int sum_of_four(int a, int b, int c, int d) {
int sum = 0;
sum += a; sum += b; sum += c; sum += d;
return sum;         }
```

+= : Add and assignment operator. It adds the right operand to the left operand and assigns the result to the left operand. So a += b is equivalent to a = a + b;

Task

Write a function int max_of_four(int a, int b, int c, int d) which reads four arguments and returns the greatest of them. Note that it is not built in max function in C. Code that will be reused is often put in a separate function that returns the greater of the two values.

Input Constraints:

Input will contain four integers(one on each line)

Output Constraints:

Print the greatest of the four integers.

Sample Input: 3 4 6 5

Sample Output: 6

COURSE OUTCOME 4: (Blooms Category: Apply) (Problem Source: Hacker rank)

Problem Statement:

You are transporting some boxes through a tunnel, where each box is a parallelepiped, and is characterized by its length, width and height. The height of the tunnel feet and the width can be assumed to be infinite. A box can be carried through the tunnel only if its height is strictly less than the tunnel's height. Find the volume of each box that can be successfully transported to the other end of the tunnel. Note: Boxes cannot be rotated.

Input Constraints:

The first line contains a single integer, denoting the number of boxes. Lines follow with three integers on each separated by single spaces, and which are length, width and height in feet of the box.

Output Constraints:

For every box which has a height lesser than 41 feet, print its volume in a separate line.

SAMPLE INPUT	SAMPLE OUTPUT
4 5 5 5 1 2 40 10 5 41 7 2 42	 125 80

Semester II

21HS2101	ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
		2	0	0	2

Preamble:

This course is offered to develop strategies and skills to enhance professional students' ability to read and comprehend engineering and technology texts. Foster their ability to write convincing job applications and effective reports. Develop their speaking skills to make technical presentations, participate in group discussions. The outcome of the course is to help students acquire the language skills of listening, speaking, reading and writing competency in English language thereby making them meet the global expectations.

Prerequisites for the course

- The prerequisite knowledge required to study this Course is the basic knowledge in English Language.

Objectives

1. To widen strategies and skills to augment ability to read and comprehend engineering and technology texts.
2. To draft convincing job applications and effective reports.
3. To develop speaking skills to make technical presentations, participate in group discussions.
4. To strengthen listening skills to comprehend technical lectures and talks in their areas of specialization.
5. To cultivate writing skills both technical and general.

MODULE I	READING AND STUDY SKILLS	6

Reading - Reading longer technical texts and taking down notes – Note Making strategies; Writing - interpreting charts (all the types), graphs – comparing and contrasting statements/paragraphs – analysing technical details; Vocabulary Development - Select Technical Vocabulary; Language Development - Active Voice and Passive Voice

Suggested Activities:	Evaluation Method
i) Visit to the Library - Reading articles on emerging trends and taking down notes in the prescribedformat - Submission through FAST FORMS - Minimum 2 ii) Writing compare and contrast statements. (Eg. Windows 10 Vs Windows 1, RPA Developer Vs RPA Analyst, Edge Computing Vs Quantum Computing) related to the programme. iii) Teaching of Grammar Contents	i) Content & Structure ii) Submission: Fast form Document Submitted document will be assessed for a) Communication Etiquette b) Language Style c) Sentence Construction Activity iii will be assessed through Google form tests/ written tests.

MODULE II	**INTRODUCTION TO PROFESSIONAL WRITING**	**6**

Reading - Technical related topics; Writing - purpose statements – extended definitions - writing instructions – checklists – recommendations – Minutes of the Meeting ; Vocabulary Development - select Technical Vocabulary ; Language Development - Subject Verb Agreement, Compound Words.

Suggested Activities:	Evaluation Method
i) Visit to the Library - Reading articles on emerging trends and writing down purpose statements and extended definitions. Submission through FAST FORMS - Minimum 2 ii) Writing a set of 8 Instructions, Recommendations and Checklists for the suggested topics. (each 2 sets) iii) Teaching of Grammar Contents	i) Content & Structure ii) Submission: Fast form Document Submitted document will be assessed for a) Format b) Language Style c) Sentence Construction Activity iii will be assessed through Google form tests/ written tests.

MODULE III	**INTERVIEW SKILLS**	**6**

Listening - Listening to mock Interviews ; Speaking - answering Interview questions – GD Strategies; Reading- longer texts both general and technical, practice in speed reading ; Writing - Job Application - Resume; Writing opinion paragraph - Writing paragraphs with reasons; Language Development - If – Conditionals

Suggested Activities	Evaluation Method
i) Listening to UPSC Toppers Mock Interviews. ii) Drafting Job application and Resume building. iii) Teaching of Grammar Contents	i) Answering questions for Interview questions(Androidapp based) Responses will be assessed for a) Fluency b) Communication etiquette c) Language style ii) Submission: Fast form Document Activity iii will be assessed through Google form tests/ written tests.

MODULE IV	**REPORT WRITING I**	**6**
Writing - Fire accident Report, Industrial Visit Report, Project Report; Vocabulary Development- finding suitable synonyms - paraphrasing ; Language Development - Clauses.		

Suggested Activities:	Evaluation Method
i) Drafting reviews and reports onIndustries - a) Profile & Products b) Trending technology adopted c) Careers d) Latest news Min - 2 Industries ii) Teaching of Grammar Contents	i) Content & Structure ii) Activity ii will be assessed through Google form tests/written tests.

MODULE V	**REPORT WRITING II**	**6**
Writing - Writing Feasibility Reports, Survey Reports, Business Report; Vocabulary Development - verbal analogies ; Language Development - advanced use of Articles, Prepositional Phrases.		

Suggested Activities:	Evaluation Method
i) Drafting feasibility report on- a) Launching a new product / Technology Min - 2 II) Teaching of Grammar Contents	i) Content & Structure Activity ii will be assessed through Google form tests/ written tests.
Total Periods	**30**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
(i) Google Form based - on-line Test (ii) Written Test	(i) Google Form based - on-line Test incorporating Listening, Speaking and Reading	Written Test

Outcomes

Upon completion of the course, the students will be able to:

CO1	Understand advanced technical texts from varied technical genres to understandengineering concepts and explore more.
CO2	Review technical contents written on par with international standards and rewrite contents using the right vocabulary without grammatical errors to make their articles published in reputed journals.
CO3	Articulate appropriately in interviews and Group Discussions effortlessly following the strategies expected by the corporate world.
CO4	Write reports utilizing the required format prescribed on par with internationalstandards using the exact vocabulary to make their reports worthy to be read.
CO5	Appraise the need for new products and write feasibility and survey reports following the format prescribed in a way to create awareness.

Text Books

1. Mike Markrl. Technical Communication,Palgrave Macmillan: London, 2012.
2. Sumant,S and Joyce Pereira. Technical English II. Chennai: Vijay Nicole Imprints Private Limited, 2014.
3. Kumar, Sanjay and Pushp Lata. Communication Skills: A Workbook. New Delhi: OUP, 2018.

Reference Books

1. Raman, Meenakshi & Sangeetha Sharma. Communication Skills. New Delhi: OUP, 2018
2. Rizvi M, Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-HillPublishing Company Limited, 2007

Web Resources

1.1. Interpretation of Charts : https://youtu.be/4lxA7lo9GLU : https://www.englishhints.com/charts-and-graphs.html
2. Instructions https://www.wikihow.com/Write-Clear-Instructions
3. Resume building https://novoresume.com/career-blog/how-to-write-a-resume-guide
4. Report writing - https://www.youtube.com/watch?v=FXIuHOFAxos ; https://www.deakin.edu.au/students/studying/study-support/academic-skills/report- writing
5. UPSC Interview: https://www.youtube.com/watch?v=OhJWg-0qdI0

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				2						2	1	1		
2				2							2			
3							2		2	2				
4									2	2	2			
5									1	2	2	1		

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

SUGGESTED COURSE LEVEL ASSESSMENT QUESTIONS:

COURSE OUTCOME 1 (CO 1) : Understand advanced technical texts from varied technical genres to understand engineering concepts and explore more.

1) Read the given passage and take notes.
2) Analyse the given type of chart or graph and answer the questions given.
3) Analyse the given chart or graph and write paragraphs comparing and contrasting the data.
4) Analyse the given chart or graph and write paragraphs giving importance to technical details.
5) Fill in the blank with appropriate technical vocabulary.
6) Convert the given active voice sentence into passive voice or impersonal passive voice.

COURSE OUTCOME 2 (CO 2) : Review technical contents written on par with international standards and rewrite contents using the right vocabulary without grammatical errors to make their articles published in reputed journals.

1) Write a purpose statement for the tool or gadget given.
2) Write an extended definition for the given word.
3) Write 8 instructions / recommendations on the given topic.
4) Write the Minutes of the meeting for the given meeting.
5) Fill in the blank with appropriate Subject Verb agreement.
6) Fill in the blank with suitable compound words.

COURSE OUTCOME 3 (CO 3) : Articulate appropriately in Interviews and Group Discussionseffortlessly following the strategies expected by the corporate world.

1) Listening to mock interviews and answering the questions.
2) Listen to the strategies of GD and answer the given questions.
3) Read and submit a recording of technical content following the strategies of speed reading.
4) Write Job application with a cover letter for the given job description.
5) Write paragraphs expressing opinion on the given topic.
6) Fill in the blank / complete the sentence with appropriate If-Conditionals.

COURSE OUTCOME 4 (CO 4) : Write reports utilizing the required format prescribed on parwith international standards using the exact vocabulary to make their reports worthy to be read.

1) Write a fire accident report for the provided incident.
2) Write an Industrial visit report.
3) Write a report on the Project work undertaken by the candidate giving importance to the current status report and the time needed for the completion of the project.
4) Find the appropriate synonym for the given word.
5) Paraphrase the given passage.
6) Fill in the blank with appropriate clauses.

COURSE OUTCOME 5 (CO 5) : Appraise the need for new products and write feasibility andsurvey reports following the format prescribed in a way to create awareness.

1) Write a Feasibility report for a business / project proposal given.
2) Write a survey report for the given scenario.
3) Pick out the appropriate Verbal Analogy.
4) Fill in the blank with appropriate articles.
5) Complete the sentence with appropriate Prepositional Phrases.
6) Choose the appropriate word to complete the sentence.

21MA2201	**PARTIAL DIFFERENTIAL EQUATION AND APPLICATIONS OF FOURIER SERIES**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Preamble:

The course consists of topics in Complex Integration, Partial Differential Equations and Laplace Transforms with applications to various engineering problems. This course will cover the following main topics: Construction of analytic function, Taylors and Laurent's series, Poles and Residues, Half range sine series, Harmonic analysis, Fourier Series Solutions of one dimensional wave and heat flow equation and Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients.

Prerequisites for the course

Basic knowledge of Partial differentiation and Integration.

Objectives

2. To introduce to the concept of Analytical function
3. To familiarize with Complex integration
4. To introduce Fourier series analysis which is central to many applications in engineering field and its use in solving boundary value problems
5. To acquaint the student with PDE and Fourier series techniques in solving wave and heat flow problems used in various situations.
6. To improve the knowledge of Laplace transform.

UNIT I	**ANALYTIC FUNCTIONS**	**9+3**

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions – Harmonic function – Harmonic Conjugate - Construction of analytic function by Milne Thomson's method and bilinear transformation

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Construction of analytic function by Milne Thomson's method and bilinear transformation.

UNIT II	**COMPLEX INTEGRATION**	**9+3**

Complex numbers and its conjugate - Cauchy's integral theorem (without proof) – Cauchy's integral formulae and its higher order derivatives (without proof) and its applications – Taylors and Laurent's series – Types of Singularities – Poles and Residues – Cauchy's residue theorem (without proof).

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Taylor's series, Laurent's series and Cauchy's residue theorem.

UNIT III	**FOURIER SERIES**	**9+3**

Dirichlet's conditions – General Fourier series – Change of Intervals - Odd and even functions – Half range sine series – Half range cosine series - Root mean square value – Harmonic analysis for Fourier series - Engineering Applications.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Fourier series of Odd and even functions, Half range sine and cosine series, Harmonic analysis.

UNIT IV	**PDE AND APPLICATIONS OF FOURIER SERIES**	**9+3**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – Fourier Series Solutions of one dimensional equation of heat conduction - Engineering Applications.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Fourier Series Solutions of one dimensional wave equation and heat conduction equation.

UNIT V	**LAPLACE TRANSFORMS**	**9+3**

Properties of Laplace Transform – Inverse transforms – Convolution theorem (Without Proof) – Partial fraction - Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients only - Engineering Applications.

SUGGESTED EVALUATION METHODS:

- Tutorial Problems on Laplace transform using partial fraction, Convolution theorem and solving ODE.

Total Periods	**45 + 15 = 60 Periods**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**

1. Descriptive Questions	1.Assignment 2. Online Quizzes	**1. Descriptive Questions**

Outcomes

Upon completion of the course, the students will be able to:

CO1 : Apply Cauchy-Riemann equations to problems of fluid mechanics, thermodynamics and electro-magnetic fields. (Apply)

CO2: Solve complex valued integral functions using residues. (Apply)

CO3: Construct the Fourier series expansion of the periodic function. (Apply)

CO4: Solve the problems of one dimensional wave and heat equation. (Apply)

CO5: Apply Laplace Transform technique to solve the given ordinary differential equation. (Apply)

Text Books

1. B. S. Grewal, " Higher Engineering Mathematics", 45^{rd} edition, 2017.
2. Kreyszig.E, "*Advanced Engineering Mathematics*", John Wiley & Sons. Singapore, 15th edition, 2017.

Reference Books

1. A Textbook of Engineering Mathematics(Dr. A.P.J. Abdul Kalam Technical University, Lucknow) (For . Gautam Bhudh technical Universities ,Lucknow) January 2020
2. Advanced Engineering Mathematics , H. K. DASS, S. CHAND and Company Limited, New Delhi, 22^{nd} revised edition, 2018.

Web Resources

1. https://youtu.be/LGxE_yZYigI
2. Analytic functions - https://youtu.be/b5VUnapu-qshttps://youtu.be/8jPr6rGstYk
3. Complex Integration - https://youtu.be/4yC4IXcMKJg
4. Fourier series - https://youtu.be/LGxE_yZYigI
5. Applications of fourier series - https://youtu.be/YfGHNdVeyB4
6. Laplace Transform - https://youtu.be/c9NibpoQjDk

CO Vs PO Mapping and CO Vs PSO Mapping:

CO	PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2												
2	3	2												
3	3	2										2		
4	3	2										2		
5	3	2												

ASSESSMENT PATTERN :

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT – 1	CAT -2	FAT - 1	FAT –2	
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) : (Apply)

1. Construct an analytic function whose imaginary part is $v = e^{x}(x\, cos\, cosy - y\, sin\, siny)$
2. Find the bilinear transformation that maps the points Z =0, -1 ,i on to the points $i, 0, \infty$.

COURSE OUTCOME 2 (CO 2) : (Apply)

1) Solve $\int \frac{e^{2z}}{(z+1)^4} dz$ using Cauchy's Integral formula where C is $|z| = 2$.
2) Compute $\int \frac{2z-1}{z(z+1)(z-3)} dz$ using Cauchy's Residue theorem where C is $|z| = 2$.

COURSE OUTCOME 3 (CO 3) : (Apply)

1) Construct Fourier series for $f(x) = x$ in $(-\pi, \pi)$.
2) Construct Fourier series for $f(x) = x^2$ in $(-l, l)$.

COURSE OUTCOME 4 (CO 4) : (Apply)

1) Identify the PDE $u_{xx} = a^2 u_{tt}$
2) A tightly stretched string with fixed end points $x = 0, x = l$ is initially at rest in its equilibrium position. If it is vibrating, giving each point a velocity $\lambda x(l - x)$. Find the displacement of the string at any time 't'.

COURSE OUTCOME 5 (CO 5) : (Apply)

1) Solve $\frac{d^2x}{dt^2} - 3\frac{dx}{dt} + 2x = 2$, given $x = 0$ and $\frac{dx}{dt} = 5$ for $t = 0$ using Laplace transform method.
2) Find the Laplace transform for $\frac{coscosat - cos\,cosbt}{t}$.

21ME1502	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

Preamble

This course is to provide an insight and inculcate the essentials of Civil and Mechanical Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.

Prerequisites for the course

- HSC Physics

Course Objectives

1. To familiarize the materials and measurements used in Civil Engineering.
2. To provide the exposure on the fundamental elements of civil engineering structures.
3. To impart knowledge on the energy sources and sub systems that aid for energy production.
4. To enable the students to distinguish the components and working principle of IC engines,and R & AC system.
5. To illustrate the construction and working of Power Plant.

UNIT I	CIVIL ENGINEERING MATERIALS AND SURVEYING	9

Stones and bricks–types, properties and uses-materials for making concrete: cement- chemical compounds of Portland cement, types and storage-fine aggregate-functions- gradation and effect of impurities–coarse Aggregate–functions-quality water for mixing. Plain cement concrete(PCC)-functions of various ingredients, preparing placing and curing- properties of fresh Concrete and hardened concrete-Reinforced cement concrete(RCC)–uses and requirement of good RCC steel properties and uses.

UNIT II	BUILDING COMPONENTS AND STRUCTURES	9

Foundations–types, bearing capacity, requirement of good foundations, causes of failure of foundations Superstructure–brick masonry, stonemasonry, beams, columns, lintels, roofing and flooring, plastering bridges–Classification and components-dams–classification and purposes governing selection of site.

UNIT III	ENERGY SOURCES, BOILERS AND TURBINES	9

Conventional and new & renewable sources of energy, Indian and global energy scenario, Principle and operation of boilers-fire tube and water tube (one example for each type), hydraulic, steam, and gas turbines.

UNIT IV	**IC ENGINES, REFRIGERATOR AND AIR CONDITIONER**	**9**
Four stroke and two stroke IC engine cycles, functioning of petrol and diesel engines–comparisons, simple vapour Compression refrigerator and window air conditioner.		
UNIT V	**POWER PLANTS**	**9**
Principle of operation, construction and working of: hydel, steam, diesel, gas and nuclear power plantsalong with Accessories–selection, comparison, merits and demerits.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
1.WRITTERN TEST	1.ASSIGNMENT 2.ONLINE QUIZZES 3.PROBLEM –SOLVING ACTIVITIES	1. WRITTERN TEST

Course Outcomes

Upon completion of the course, the students will be able to:

CO1: Measure distance, area by surveying and proper selection and usage of construction materials.

CO2: Identify the building components and structures.

CO3: Illustrate the energy sources and functions of Boilers and Turbines.

CO4: Explain the working principles of IC engines and refrigeration and Air conditioning units.

CO5: Discuss the principle operation of different types of powerplants.

Text Books

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill PublishingCo.,NewDelhi,2017.

Reference Books

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. RamamruthamS.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,“BasicCivilEngineering”,Anuradha Agencies,2005.
4. Shantha Kumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.

Web Resources

1. https://nptel.ac.in/courses/105102088/
2. https://nptel.ac.in/courses/112107291
3. https://archive.nptel.ac.in/courses/112/103/112103262/
4. https://archive.nptel.ac.in/courses/112/107/112107208/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3						2					1		
2	3	2					2					1		
3	2	2										1	3	
4	2	2										1	3	
5	3	2											3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER					
UNDERSTAND	10	30	5	10	10
APPLY	50	70	15	15	50
ANALYZE	40	0	5		40
EVALUATE					
CREATE					
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain with neat sketch prismatic compass and principles of compass surveying.
2. Explain plain concrete, its properties and applications.

COURSE OUTCOME 2

1. Draw a neat sketch of a reinforced cement concrete column and explain.
2. Explain the types of floor suitable for residential and commercial building.

COURSE OUTCOME 3:

1. Name any four renewable sources of energy available for power generation.(**Remember)**
2. Explain with a neat sketch the working principle of fire tube boiler. (**Understand)**

COURSE OUTCOME 4:

1. Explain with a neat sketch the various parts of IC engines and describe its function. (**Understand)**
2. Describe the working principle, and applications of air conditioner with a neat sketch. (**Understand)**

COURSE OUTCOME 5:

1. Explain the factors to be considered for selection of site for thermal power plant & hydroelectric power plant. (**Understand)**
2. Draw the Nuclear Power Plant-Layout with clear explanation. (**Understand)**

21EE2601	ELECTRIC CIRCUITS AND NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

Preamble
This course introduces circuit analysis techniques applied to dc and ac electric circuits. Analyses of electric circuits in steady state and dynamic conditions are discussed. Network analysis is introduced with network parameters and transfer functions. This course serves as the most important prerequisite of all many advanced courses in electrical engineering.
Prerequisites for the course
• Physics For Engineers • Matrices and Advance Calculus
Objectives
1. To develop an understanding of the fundamental elements and laws of Electrical circuits
2. To introduce network topology and network theorems to compute parameters of electric network.
3. To understand the resonance circuit and coupled circuits.
4. To learn the transient response of R, L, C circuits.

5. To study the two port network parameter Z or Y or T or h.

UNIT I	**INTRODUCTION TO BASIC ELECTRICAL CIRCUITS**	**9**
Introduction to Circuit Elements - Ohms Law and Kirchhoff's Laws - Star-Delta Transformation- Voltage and Current Division- Source Transformation- Analysis of circuits using Mesh and Nodal analysis-Introduction to AC circuits-complex power and power factor in ac circuits, Balanced and unbalanced three phase circuits.		
UNIT II	**NETWORK TOPOLOGY AND NETWORK THEOREMS FOR DC CIRCUITS**	**9**
Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees – Cutsets - Fundamental cutsets - Cutset matrix – Tie sets - Link currents and Tie set schedules - Twig voltages and Cutset schedules. Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, and Maximum power transfer theorem		
UNIT III	**RESONANCE AND COUPLED CIRCUITS**	**9**
Resonance - Series resonance - Parallel resonance - Bandwidth - Q factor -Selectivity. Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multi winding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.		
UNIT IV	**TRANSIENT ANALYSIS**	**9**
Natural response-Forced response –Laplace transform, Application of Laplace transform to Circuit Analysis, Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.		
UNIT V	**TWO PORT NETWORKS**	**9**
Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.		
	Total Periods	**45**

Suggestive Assessment

Continuous Assessment Test (30 Marks)	Lab Components Assessments (10 Marks)	End Semester Exams (40 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Apply the Kirchhoff's laws and circuit reduction techniques to compute the electrical parameters.
2	Apply the network theorems and network topology, to determine the parameters of electric network.

3	Design a tank circuit for given frequency and to analyze the coupled circuits
4	Analyze the transient response of RL, RC and RLC circuits.
5	Evaluate the parameters of two port network.

Text Books

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, ―Engineering Circuit Analysis‖ , McGraw Hill Science Engineering, Nineth Edition, 2019.

Reference Books

1. S P Ghosh, A K Chakraborty, Network Analysis and Synthesis, Tata McGraw Hill Education Private Limited, 2010.
2. Sudhakar and S. P. Shyam Mohan, Circuits and Network Analysis and Synthesis, Fifth Edition, Tata McGraw Hill, 2015.

Web Resources

1. https://nptel.ac.in/courses/108104139
2. https://nptel.ac.in/courses/108/105/108105159/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3		2										3
2	3	3		1										3
3	3	3	3	2										3
4	3	2		3										3
5	3	2												3

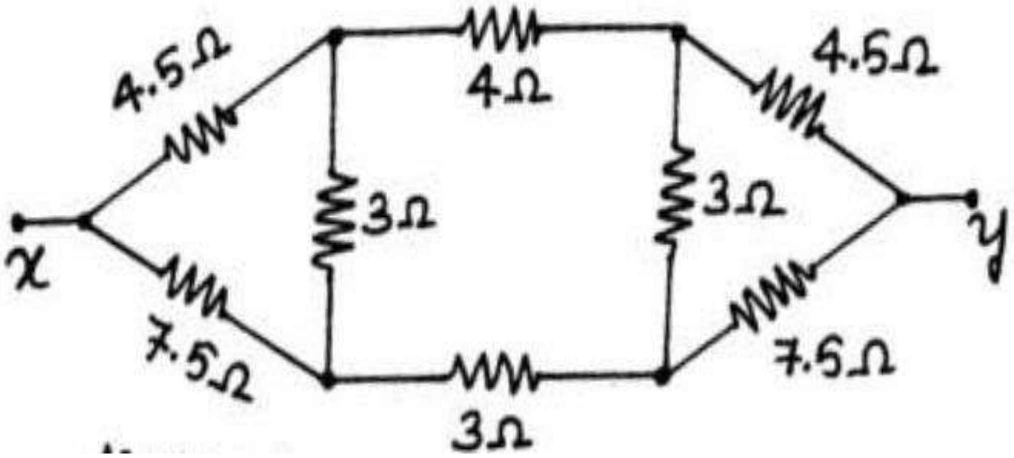
BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	Lab Components	Model Exam	END SEM EXAM
REMEMBER	10	10	05	05	10
UNDERSTAND	20	20	05	05	20
APPLY	70	50	15	15	50
ANALYZE	0	20	0	20	20
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

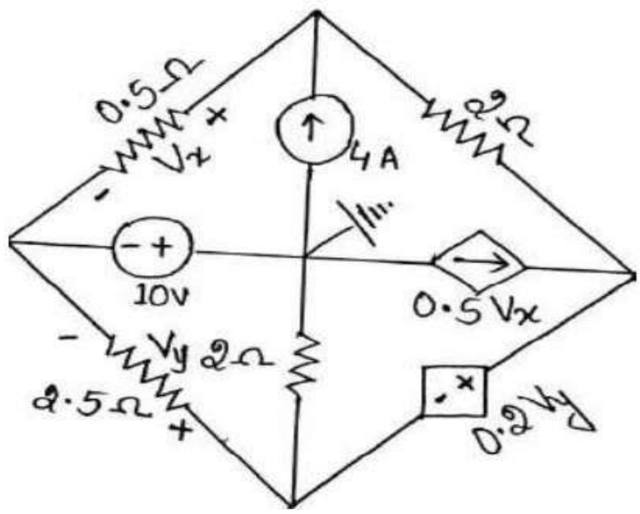
COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….

1. Use Y-Δ and Δ-Y transformation to find R_{th} between points xy **(Apply)**

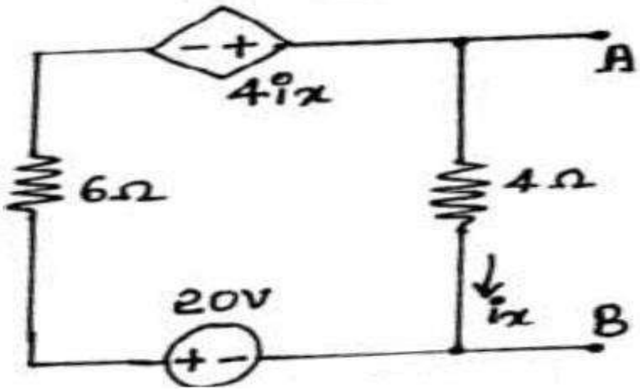


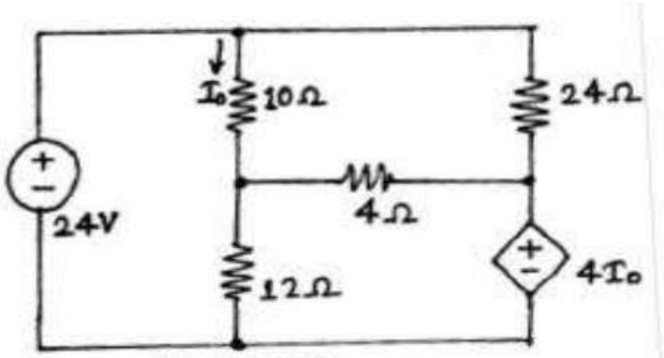
2. Solve for Vx&Vy using the super node concept for the circuit shown in Fig. **(Apply)**



COURSE OUTCOME 2:

1. Apply Norton's theorem to find 'I0' in the circuit given **(Apply)**



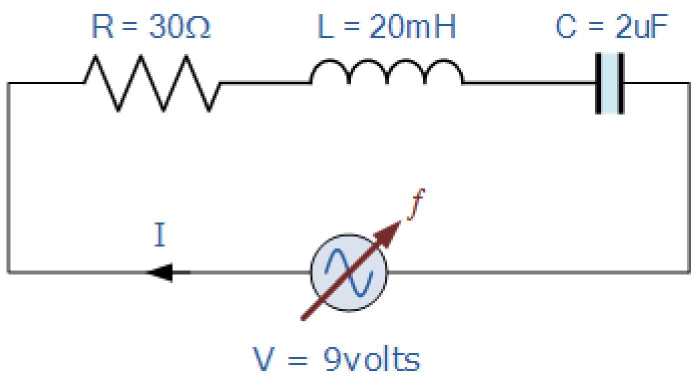


2. For the circuit (fig) given find,
   i. Thevenin's equivalent circuit at terminals A & B.
   ii. How much power would be delivered to a resistor connected to AB if RAB=5Ω
   (Apply)

COURSE OUTCOME 3:

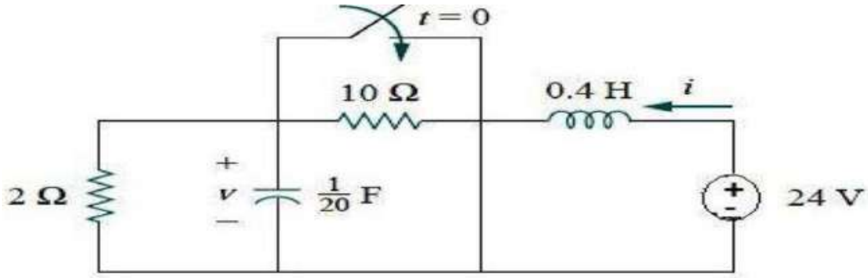
1. Design a resonant circuit with a coil connected in series with a capacitor and resister. The circuit draws a maximum current of 10A when connected to 200V, 50Hz supply. If the voltage across the capacitor is 500V at resonance, find the parameters R, L & C of thecircuit and Quality factor. **(Analyze)**

2. A series resonance network consisting of a resistor of 30Ω, a capacitor of 2uF and an inductor of 20mH is connected across a sinusoidal supply voltage which has a constant output of 9 volts at all frequencies. Calculate, the resonant frequency, the current at resonance, the voltage across the inductor and capacitor at resonance, the quality factor and the bandwidth of the circuit. **(Apply)**

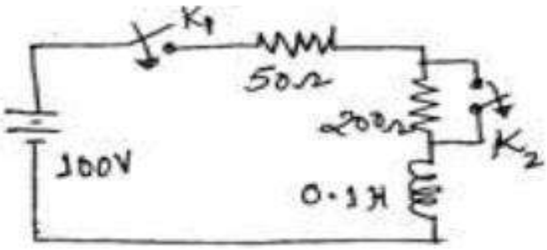


COURSE OUTCOME 4:

1. The switch in Fig. was open for a long time but closed at $t = 0$. Determine expressionsfor i and v. **(Analyze)**

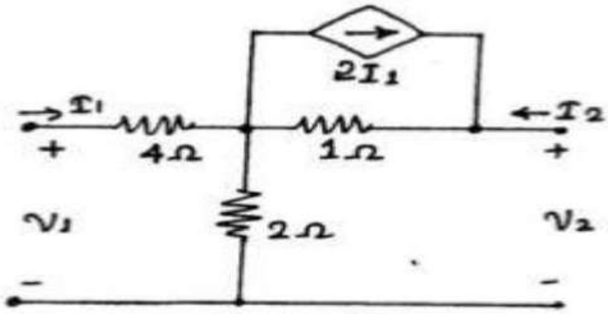


2. In the circuit of Fig , the switch K1 & K2 are closed at t = 0 secs and switch K2 is opened at t = 5 ms. Find the expression for the resulting value of the current. **(Analyze)**

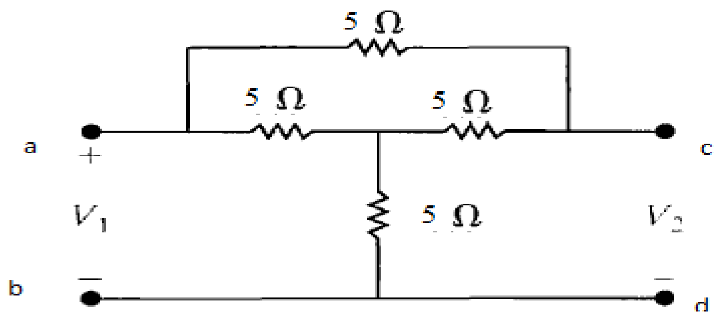


COURSE OUTCOME 5:

1. Find hybrid & ABCD parameters of the network **(Apply)**



2. Determine the Y parameter of the network shown below. **(Apply)**



21HS2103	TECHNOLOGY IN TAMIL CULTURE	L	T	P	C
		2	0	0	1

Preamble

This course is offered to develop technical thinking based on Tamil tradition and to Acquaintstudents with the fundamentals of various technologies through Tamil culture and history.

Prerequisite: The prerequisite knowledge required to study this course is basic knowledge in English and Tamil Heritage.

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	6

Weaving Industry during Sangam Age–Ceramic technology–Black and Red Ware Potteries (BRW) – Graffition Potteries

UNIT II	DESIGN AND CONTRIBUTION TECHNOLOGY	6

Designing and Structural construction House & Designs in household materials during Sangam Age – Building materials and Hero Stones of Sangam Age– Details of Stage Constructions in Silapathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo –Saracenic architecture at Madras during British Period.

UNIT III	MANUFACTURING TECHNOLOGY	6

Art of Ship Building - Metallurgical studies- Jewells making - Iron industry - Iron smelting, steel - Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads -Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gemstone types described in Silapathikaram.

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	6

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea – Fisheries – Pearl- Conceiving-Ancient Knowledge of Ocean-Knowledge Specific Society.

UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING	6

Development of Scientific Tamil – Tamil computing–Digitalization of Tamil Books–Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries –Sekai Project.

TOTAL PERIODS	30

Course Outcomes:

At the end of the course the students will be able to

CO1	To learn the techniques adopted in Industries of ancient Tamil culture.
CO2	To assess the technical competence of ancient Tamil.

CO3	To achieve the ability to think about various production technologies in Tamil Culture.
CO4	To explore the recovery and development of agricultural and water management technicalskills of Tamil culture.
CO5	To enumerate the technical development that Tamil has achieved in the field of science and computer.

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								**1**	**2**	**3**	**1**	**3**		
2								**1**	**3**	**2**	**3**	**2**		
3								**1**	**3**	**2**	**1**	**2**		
4								**3**	**2**	**2**	**3**	**2**		
5								**2**	**3**	**3**	**2**	**3**		

TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL–(in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi-'Sangam City Civilization on the bank of river Vaigai'(Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published By: TheAuthor)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu) Journey of Civilization Industo Vaigai (R.Balakrishnan) (Published by:RMRL)–Reference Book

21CS2501	Introduction to Computing using Python (Common for AI&DS,CSE,CSBS,ECE,EEE,IT)	L	T	P	C
		3	0	2	4

Preamble

This course provides learners an insight into Python programming, and develop programming skills to manage the development of software systems. It covers programming environments, important instructions, data representations, intermediate level features, image processing, exception handling and file data processing of Python.

Prerequisites for the course

- Problem Solving Techniques, Logical Thinking

Objectives

1. To know the features of Python.
2. To develop Python programs with conditionals and loops.
3. To define Python functions and use function calls.
4. To use Python data structures – strings, lists, tuples, dictionaries.
5. To work with files in Python.
6. To work with images.

UNIT I	INTRODUCTION TO PYTHON PROGRAMMING	4

Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables andIdentifiers – Arithmetic Operators– Values and Types – Statements - Operators – Boolean Values – Operator Precedence – Expression - Conditionals: if, if-else, if elif else Constructs

UNIT II	LOOPS, FUNCTIONS AND LISTS	6

Loop Structures/Iterative Statements –Loop Control Statements – List – Adding Items to a List – Finding and Updating an Item – Nested Lists –List Concatenation – List Slices – List Methods – List Loop – Mutability. Function Call and Returning Values – Fruitful Function – Parameter Passing – Local and Global Scope – Recursive Functions.

UNIT III	STRING, ARRAYS, TUPLES	7

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions. –Using Arrays with Numpy: Vectors and operations - vector properties and characteristics, Pandas - Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value.

UNIT IV	DICTIONARY, FILES	6

Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary.

Introduction to Files – File Modes – Opening and Closing Files – Reading and Writing Files

UNIT V	EXCEPTION HANDLING, IMAGE PROCESSING	7

Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.
Image Processing - Image File Formats, Image-Manipulation Operations, The Properties of Images, Python Image Library(PIL)- Converting an Image to Black and White/Grayscale, Blurring an Image, Edge Detection and Reducing the Image Size.

Total Periods	**30 Theory +30 Lab**

Laboratory Requirements

- 60 Systems with windows / LINUX operating system withpython IDLE or equivalent.

Suggestive Assessment

Continuous Assessment Test (30 Marks)	Lab Components Assessments (20 Marks)	End Semester Exams (50 Marks)
1. DESCRIPTIVE QUESTIONS	1. LAB EXPERIMENTS 2. MODEL EXAMINATION	1. DESCRIPTIVE QUESTIONS

Outcomes

Upon completion of the course, the students will be able to:

CO1: Write Python programs for solving problems using conditional statements.
CO2: Write Python programs for solving problems using looping statement and list and decompose a Python program into functions.
CO3: Represent data using Python strings, arrays, tuples, dictionaries and solve computational problems using them and use Numpy and Pandas libraries in real time applications.
CO4: Develop programs to read and write data from/to files in Python and handle exceptions while dealing with data.
CO5: Apply the power of graphics for processing images.

Text Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition,Shroff/O'Reilly Publishers, 2016

Reference Books

1. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.

Web Resources

1. Python for Data science - https://onlinecourses.nptel.ac.in/noc20_cs36/course (Unit III – Numpy, Pandas)
2. https://www.geeksforgeeks.org/image-processing-in-python-scaling-rotating-shifting-and-edge-detection/ (Unit V)

List of experiments

S.NO	NAME OF EXPERIMENTS	CO
1	Basic Python Programming a) Alice buys a toy with a selling price of 100 rupees. There is a discount of x percent on the toy. Develop a python program to find the amount Alice needs to pay for it.	**CO1**
2	Python Programs using conditionals – if, if – else, if – elif – else statements **b)** Write a program that takes cost price and selling price as input and displays whether the transaction is a **Profit** or a **Loss** or **Neither.** a) Chef considers the climate HOT if the temperature is **above** 2020, otherwise he considers it COLD. You are given the temperature *C*, write a python program to find whether the climate is HOT or COLD. b) Write a Python Program to read the unit of electricity consumed in a house and calculate the amount to be paid for the electricity consumed. The bill amount should be calculated as per the given specification: a. For 0 to 100 units the per unit is ₹ 0/- b. For 0 to 200 units, for the first 100 unit the per unit cost is zero and the next 100 units, the consumer shall pay ₹ 1.5 per unit. c. For 0 to 500 units, the consumer shall pay ₹ 0 for the first 100 units, for the next 100 units the consumer shall pay ₹ 2 per unit, for the next 300 units the unit cost is ₹3.00/-	CO1
	Python Programs using looping statements a) Implement Python Script to generate first N natural numbers. b) Implement Python Script to check given number is palindrome or not. c) Implement Python script to print factorial of a number. d)Implement Python Script to check given number is Armstrong or not. e) Square the Digits : Given a two digit number, calculate the sum of square of the digits. Repeat the same for the output till any of the number in series repeats. Output should be the first number that repeats in the process. Sample : Input : 13	

3	Explanation : (‘^’ denotes power in this explanation)Step 1 : 1^2 + 3^2 = 1 + 9 = 10 Step 2 : 1^2 + 0^2 = 1 + 0 = 1 Step 3: 1^2 = 1 1 repeats hence output should be “1” Output: 1 Input: 7 Explanation: Step 1 : 7 ^2 = 49 Step 2 : 4^2 + 9^2 = 16 + 81 = 97 Step 3 : 9^2 + 7^2 = 81 + 49 = 130 Step 4: 1^2 + 3^2 + 0^2 = 1+ 9 + 0 = 10 Step 5 : 1^2 + 0^2 = 1 + 0 = 1 Step 6: 1^2 = 1 1 repeats hence output should be “1” Output: 1	CO2
4	Python Programs using Functions a) Write a program which makes use of function to display all such numbers which are divisible by 7 but are not a multiple of 5, between 1000 and 2000. b) Have the function CodelandUsernameValidation(**str**) take the **str** parameter being passed and determine if the string is a valid username according to the following rules: 1. The username is between 4 and 25 characters. 2. It must start with a letter. 3. It can only contain letters, numbers, and the underscore character. 4. It cannot end with an underscore character.If the username is valid then your program should return the string **true**, otherwise return the string **false**. **Examples** Input: "aa_" Output: falseInput: "u__hello_world123" Output: true	CO2
	Python Programs using List a) Write a program which accepts a sequence of comma-separated numbers from console and generate a list and a tuple which contains every number. Suppose the following input is supplied to the program: 34, 67, 55, 33, 12, 98. Then, the output should be: ['34', '67', '55', '33', '12', '98'] ('34',67', '55', '33', '12', '98').	

<table>
<tr>
<td>5</td>
<td>
b) In this program, create a list of numbers from 1 to 50 named list_1. The numbers should be present in the increasing order: Ex list_1 = [1,2,3,4,5,....,50] i.e. index zero should be 1, index one should be 2, index two should be 3 and so on. Given an input let's say a, you have to print the number of elements of list_1 which are divisible by a, excluding the element which is equal to a. Input: Number a Output: In a single line, the number of elements (i.e. the count and not the elements) which are divisible by a. Example: Input: 24 Output: 1
c) In this program, create a list of numbers from 1 to 50 named list_1. The numbers should be present in the increasing order: Ex list_1 = [1,2,3,4,5,....,50] i.e. index zero should be 1, index one should be 2, index two should be 3 and so on. Given an input let's say a, you have to print the number of elements of list_1 which are divisible by a, excluding the element which is equal to a. Input: Number a Output: In a single line, the number of elements (i.e. the count and not the elements) which are divisible by a. Example: Input: 24 Output: 1
d) Given a list l of size N and two elements x and y, use counter variables to find which element appears most in the list, x or y. If both elements have the same frequency, then return the smaller element. Write a Python program to implement the above said statement.
Note: We need to return the element, not its count.
Example 1:
Input:
N = 11
l = [1,1,2,2,3,3,4,4,4,4,5]
x = 4, y = 5
Output: 4
Explanation:
frequency of 4 is 4.
frequency of 5 is 1.
Example 2:
Input: N = 8 l = [1,2,3,4,5,6,7,8] x = 1, y = 7 Output: 1
Explanation: frequency of 1 is 1. frequency of 7 is 1.
Since 1 < 7, return 1.
</td>
<td>CO3</td>
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<td>
Python Programs using String, Tuples, Numpy array andPandas.
a) Accepts a string and calculate the number of upper caseletters and lower case letters.
b) Write a python program to check whether the given string is palindrome or not.
c) Create all possible strings by using 'a', 'e', 'i', 'o', 'u'. Use the characters exactly once.
d) Python Program to Sort a List of Tuples in Increasing Order by the Last Element in Each Tuple
e) Use mtcars.csv dataset do the following:
</td>
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</table>

6	What is the type of each variable of the mtcarsdata set? o Divide the column that has the car name into columns that contain the make and model of the car. o Do all observations have a make and model value? If there are missing values, can you fix them? (Hint, use Google to help you.) o Some car companies have more than one make. In this data Chrysler, Plymouth, and Dodge were all made by Chrysler. Likewise Cadillac and Pontiac are made by GM and Lincoln and Ford are both made by Ford. Create a company variable based on the data in the make variable o Create a name for use in displaying results that is a character string composed of make, a space character, if the company name is not the same as the make then the company in parentheses (), and model. **f) Write a python program to sort the DataFrame first by 'name' in descending order, then by 'score' in ascending order.** **Sample Python dictionary data and list labels:** exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily', 'Michael', 'Matthew', 'Laura', 'Kevin', 'Jonas'],'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']} labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j'] Values for each column will be: name : "Suresh", score: 15.5, attempts: 1, qualify: "yes", label: "k" **Expected Output: Orginal rows:**	CO3

	name	score	attempts	qualify
a	Anastasia	12.5	1	yes
b	Dima	9.0	3	no
c	Katherine	16.5	2	yes
d	James	NaN	3	no
e	Emily	9.0	2	no
f	Michael	20.0	3	yes
g	Matthew	14.5	1	yes
h	Laura	NaN	1	no
i	Kevin	8.0	2	no
j	Jonas	19.0	1	yes

Sort the data frame first by 'name' in descending order, then by

	'score' in ascending order: name score attempts qualify a Anastasia 12.5 1 yes b Dima 9.0 3 no c Katherine 16.5 2 yes d James NaN 3 no e Emily 9.0 2 no f Michael 20.0 3 yes g Matthew 14.5 1 yes h Laura NaN 1 no i Kevin 8.0 2 noJonas 19.0 1 yes	
7	Python Programs using Dictionary a)Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get() 4)change values 5) use len() b) Write a Python Program to multiply all the items in a dictionary.	CO3
8	Python Programs using Files a) Write Python script to display file contents. b) Write Python script to copy file contents from one file to another. c) Write a Python program to count the number of lines, words, letters, blank spaces in a file.	CO4
9	Python Programs using Exceptions Write a Python program to solve the following: (Use Exception Handling) You are given a string . Your task is to find out whether is avalid regex or not. **Input Format** The first line contains integer , the number of test cases. The next lines contains the string . **Constraints:** 0<T<100 **Output Format** Print "True" or "False" for each test case without quotes. **Sample Input** 2 .*\+ .*+ **Sample Output** True Fals e **Explanation** .*\+ : Valid regex. .*+: Has the error multiple repeat. Hence, it is invalid.	CO4

10	Calculation of the Area : Don't measure Monte Hall : 3 doors and a twist Sorting : Arrange the books	CO2
11	Searching : Find in seconds Anagram Lottery Simulation - Profit or Loss	CO2
12	Simulate a password generator Simulate a grade book for a teacher Rock Paper and Scissor.	CO2
13	Python Program for: Converting an Image to Black and White/Grayscale Blurring an Image, Edge Detection and Reducing the Image Size	CO5

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	2	2	1	1									3
2	1	2	1	1	1									3
3	1	2	1	1	1									3
4	1	1	1	2	1									2
5	2	2	2	2	1									2

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	Lab Components	Model Exam	END SEM EXAM
REMEMBER	10	10			10
UNDERSTAND	10	10			20
APPLY	80	80	100	100	70
ANALYZE					
EVALUATE					
CREATE					
	100	100	100	100	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Write a Python Program to read the unit of electricity consumed in a house and calculate the amount to be paid for the electricity consumed. The bill amount should be calculated as per the given specification:

a. For 0 to 100 units the per unit is ₹ 0/-

b. For 0 to 200 units, for the first 100 unit the per unit cost is zero and the next 100 units, the consumer shall pay ₹ 1.5 per unit.

c. For 0 to 500 units, the consumer shall pay ₹ 0 for the first 100 units, for the next 100 units the consumer shall pay ₹ 2 per unit, for the next 300 units the unit cost is ₹3.00/- (Apply)

2. Chef and Chefina are at positions X and Y on a number line. They both love badminton. It is known that badminton courts are located at every integer point. They want to find a court such that the maximum distance travelled by either of them is **minimized**. Formally, suppose they choose the badminton court at position Z. You need to find the minimum value of max(|X-Z|, |Y- Z|)max(|X−Z|,|Y−Z|) across all possible choices of Z. Here, |X| denotes absolutevalue of X. Write a Python Program to Report this minimum value.

Input Format

The first line of input will contain a single integer T, denoting the number of testcases.

Each test case consists of two space-separated integers X and Y.

Output Format

For each test case, output the minimum possible value of \max(|X-Z|, |Y-Z|)max(|X−Z|,|Y−Z|).

Constraints

1≤T≤1000

1≤X,Y≤1000

X<=Y

Sample :

Input 4

3 5

7 6

1 10

Output 1

1

5

16

3. Develop a Python Program to Check if a Date is Valid and Print the Incremented Date if it is. (Apply)

COURSE OUTCOME 2:

1. Write a Python Program to Read a Number n and Compute n+nn+nnn. (Apply)
2. Write a program to find Sum of Digit of a Number using Recursion in Python. (Apply)
3. Differentiate break and continue. (Understand)

COURSE OUTCOME 3:

1. What is printed by the following statements? (Apply)

```
s = "engineering"
r = ""
for item in s:
    r= item.upper() + rprint(r)
```

2. Is string is mutable. Justify your answer. (Understand)
3. Write a Python Program to count the number of lowercase letters and uppercaseletters in a string. (Apply)

COURSE OUTCOME 4:

1. What happens if the file is not found in the following Python code? (Apply)

```
a=False
while not a:
try:
f_n = input("Enter file name")
i_f = open(f_n, 'r')
except:
print("Input file not found")
```

2. Write a Python Program that Reads a Text File and Counts the Number of Times a Certain Letter Appears in the Text File. (Apply)

3. Write a Python Program to Extract Numbers from Text File. (Apply)

4. Write a Python Program to merge two files into a third file. (Apply)

COURSE OUTCOME 5:

1. Write a python program to convert RGB image to Black and white Image. (Apply)

2. How will you handle exception when it is raised? Explain. (Understand)

21GE1512	ENGINEERING WORKSHOP	L	T	P	C
		0	0	4	2

Prerequisites for the course

- Basic Science

Preamble

Workshop is a hands-on training practice to Mechanical, EEE, Civil engineering students. It deals with fitting, carpentry, sheet metal, welding, Plumbing, Masonry & Concrete, electrical wiring and related exercises. Also, it will induce the habit of selecting right tools, planning the job and its execution

Objectives

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

S.No	List of Experiments	CO
1	Study of joints in roofs	C107.1
2	Hands-on-practice: T joint	C107.1
3	Preparation of Butt joints, lap joints and T joints by shielded metal arc welding	C107.2
4	Forming and Bending - Model Making-Tray, Funnel, dustpan	C107.2
5	Study of pipeline joints, its locations and functions; valves, taps, couplings, unions, reducers, elbows in household fittings	C107.3
6	Hands-on-exercise: Basic pipe connections, mixed pipe material connections, pipe connections with different joining components	C107.3
7	Study of basic construction materials, masonry and concretes	C107.3
8	Residential house wiring using switches, fuse, indicator,lamp and energy meter	C107.4
9	Fluorescent lamp wiring	C107.4
10	Earthing Techniques	C107.4
11	Stair case wiring	C107.4
12	Go down Wiring	C107.4
13	Study of Electronic components and equipment's- Resistor Color Coding and CRO	C107.5
14	Study of logic gates AND, OR, EX-OR and NOT	C107.1
15	Soldering practice – Components Devices and Circuits – Using general purpose PCB	C107.6

S.No.	List of Projects	Related Experiment	CO
1.	Making a Switch Board	Carpentry	C107.1
2.	Making a Tool Stand		C107.1
3.	Making a Table Drawer		C107.1
4.	Fabrication of Footstep Pedastal		C107.1
5.	Making a Welding Fixtures	Welding	C107.2
6.	Making a Sheet Metal Bending Machine		C107.2
7.	Fabrication of Metal Box		C107.2
8.	Fabrication of Welding Chute	Sheet Metal	C107.2
9.	Fabrication of Tool Box		C107.2
10.	Fitting water pipeline to wash basin	Plumbing	C107.3
11.	Construct of partition wall using Flemish bond	Masonry & Concrete	C107.3
12.	Grade of Concrete		C107.3
13.	House Wiring	1. Fluorescent Wiring 2. Staircase Wiring 3. Go down Wiring 4. Residential House Wiring	C107.4
14.	GSM based House Monitoring Control System	Soldering Practice – Component Devices & Circuits	C107.6
15.	Android based electrical appliance control	Soldering Practice – Component Devices & Circuits	C107.6

Suggestive Assessment Methods

Lab Components Assessments (50 Marks)	End Semester Exams (50 Marks)
50	50

Outcomes		
Upon completion of the course, the students will be able to:		
CO 1	Fabricate carpentry components	
CO 2	Use welding equipment's to join the structures and sheet metal works	
CO 3	Perform basic plumbing operations and concrete study	
CO 4	Carry out basic home electrical works and appliances	
CO 5	Measure the electrical and electronic Parameters and quantities	
CO 6	Elaborate on the components, gates, soldering practices	
Laboratory Requirements		
	CIVIL	
1	Assorted components for plumbing consisting of metallic pipes, Plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings	15 Sets
2	Carpentry vice (fitted to work bench)	15 Nos
3	Standard woodworking tools	15 Sets
4	Models of industrial trusses, door joints, furniture joints	5 Nos
5	Power Tools: Demolition Hammer Hand Drilling Machine Wooden Cutter	2 Nos. 2 Nos. 2 Nos.
	MECHANICAL	
1	Arc welding transformer with cables and holders	5 Nos.
2	Welding booth with exhaust facility	5 Nos.
3	Welding accessories like welding shield, chipping hammer, Wire brush, etc.,	5 Sets
4	Power Tool: Angle Grinder	2 Nos.
5	Sheet metal working tools	15 Sets.
6	Standard working tools	15 sets
	ELECTRICAL	
1	Assorted electrical components for house wiring	15 Sets

2	Electrical Measuring Instruments	10 Sets
3	Study purpose items: Iron box, fan and regulator, emergency lamp	1 Each
4	Megger (250V/500V)	1No.
5	Power Tools: (a) Range Finder (b) Digital Live-wire detector	2 Nos
ELECTRONICS		
1	Soldering guns	10 Nos.
2	Assorted electronic components for making circuits	50Nos.
3	Small PCBs	10 Nos.
4	Multimeters	10Nos.

Text Books

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, 2006.
3. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A. &Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.

Web Resources

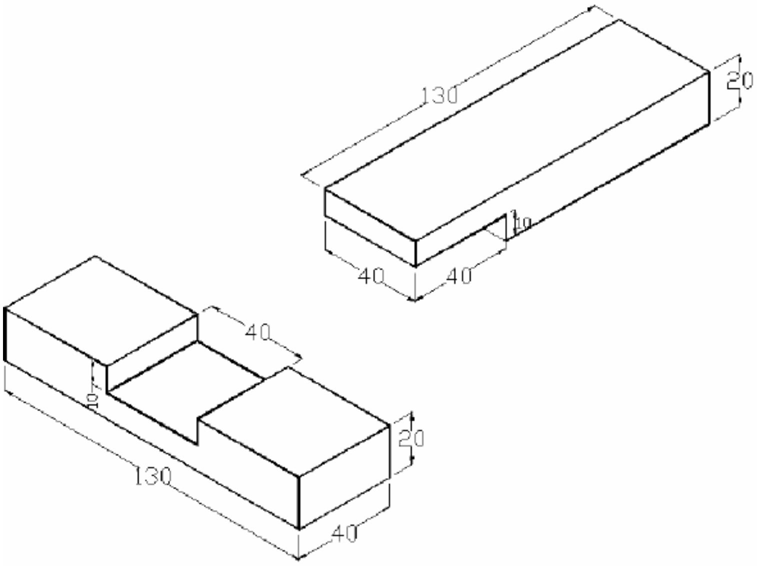
1. https://mechanicalenotes.com/engineering-workshop/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2						1			1	3	
2	2	3	2						1			1	3	
3	3	3	1						1			1	3	
4	3	2	2						1			1	3	
5	2								1				1	

COURSE LEVEL ASSESSMENT QUESTIONS

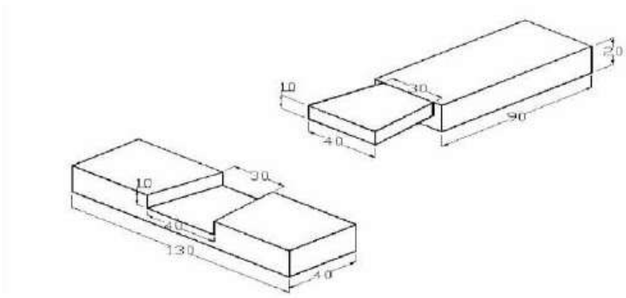
COURSE OUTCOME 1: Students will be able to fabricate carpentry components (Apply)



COURSE OUTCOME 1: Students will be able to fabricate carpentry components (Apply)

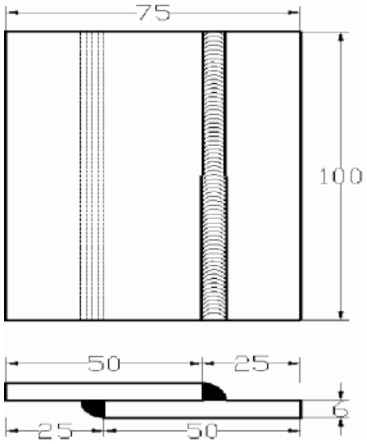
1) Make a T-lap joint from the given wood pieces as shown in the drawing.

2) Make a dovetail joint from the given wooden work piece as per the drawing given below.

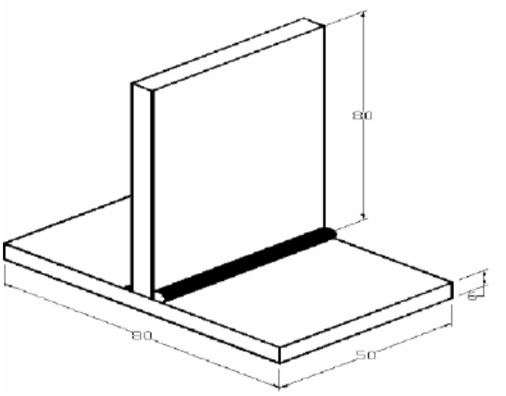


COURSE OUTCOME 2: Students will be able to Use welding equipment's to join the structures and sheet metal works (Apply)

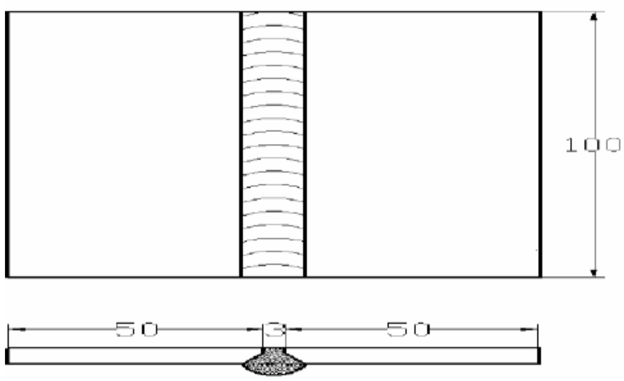
1. Make a Lap joint from the given pieces using arc welding as shown in the drawing.



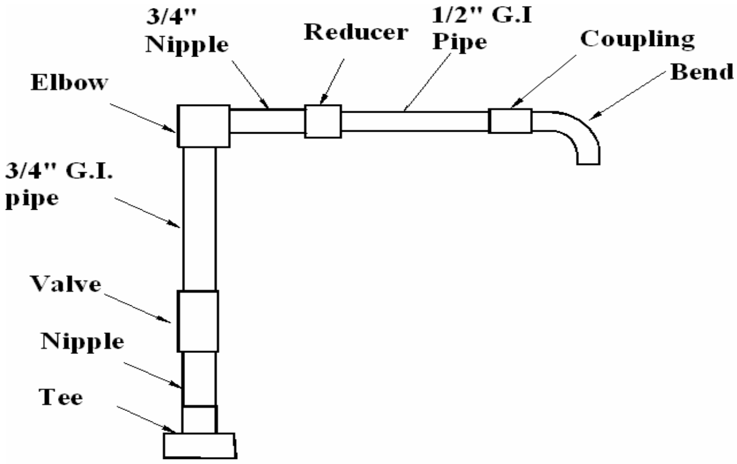
1. Prepare a ‘T’ joint from the given M.S. plates using arc welding as shown in thediagram



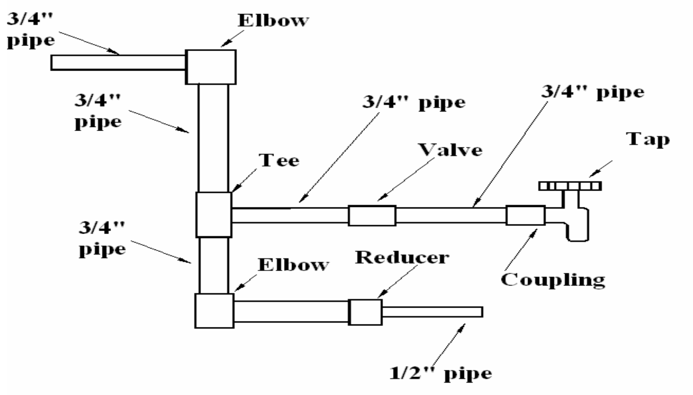
2. Prepare a ‘Butt’ joint from the given M.S. plates using arc welding as shown in thediagram



COURSE OUTCOME 3: Students will be able to perform basic plumbing operations



1. Make a pipe fitting connections from the given GI / PVC pipes and fittings as shownin the drawing.



3. Prepare the GI / PVC Pipe joint by using the given pipes and fittings as per thediagram given below.

3. Study of basic construction materials, masonry and concretes

COURSE OUTCOME 4: Students will be able to carry out basic home electricalworks and appliances.

1. Make an industrial illumination circuit wiring using switches, fuse, indicator, lampand energy meter.

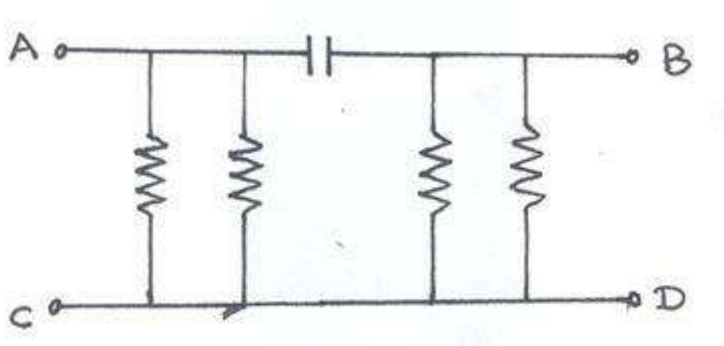
COURSE OUTCOME 5: Students will be able to measure the electrical and electronic parameters and quantities

1. Conduct an experiment using a starter to show the lamp will continue to glow even

when starter is removed.

COURSE OUTCOME 6: Students will be able to elaborate on the components, gates,soldering practices

1. Assemble the below circuit in the given board and verify the connectivity of the circuit using multimeter and disassemble the components from the board.



21EE2611	ELECTRICAL CIRCUIT ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course

- Matrices and Calculus
- Physics For Engineers

Preamble

The significance of the Electrical Circuits and Simulation Lab is renowned in the various fields of engineering applications. For an Electrical Engineer, it is obligatory to have the practical ideas about the Electrical Circuits and Simulation. By this perspective we have introduced a Laboratory manual cum Observation for Electrical Circuits and Simulation. The manual uses the plan, cogent and simple language to explain the fundamental aspects of Electrical Circuits and Simulation in practical. The manual prepared very carefully with our level best. It gives all the steps in executing an experiment.

Objectives

1. To simulate various electric circuits using MATLAB and gain practical experience on electric circuits.
2. To gain practical experience on verification of theorems.
3. To impart knowledge of measurement using CRO.
4. To instil practical experience on RL, RC and RLC circuits.
5. To learn practically resonance and three phase circuits.

S.No	List of Experiments	CO
1	Simulation and experimental solving of electrical circuit	**1**

	problems using Kirchhoff's voltage and current laws.	
2	Simulation and experimental solvingproblems using Thevenin's theorem.	2
3	Simulation and experimental solving of electrical circuit problems using Norton's theorem.	**2**
4	Simulation and experimental solving problems using Superposition theorem.	2
5	Simulation and experimental verification of Maximum Powertransfer Theorem.	2
6	Simulation and experimental verification of Reciprocity Theorem and Milliman's Theorem	2
7	Study of analog and digital oscilloscopes and measurement ofsinusoidal voltage, frequency and power factor.	3
8	Simulation and Experimental validation of RL and RC electricalcircuit transient.	4
9	Simulation and Experimental validation of frequency responseof RLC electrical circuit transient.	4
10	Design and Simulation of series and parallel resonance circuit.	4
11	Simulation of three phase balanced and unbalanced star, deltanetworks circuits.	5
12	Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave using hard ware anddigital simulation.	5

S.No.	**List of Projects**	**Related Experiment**	**CO**
1.	24V/12V Battery Voltage Level Indicator	**1,2,**	**1**
2.	Liquid Dispenser For Bottling Plants	**2,3,4,5,6**	**2**
3.	On/Off Remote Control For Two Appliances	**1,2,3,4,5,6**	**1,2**
4.	DIY electronic Piano	**2,3,4,5,6**	**2**
5.	Brightness controller	**2,3,4,5,6**	**2**
6.	Security Alarm For Two-Wheelers	**2,3,4,5,6**	**2**
7.	Smart fan	**7-12**	**3,4**
8.	UP down fading LED light	**7-12**	**4**
9.	Electronic repellent	**7-12**	**4**
10.	TV remote control jammer	**7-12**	**5**
11.	Non-contact AC line detector	**7-12**	**5**
12.	Music reactive LED	**7-12**	**5**
13.	Rain Sensing Automatic car wiper	**7 - 12**	**5**

14.	Water level sensing device	**7 - 12**	**5**
15.	Continuity tester circuit	**7 - 12**	**5**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams(40 Marks)
Record NoteViva **Model Examination**	**Experiment** **Viva**

Outcomes

Upon completion of the course, the students will be able to:

CO1	Conduct tests on basic electric circuits and able to verify the laws and principles of electrical circuits.
CO2	Perform practical verification of theorems.
CO3	Perform measurements using CRO.
CO4	Perform practical verification of RL, RC and RLC circuits and resonance circuits
CO5	Design three phase circuits using PSPICE/ MATLAB/e-Sim/Scilab

Laboratory Requirements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Regulated Power Supply: 0 – 15 V D.C - 10 Nos / Distributed Power Source.

2. Function Generator (1 MHz) - 10 Nos.

3. Single Phase Energy Meter - 1 No.

4. Oscilloscope (20 MHz) - 10 Nos.

5. Digital Storage Oscilloscope (20 MHz) – 1 No.

6. 10 Nos. of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/Pspice / MATLAB /other Equivalent software Package) and Printer (1 No.)

7. AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.)

8. Single Phase Wattmeter – 3 Nos.

9. Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box - 6 Nos each.

10 Circuit Connection Boards - 10 Nos.

11. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

Reference Books

1. Lab manual

Web Recourses

1. https://vlab.amrita.edu/?sub=1&brch=75
2. http://vlabs.iitb.ac.in/vlabs-dev/labs_local/network_lab/labs/explist.php

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	3		3				2		2	3	
2	3		2	3		3				2		2	3	
3	3		2	3		3				2			3	
4	3			3		3				2			3	
5	3			3		3				2		2	3	

CO Vs PO Mapping and CO Vs PSO Mapping

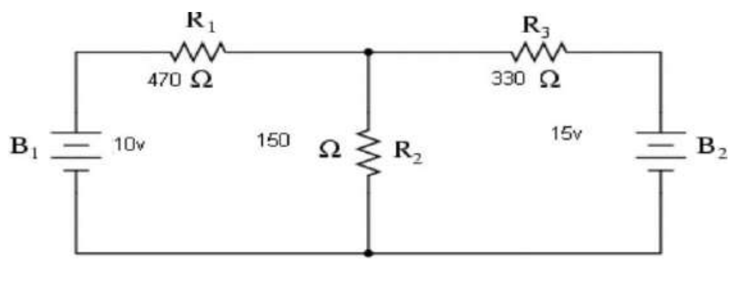
1- Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CO1	CO2	CO3	CO4	CO5	MODEL EXAM	END SEM EXAM
REMEMBER	0	0	0	0	0	0	0
UNDERSTAND	40	40	40	40	40	40	20
APPLY	60	60	60	60	60	60	40
ANALYZE	0	0	0	0	0	0	0
EVALUATE	0	0	0	0	0	0	0
CREATE	0	0	0	0	0	0	0

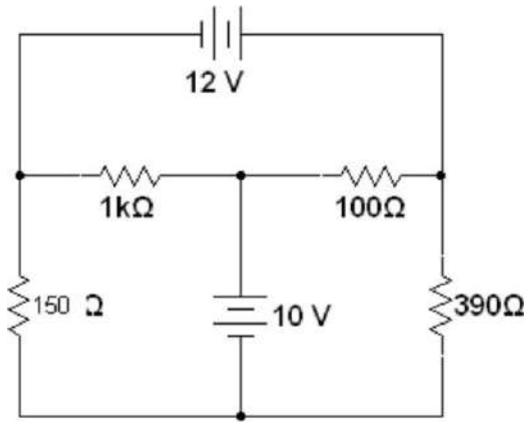
COURSE LEVEL ASSESSMENT QUESTIONS COURSE OUTCOME 1:

1. Draw a two loop resistive network with a voltage source. Do the KCL and KVL verification.
2. Convert the circuit into a single voltage source with internal resistance by suitable theorem.

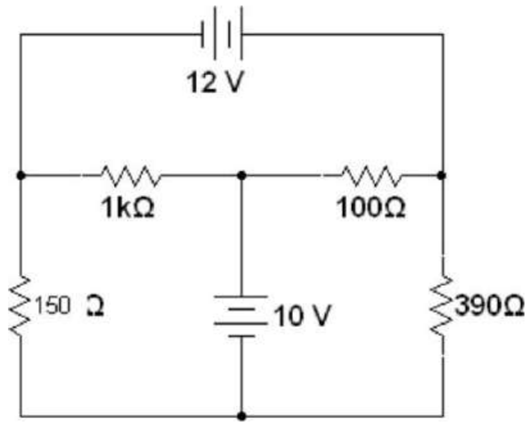


COURSE OUTCOME 2: CO2 (Apply)

1. Conduct an experiment to determine the current through the 100Ωresistor for the given circuit using Thevenins theorem and compare with



1. Conduct an experiment to determine the current through the 100Ω resistor for the given circuit using superposition theorem and compare with theoretical result



COURSE OUTCOME 3: CO3 (Understand)

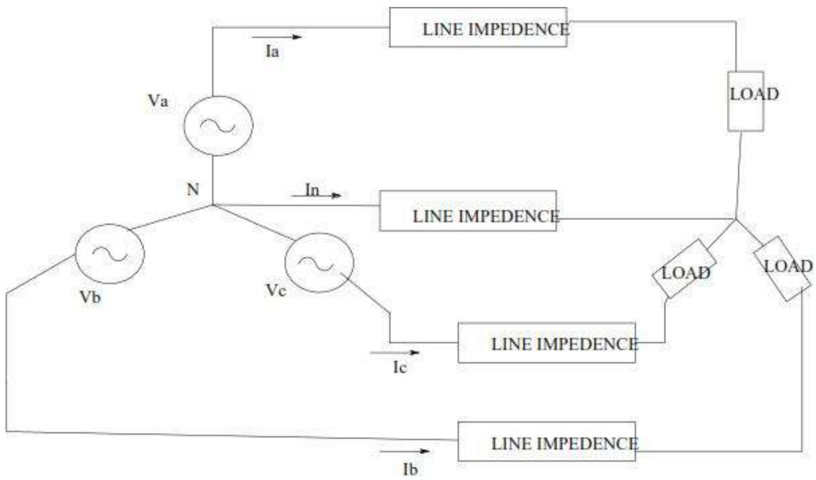
1. Infer the measurement of sinusoidal voltage, frequency and power factor using digital oscilloscopes
2. For an Input of 5 V 250 KHz for sinusoidal and square wave calculate the time period manually and plot it using suitable experiment. Compare the results

COURSE OUTCOME 4: CO4 (Apply)

1. Construct steady state analysis of series and parallel resonance circuits with sinusoidal excitation.
2. Design a parallel resonance circuit for a frequency of 2KHz with R= 1KΩ, C=0.6μf and simulate it by using any one of simulation tool.

COURSE OUTCOME 5: CO5

1. Problems on analysis of balanced and unbalanced Y/Δconfigurations.
2. Use circuit simulation software to build the three phase circuit under unbalanced condition as shown with magnitude of 220V50Hz, Va = 190 ∠0 o, line impedance of 5+j6 Ω , load impedance of 20+j20 Ω and analyze it by observing line currents, neutral current, power loss in each line and power factor of each phase.



REQUIREMENTS				
SL.No	**Name of the Equipments / Software**	**Required**	**Available**	**Deficiency %**
1	FUNCTION GENERATORS 1 MHZ	10	10	0
2	SINGLE PHASE ENERGY METER	1	1	0
3	OSCILLOSCOPE 20MHZ	10	10	0
4	DIGITAL STORAGE OSCILLOSCOPE20MHZ	1	1	0
5	PC WITH CIRCUIT SIMULATION SOFTWARE	10	10	0
6	PRINTER	1	1	0
7	AC OR DC VOLTMETERS	10	10	0
8	AC OR DC AMMETERS	10	10	0
9	MULTIMETERS	5	5	0

10	SINGLE PHASE WATTMETER	3	3	0
11	DECADE RESISTANCE BOX	6	6	0
12	DECADE INDUCTANCE Box	6	6	0
13	DECADE CAPACITANCE BOX	6	6	0
14	CIRCUIT CONNECTION BOARD	10	10	0
15	NECESSARY QUNATITIES OF RESISTOR INDUCTORS CAPACITORS OF VARIOUSCAPACITIES	25	25	0
16	REGULATED POWERSUPPLY 0 TO 15V DC	10	10	0

Semester III

21HS3101	ETHICS AND VALUES	L	T	P	C
		3	0	0	3

Preamble

The course is designed with the purpose of helping students in developing a holistic perspective about life. It opens the space for the student to explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society and as a unit in nature.

Prerequisites for the course

- Nil

Objectives

- To help students distinguish between values and skills.
- To help students identify what they 'really want to be' in their life and profession.
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

MODULE 1	Course Introduction - Need, Basic Guidelines, Content and Process for Value Education	9

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillmentof aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario

Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

SUGGESTED EVALUATION METHODS:

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

MODULE 2	Understanding Harmony in the Human Being - Harmony in Myself	9

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha (happiness and physical facility)
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam(control) and Swasthya (Health); correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Swasthya

SUGGESTED EVALUATION METHODS:

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with disease.

MODULE 3	Understanding Harmony in the Family and Society- Harmony inHuman-Human Relationship	9

1. Understanding the meaning of *Vishwas*; Difference between intention and competence
2. Understanding the meaning of *Samman* (respect), Difference between respect and differentiation; the other salient values in relationship
3. Understanding the harmony in the society (society being an extension of family):

Samadhan, *Samridhi*, *Abhay*, *Sah-astitva* (Resolution, Prosperity, fearlessness, co-existence) as comprehensive Human Goals

SUGGESTED EVALUATION METHODS:

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives. Pay a visit to the old age home / orphanage / physically & mentally challenged asylum and support them in catering their needs to ensure mutual happiness.

MODULE 4	Understanding Harmony in the Nature and Existence – Whole existence as Coexistence	9

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclabilityand self-regulation in nature
3. Understanding Existence as Coexistence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

SUGGESTED EVALUATION METHODS:

Include practice sessions to discuss human beings as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc. Submit a video documentary highlighting the ways of humans creating an imbalance in nature and ways to prevent it.

MODULE 5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**	**9**

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in Professional Ethics:
   a) Ability to utilize the professional competence for augmenting universal human order,

   b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order

SUGGESTED EVALUATION METHODS:

- Include a presentation session on identifying human inventions that are non eco friendly and brainstorming to come up with eco friendly production systems or eco friendly alternatives.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Written Assessment MCQ / written exam	Activity / Presentation in theclassroom / on or off campusactivities	Written Examination

Upon completion of the course, the students will be able to:

CO1 - Understand the significance of value inputs in a classroom and start applying them intheir life and profession

CO2 Distinguish between values and skills, happiness and accumulation of physicalfacilities, the Self and the Body, Intention and Competence of an individual, etc.

CO3 Understand the value of harmonious relationship based on trust and respect in their lifeand profession

CO4 Understand the role of a human being in ensuring harmony in society and nature.

CO5 Distinguish between ethical and unethical practices, and start working out the strategyto actualize a harmonious environment wherever they work.

Text Books

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

Reference Books

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond& Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972,Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.

CO Vs PO Mapping and CO Vs PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PO 2	PSO 3
1								3							
2								3							
3								3							
4								3				2			
5								3				2			

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT – 1	**CAT -2**	**FAT - 1**	**FAT - 2**	
REMEMBER	20	20	5	5	20
UNDERSTAND	30	30	5	5	30
APPLY	30	30	5	5	30
ANALYZE	20	20	10	10	20
EVALUATE					
CREATE					

1- Low, 2- Medium, 3-High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) : Need, Basic Guidelines, Content and Process for Value Education

1) Explain the process of value education.
2) Illustrate the content of value education.
3) What should be the content of value education to make it complete? How do values relate to our day to day living?
4) Explain the content of self – exploration?
5) “Mutual fulfilment in human relationships is something we want, we aspire for.” Explain
6) What is value education? Why is there a need for value education?
7) How does value education help in fulfilling one's aspirations?
8) What are the basic guidelines for value education?
9) Write a short note on the need for value education in today’s scenario.
10) Values and skill complement each other. Elaborate.

COURSE OUTCOME 2 (CO 2) : Understanding Harmony in the Human Being - Harmony in Myself

1) Distinguish between Sukh and Suvidha in detail taking needs of yourself as an example
2) How can we ensure harmony in self (‘I’)?
3) The needs of the self are qualitative. Illustrate.
4) ‘The need for physical facilities is temporary’ – explain the meaning of this statement with any two examples.
5) Do you think that human beings are a sum-total of sentiments and physical aspects, the ‘self’ and the ‘body’? Explain your answer using examples.
6) ‘Human being is the co-existence of the Self and the Body’ – elaborate on this statement.
7) Explain how activities in 'I' are continuous.
8) “I am the seer, doer and enjoyer. The body is my instrument” – Explain.
9) Explain the relation between the self and the body. What is the responsibility of the self towards the body?
10) Define Sanyam and Swasthya. How are they helpful in keeping harmony between self and body?

COURSE OUTCOME 3 (CO 3) :Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1) Define trust. or How is ‘trust’ the foundation value of relationships?
2) Define ‘affection’. or How does affection lead to harmony in the family?
3) How can you say that love is the complete value?
4) What is the meaning of justice in human relationships? How does it follow from family to world family?
5) ‘Discrimination leads to acrimony in relationships’. Explain. What problems are created when we discriminate?
6) What values are necessary in human relationships? Explain each briefly.
7) What is the basis of ‘respect’ for a human being? Do you see that other human beings

are also similar to you? Explain.

8) Explain the comprehensive human goal. How does fearlessness follow from right understanding and prosperity?
9) Critically examine the state of society today in terms of fulfillment of comprehensive human goals.
10) What is the comprehensive human goal? Explain how this is conducive to sustainable happiness and prosperity for all.

COURSE OUTCOME 4 (CO 4) : Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1) What is sanskaar? Explain its effects or the conformance of the human order.
2) Explain the harmony in nature.
3) Define harmony in nature and how you will create it. Explain with examples.
4) What are the four orders of nature? Briefly explain them.
5) Present the difference and similarity between a human being and an animal. Give examples to support your answer.
6) "Other than human order, the three orders are mutually fulfilling to each other". Explain with examples.
7) 'Existence is coexistence'. Give your opinion.
8) How is the activity in human order different from that of animal and plant order?
9) Explain the concept of holistic perception of harmony in existence. 10)Explain how there is recyclability and self regulation in nature.

COURSE OUTCOME 5 (CO 5) : Implications of the above Holistic Understanding of Harmony on Professional Ethics.

1) How does right understanding provide the basis for ethical human conduct? Give two examples.
2) What is ethical human conduct? Explain in terms of values, policies and character with appropriate examples.
3) What do you understand about the definitiveness of ethical human conduct? Why is this definiteness desirable?
4) Describe briefly the criteria for evaluation of holistic technology. Support your answer with an example.
5) Give a critical review of the current management models in the profession.
6) Elaborate on the meaning of swatwa (innateness), swatantrata (self organization) and swarajya (self expression). How are they related?
7) What do you mean by professional ethics?
8) What do you understand by competence in professional ethics? Give two examples of its implications in industry.
9) What are the implications of value based living at all four levels of living? Explain.
10) What is utility value and artistic value? How are both important in human life? Explain with example

21MA3204	Transforms Techniques and Numerical Methods	L	T	P	C
		3	1	0	4

Preamble

This course is designed to train students with the basic Integral Transform techniques. Application of these transforms techniques in solving ordinary differential equations and partial differential equations will be discussed. Numerical methods contain solution of system of linear equations, roots of non-linear equations, interpolation, numerical differentiation and integration. It plays an important role for solving various engineering sciences problems.

Prerequisites for the course

Basic Knowledge about transforms.

Objectives

The Course will enable learners:

1. To acquaint the student with Fourier transform techniques used in wide variety of situations
2. To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems
3. To acquaint the student with understanding of numerical techniques of differentiation and integration, this plays an important role in engineering and technology disciplines.
4. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
5. To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I	FOURIER TRANSFORMS	9+3

Statement of Fourier integral theorem – Fourier transform pair – Properties of Fourier transforms - Fourier sine and cosine transforms – Transforms of simple functions – Convolution theorem – Parseval's identity.

SUGGESTED EVALUATION METHODS:

Tutorial Problems on Fourier sine and cosine transforms, Convolution theorem, Parseval's identity

UNIT II	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	9+3

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction) - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

SUGGESTED EVALUATION METHODS:

Tutorial Problems on Inverse Z-transform (using partial fraction) - Convolution theorem, Solving of difference equations

UNIT III	**SOLUTION OF ALGEBRAIC AND SYSTEM OF EQUATIONS**	**9+3**
Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Pivoting – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel **SUGGESTED EVALUATION METHODS:** Tutorial Problems on Gauss elimination ,Gauss Jordan , Gauss Jacobi and Gauss Seidel method.		
UNIT IV	**INTERPOLATION AND NUMERICAL INTEGRATION**	**9+3**
Lagrange's interpolation formula for unequal intervals – Newton's forward and backward difference interpolation for Equal interval – Numerical single integrations using Trapezoidal methods , Simpson's 1/3 rule and Simpson's 3/8 rule **SUGGESTED EVALUATION METHODS**: Tutorial Problems on Newton's forward and backward interpolation, Numerical integration		
UNIT V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
Solution of Ordinary Equations by Single step methods: Taylor's series method - Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's method for solving first order equations. **SUGGESTED EVALUATION METHODS:** Tutorial Problems on Taylor's series ,Euler's method Fourth order Runge-Kutta method		
	Total Periods	**45+15 = 60 Periods**

Suggestive Assessment Methods		
Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
1. Descriptive Questions	1.Assignment 2. Online Quizzes	1. Descriptive Questions

Outcomes	
Upon completion of the course, the students will be able to :	
CO 1	Apply the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering. (Apply)
CO 2	Utilize the effective mathematical tools for the solutions of partial differential

	equations by using Z transform techniques for discrete time systems. (Apply)
CO 3	Solve the algebraic and transcendental equations using numerical techniques (Apply)
CO 4	Apply numerical techniques in interpolations and integrations (Apply)
CO 5	Solve the ordinary differential equation using numerical techniques (Apply)

Text Books

3. Grewal B.S, Higher Engineering Mathematics, Khanna Publications, 45nd Edition, 2017.
4. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 11th Edition, Khanna Publishers, New Delhi, 2016

Reference Books

- Kreyszig.E, "Advanced Engineering Mathematics", John Wiley & Sons. Singapore, 15th edition, 2017
- Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016
- Veerajan, T., Engineering Mathematics I, Tata McGraw Hill Publishing Co., New Delhi, 5th edition 2017
- Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2016

Web Resources

1. Fourier transforms - https://youtu.be/lkAvgVUvYvY
2. Z – transform - https://youtu.be/zmxWaXvKfdc
3. Solving System of equations - https://youtu.be/oD8-Bb5YYmo
4. Numerical Integration - https://youtu.be/YTHt4Sp8Hag
5. Numerical Solution of Ordinary Differential Equations - https://youtu.be/m2p6hrQGaxQ

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2												
4	2	3												
5	2	3												

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT – 1	CAT -2	FAT – 1	FAT - 2	
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) : (Apply)

1) Find the Fourier transform for $f(x) = \begin{cases} 1-|x| & : |x| \le 1 \\ 0 & : \ elsewhere \end{cases}$ and hence deduce that (i) $\int_0^\infty (\frac{\sin x}{x})^2 \, dx = \frac{\pi}{2}$ (ii) $\int_0^\infty (\frac{\sin x}{x})^4 \, dx = \frac{\pi}{3}$
2) Find the Fourier sine and cosine transform of $f(x) = e^{-ax} : x > 0, a > 0.$ Hence deduce that (i) $\int_0^\infty \frac{s}{s^2+a^2} \sin sx \ \ ds = \frac{\pi}{2} e^{-ax}$

   (ii) $\int_0^\infty \frac{1}{s^2+a^2} \cos sx \ \ ds = \frac{\pi}{2a} e^{-ax}$

COURSE OUTCOME 2 (co 2) : (apply)

1) solve by using z- transform $x_{n+2} - 3x_{n+1} + 2x_n = 0$ given that x_0 =0 and $x_1 = 1.$
2) Find $Z^{-1}(\frac{z^2}{(z-1)(z-3)})$ using convolution theorem

Course outcome 3 (co 3) : (apply)

1) Solve $x + y + 54z = 110$, $27x + 6y - z = 85, 6x + 15y + 2z = 72$ by Using gauss jacobi and gauss-seidel iteration method
2) find by newton's method the real positive root of to three decimal places

COURSE OUTCOME 4 (CO 4) : (Apply)

1) Find the y(3) in the following table using Lagrange's interpolation formula

x	0	1	2	4
y	1	3	9	81

2) From the following table of half yearly premium for policy maturing at different ages, Estimate the premium maturing at the age 46 and 63.

Age	45	50	55	60	65
premium	114.84	96.16	83.32	74.48	68.48

COURSE OUTCOME 5 (CO 5) : (Apply)

1) Find y(0.8) given that $dy/dx = y - x^2$, y(0.6) =1.7393 by using Runge Kutta method of fourth order. Take h = 0.1
2) Using Eular's method, solve $dy/dx = xy + y^2$, y(0) = 1 at x = 0.1, 0.2, 0.3 and continue the solution at x = 0.4 by Milne's predictor corrector method.

21EE3601	**ANALOG AND INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

It is an introductory course which emphasizes the fundamental concepts and overview of Electronic devices and the concepts discussed herein are intended to provide clarification on basic integrated circuits for Electrical Engineering graduates.

Prerequisites for the course

1. Physics For Engineers

Objectives

- To study the structure of basic semiconductor devices.
- To learn the functionality of positive, negative feedback amplifiers and Oscillators.
- To familiarize the IC fabrication procedure and Voltage regulators
- To introduce the characteristics and applications of OP-AMP.
- To impart knowledge on special ICs

UNIT I	**SEMICONDUCTOR DEVICES AND ITS APPLICATIONS**	**9**

PN junction diode - Rectifiers – Display devices- LED, Laser diodes, Zener diode-BJT, JFET, MOSFET- Analysis of CE, CB, CC amplifiers

UNIT II	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9**
Negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, Expression for frequency and phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.		
UNIT III	**IC FABRICATION & ITS APPLICATIONS**	**9**
IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging, IC voltage regulators – LM78XX, LM79XX, SMPS - ICL 8038 function generator IC.		
UNIT IV	**CHARACTERISTICS & APPLICATIONS OF OP AMP**	**9**
Ideal OP-AMP characteristics, DC characteristics, AC characteristics, Basic applications of op-amp – Inverting and Non-inverting amplifiers- V/I & I/V converters. Multi-vibrators, clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response.		
UNIT V	**SPECIAL INTEGRATED CIRCUITS**	**9**
Single stage active filters, Sallen Key, Butterworth, VCOs and timers Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565- phase locked loop IC, AD633 Analog multiplier ICs.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive	Assignment Online Quizzes Problem-Solving Activities	Descriptive

Outcomes

Upon completion of the course, the students will be able to :

CO 1	Illustrate the characteristics of semiconductor devices and to Analyse the amplifiers
CO 2	Design the feedback amplifiers oscillators.
CO 3	Apply IC fabrication techniques and design of voltage regulators
CO 4	Analyze the characteristics of Op-Amp
CO 5	Design circuits using special IC's.

Text Books

1. Boylestad / Nashelsky “Electronic Devices and Circuit “Pearson ,Eleventh Edition, January 2015.
2. Choudhary D. Roy , Shail B. Jain “Linear Integrated Circuits “ new age publishers 2018

Reference Books

1. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2ndedition2014.
2. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGrawHill, 3rdEdition, 2003
3. Robert L.Boylestad,“Electronic devicesandcircuittheory”,2002.
4. Fiore, ”Opamps &Linear Integrated Circuits Concepts & applications”,Cengage,2010.
5. Floyd,Buchla, ”Fundamentals of AnalogCircuits,Pearson,2013.
6. Jacob Millman, Christos C.Halkias, ‘Integrated Electronics – Analog and Digital circuitssystem’,McGrawHill,2003.

Web Resources

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108108111

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2							2		1		3	3
2	3	2	3						1				3	3
3	3								1				3	3
4	3	2	3						2				3	3
5	3								2				3	3

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOM CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	0	0	10
UNDETSTAND	30	30	5	5	30

APPLY	60	60	10	10	60
ANALYZE	0	0	10	10	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Illustrate the drift and diffusion currents for PN diode.(Illustrate)
2. Contrast the construction and operation of PN junction with zener diode (Analyze)

COURSE OUTCOME 2:

1. Design a negative feedback amplifier has an open loop gain of 60000 and a closed loop gain of 300. If the open loop upper cut off frequency is 15KHz, Choose the closed loop upper cutoff frequency. Also, calculate the total harmonic distortion with feedback if there is 10% harmonic distortion without feedback.(Design)
2. A crystal has the following parameters L = 0.5 H, Cs = 0.06 pF, Cp = 1pF and R = 5kΩ. Design the series and parallel resonant frequencies and Q-factor of the crystal. (Design)

COURSE OUTCOME 3:

1. Apply the basic fabricating technology of ICs using planar technology (Apply)
2. Design a suitable IC voltage regulators LM78XX with the specifications of input voltage less than 50v (Design)

COURSE OUTCOME 4:

1. What is Slew rate? Analyze the causes of slew rate and explain its significance in applications (Analyzing)
2. Examine the functions of all the basic building blocks of an Op-Amp. (Analyzing)

COURSE OUTCOME 5:

1. Design and draw the waveform of a 1kHz square wave generator using 555 timer for duty cycle of 50%(Design)
2. Design a frequency synthesizer circuit using PLL IC 565. Explain in detail about the operation and applications of it(Design) COURSE OUTCOME 5: Interpret quantum theory concepts & study the density of states for various Quantum confinements. (Apply)

21EE3602	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

Preamble

Direct Current (DC) machine is a highly versatile energy converting device. They can be designed to give a wide variety of voltage-current or speed- torque characteristics for both dynamic and steady-state operation. Due to their flexibility in speed control, DC motors and transformers are widely used in applications requiring a wide range of speeds or precise control of output.

Prerequisites for the course

1. Physics for Engineers
2. Electrical circuits and network analysis

Objectives

1.To impart knowledge on the learning of magnetic circuits.

2.To acquire knowledge on electromechanical energy conversion

3. To analyse the construction details, operation, performance of DC generators and its applications.

4. To know the construction details, operation, performance, Speed control of DC motors, and its applications.

5. To learn the construction details, operation, performance of single-phase transformers and various connections of three-phase transformers

UNIT I	ELECTROMAGNETIC CIRCUITS	9

Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - energy balance in magnetic circuits- magnetic force - co-energy in singly excited and multi excited magnetic field system MMF of distributed windings - magnetic saturation - leakage fluxes

UNIT II	ELECTROMECHANICAL ENERGY CONVERSION	9

Principle of electromechanical energy conversion forces and torque in magnetic field systems- – Winding Inductances- magnetic fields in rotating machines- Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.

UNIT III	DC GENERATORS	9

Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced EMF, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators.

UNIT IV	DC MOTORS	9
Principle of operation, significance of back EMF, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.		
UNIT V	**TRANSFORMER**	**9**
SINGLE PHASE TRANSFORMER Construction and principle of operation, equivalent circuit, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test separation of core losses, parallel operation of single-phase transformers. **AUTOTRANSFORMER AND THREE PHASE TRANSFORMER** Construction and working of auto transformer, Three Phase Transformer- Construction, types of connections, Scott connection.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive	1. Assignment 2.Online Quizzes 3.Problem-Solving Activities	Descriptive

Outcomes

Upon completion of the course, the students will be able to :

CO 1	Apply the concepts of magnetic circuits and the properties
CO 2	Observe the electromechanical energy conversion in rotating machines.
CO 3	Categorize the types of DC generators performance and its applications.
CO 4	Examine (An) the performance, speed control and to apply braking of DC motors.
CO 5	To analyze the performance behavior of single-phase transformer and various connections of three-phase transformers.

Text Books

1. D. P. Kothari & I. J. Nagrath, " Electrical Machines", Tata- McGraw-Hill, New Delhi, 5^{th} Edition, 2017
2. A. K. Sawhney and A. Chakrabarti, " A Course in Electrical Machine Design",6th Edition, Dhanpat Rai & Co (P) Ltd., January 2016.

Reference Books

1. R.K.Rajput, "Electrical Technology", Laxmi Publications, 3rd edition, 2005.
2. Vincent Deldoro, "Electromechanical Energy Conversion" PHI III edition, 2004.
3. Gupta.J.B,"Theory of Performances of Electrical Machines'' Katson, 7th Edition, 1987
4. M.G.Say, Theory and performance of electrical machines, Tata-McGraw hill, 2000.

Web Recourses

1. https://nptel.ac.in/courses/108105155
2. https://nptel.ac.in/courses/108105017
3. https://nptel.ac.in/courses/10810602

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2	2										2	
2	3	2	2										2	
3	3	2	1										3	
4	3	2		2									2	
5	3	2		3									2	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	15	10	20
UNDERSTAND	30	30	15	15	30
APPLY	20	20	10	15	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	0	0	15
CREATE	0	0	0	0	0
	100	100	50	50	100

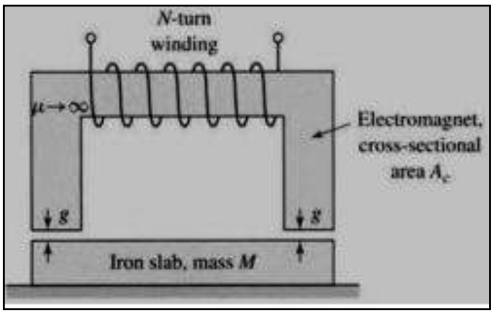
COURSE LEVEL ASSESSMENT QUESTIONS COURSE OUTCOME 1:

1. Two coupled coils have self and mutual inductance of L_{11} = 3+0.5x ; L_{22} = 2+0.5x ; L_{12}= L_{21} = 0.3x over a certain range of linear displacement x. the first coil is excited by a constant current of 15 A and the second by a constant current of -8 A. Determine, (i) Mechanical work done if x changes from 0.6m to 1m. (ii) Energy supplied by each electrical source. (Apply)

2.The magnetic circuit has dimensions: Ac=4*4 cm^2, lg=0.06 cm, lc =40 cm and N=600 turns. Assume the value of μr=6000 for iron. Measure the exciting current for B_c =1.2 T and the corresponding flux and flux linkages. (Apply)

COURSE OUTCOME 2:

1. An actuator with a rotating vane is shown in Fig. 3.26. You may assume that the permeability of both the core and the vane are infinite (μ -> ¥). The total air-gap length is 2g and shape of the vane is such that the effective area of the air gap can be assumed (Apply)
2. As shown in Fig. below, an N-turn (N = 100) electromagnet is to be used to lift a slab of iron of mass M. The surface roughness of the iron is such that when the iron and the electromagnet are in contact, there is a minimum air gap of g_{min} = 0.18 mm in each leg. The electromagnet cross-sectional area Ac = 32 cm2 and coil resistance is 2.8 Ω. Calculate the minimum coil voltage which must be used to lift a slab of mass 95 kg against the force of gravity. Neglect the reluctance of the iron. (Apply)



COURSE OUTCOME 3:

1. A separately excited generator when running at 1000rpm supplied 200A at 125V. What will be the load current when the speed drops to 800rpm if it is unchanged? Given that armature resistance=0.04Ω and brush drop=2V. Derive the necessary equations. (Apply)
2. A 4 pole 50 kW 250 V wave wound shunt generator has 400 armature conductors. Brushes are given a lead of 4 commutator segments. Calculate the demagnetization ampere-turns per pole if shunt field resistance is 50Ω. Also calculate extra shunt field turns per pole to neutralize the demagnetization (Apply)
3. In a Hopkinson's test on a pair of 500V, 100kW shunt. Generators, the following data was obtained: Auxiliary supply: 30A at 500V Generator output current: 200A Field Currents: 3.5A (Generator) and 1.8A (Motor). Armature circuit resistances: 0.075Ω each machine. Voltage drop at the brushes: 2V (each machine). Calculate the efficiency of the machine acting as a generator (Apply)

COURSE OUTCOME 4:

1. A 230 volts DC Shunt motor on no-load runs at a speed of 1200RPM and draw a current of 4.5 Amperes. The armature and shunt field resistances are 0.3 ohm and 230 ohms respectively. Calculate the back EMF induced and speed, when loaded and drawing a current of 36 Amperes. (Apply)
2. A 500V DC Shunt Motor running at 700 rpm takes an armature current of50A.Its effective armature resistance is 0.4Ω. What resistance must be placed in series with the armature to reduce the speed to 600 rpm, the torque remaining constant? (Apply)
3. A 220 V, 22 A, 1000 rpm dc shunt motor has armature circuit resistance of 0.1 ohm and field resistance of 100 ohm. Calculate the value of additional resistance to be inserted in the armature circuit in order to reduce the speed to 800 rpm. Assume the load torque to be (i) proportional to the speed and (ii) proportional

to square of the speed (Apply)

COURSE OUTCOME 5:

1. A 100 KVA 1100/200v single phase transformer has the following parameters.R1 = 1Ω, X1= 3Ω, R2=0.04Ω, X2=0.012Ω. Find the equivalent resistance and leakage reactance as referred to High Voltage winding. (Apply)
2. Calculate the efficiency for half, full load of a 100KVA transformer for the P.F of unity and 0.8, the copper loss at full load is 1000W and iron loss is 1000W. (Apply)

21EE3603	FUNDAMENTALS OF APPLIED ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

Preamble

The Course is designed to impart knowledge of fundamentals of vector calculus, concept of electric and magnetic fields (both static and time varying) applicable to electrical engineering. The course exposes the students to the concept of resistance, capacitance, and Inductance. Students will get an idea about behaviour of field in materials (magnetic, conducting, insulating materials) at the interface of two different materials and their applications to Electrical Engineering. Force, torque, generator and transformer working principles are explained with Electromagnetic Fields.

Prerequisites for the course

- Physics for Engineers
- Matrices and Calculus

Objectives

1.To convey the basic concepts of scalars and vector fields.

2. To impart the knowledge on electrostatics and Capacitance.

3. To impose the concept of magnetostatics and inductance

4. To examine the relationship between Magnetic and Electric fields.

5.To study the various electric & magnetic field concepts both in static and time varying Condition

UNIT I	Review of Scalar and Vector Fields	9

Different Co-ordinate Systems: Cartesian, Cylindrical and Spherical –Differential elements in different coordinate systems – Del Operator: Divergence, Curl and Gradient, Divergence Theorem – Stoke’s Theorem - Helmholtz’s Decomposition.

UNIT II	Electrostatics	9

Coulomb’s law – Electric Field Intensity – Electric Flux – Gauss’s Law – Potential due to Point, Line and Surface Charge Distributions. Different current flow mechanisms – Continuity equation and relaxation time - Boundary conditions – Laplace and Poisson’s equations - Solutions – Analytical

Methods – Variables separable methods – Method of images – Numerical Techniques - Finite Difference Method – Electrostatic Energy – Capacitance Calculations.		
UNIT III	**Magneto statics**	**9**
Fields – Magnetic Flux – Biot Savart's Law – Ampere's Law – Magnetic Torque and Moment – Forces Magnetic Fields – Vector Potential – Magnetic Boundary Conditions – Inductors and Inductance Calculations - Magnetic Energy.		
UNIT IV	**Electromagnetic Fields**	**9**
Faraday's law – Lenz's Law – Maxwell's equations – Displacement current – Maxwell's Equations in Final Forms – Time Varying Fields - Relation between field theory and circuit theory.		
UNIT V	**Electromagnetic Waves Generation & Applications**	**9**
Propagation of waves in lossy dielectrics, conductors and free space – Skin effect – Complex Permittivity- Power and Poynting Vector, Sources, Effects and application of Electromagnetic fields.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive	1.Assignment 2.Online Quizzes 3.Problem-Solving Activities	Descriptive

Outcomes

Upon completion of the course, the students will be able to :

CO 1	Apply the basic mathematical concepts related to electromagnetic vector fields.
CO 2	Analyse the basic concepts of electrostatic fields , electrical potential and its applications.
CO 3	Examine the concept of magnetostatics fields, and its applications .
CO 4	Make use of the relationship between Magnetic and Electric fields.
CO 5	Analyse the concepts of EM Waves and characterizing parameters

Text Books

1. Matthew N. O. Sadiku & S. V. Kulkarni, 'Principles of Electromagnetics', Oxford University Press, New York, Sixth Edition, 2015.
2. William Hayt, John A. Buck, 'Engineering Electromagnetics', McGraw-Hill, EighthEdition, 2012.

Reference Books

1. Joseph A. Edminister, 'Schaum's Outline of Electromagnetics', McGraw-HillProfessional, Fourth Edition, 2013.
2. Karl E. Lonngren, Sava Savov, Randy J. Jost, 'Fundamental ofElectromagnetic with MATLAB', 2007

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_ee68/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2		2							2		3	3
2	3	3		2							2		3	3
3	3	2		2							2		3	3
4	3	2		2							2		3	3
5	3	2		2							2		3	3

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	10	10	5	5	10
APPLY	30	50	10	10	40
ANALYZE	50	30	10	10	40
EVALUATE	0	0			0
CREATE	0	0			0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Apply the basic mathematical

1. Find the nature of the following fields by determining divergence and curl A = 30 a_x+2xy a_y+5x$z^2$$a_z$ (Apply)

concepts related to electromagnetic vector fields.

2. Given that $A = 30e^r a_r - 2r\ a_z$ in cylindrical coordinates evaluate both sides of divergence theorem for the volume enclosed by r =2, z=0 and z=5. (Apply)

COURSE OUTCOME 2: Students will be able to Analyse the basic concepts of electrostatic fields, electrical potential and its applications.

1. Find the Electric Potential at any point given the Electric Field E=2r/(r^2 +a^2)^2 $\bar{r}$ The Boundary conditions are: at r=∞, V=0and r=0 and V=100. (Analyse)
2. Find the potential at r A = 5 m with respect to r B = 15 m due to point charge Q=500 Pc at the origin and zero reference at infinity. (Analyse)

COURSE OUTCOME 3: Students will be able to Examine the concept of magnetostatics fields, and its applications

1. The core of a toroid is of 12 cm2 area and is made of material with μr=200. If the mean radius of the toroid is 50cm. Calculate the number of turns needed to obtain an inductance of 2.5H. (Analyse)
2. An iron ring with a cross sectional area of 8cm2 and a mean circumference of 120cm is wound with 480 turns of wire carrying a current of 2 A. the relative permeability of the ring is 1250. Calculate the flux established in the ring. (Analyse)

COURSE OUTCOME 4: Students will be able to Make use of the relationship between Magnetic and Electric fields.

1. A sinusoidal plane wave is transmitted through a medium whose electric field strength is 10KV/m and relative permittivity of the medium is 4.Determine the mean rms power flow/unit area.(Apply)
2. An iron ring with a cross –sectional area of 3 cm*cm and a mean circumference of 15 cm is wound with 250 turns of wire carrying a current of 0.3 A.The relative permeability of the ring is 1500.Calculate the flux established in the ring.(Apply)

COURSE OUTCOME 5:Students will be able to Analyse the concepts of EM Waves and characterizing parameters

1. A 6580 MHz uniform plane wave is propagating in a material medium of εr =2.25. If the amplitude of the electric field intensity of lossless medium is 500V/m. Calculate the phase constant ,propagation constant, velocity, wave length and intrinsic impedance. (Analyse)

2. A free space- silver interface has E(incident)=100V/m on the free space side. The frequency is 15MHz and the silver constants are εr –μr =1 ,σ =61.7MS/m. Evaluate E(reflected) and E(transmitted) at the interface. (Analyse)

21EE3604	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

It is an advance course which deals with input and output signal variations of system. The fundamental of Transform equations, Laplace equations, Fourier series and Z-Transforms plays the vital role in analyzing the signals of system.

Prerequisites for the course

Transform equations – Laplace equations – Fourier series - Z-Transforms

Objectives

- To understand the basic properties of signal & systems and the various methods of classification
- To analyze the Fourier series, Fourier transform and their properties
- To apply the concept of Laplace transforms in Continuous time signals systems
- To analyze Linear Time Invariant systems in Discrete Time Fourier Transform and Z Transform
- To enhance the knowledge and determine the real time applications of signals and systems

UNIT - 1	INTRODUCTION OF SIGNALS AND SYSTEMS	12

Continuous time signals (CT signals) – Discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals – Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals

UNIT - 2	ANALYSIS OF CONTINUOUS TIME SIGNALS	12

Continuous Time Signal systems and Discrete Time Signal systems- Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable - Fourier series analysis- trigonometric, cosine and Exponential Fourier series - Fourier Transform – Properties of Fourier transform

UNIT - 3	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	12

Introduction of Impulse response - convolution integrals - Fourier and Laplace transforms in Analysis of Continuous time signals systems - Systems connected in series / parallel

UNIT - 4	ANALYSIS OF DISCRETE TIME SIGNALS	12

Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties - Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems - DT systems connected in series and parallel.

UNIT - 5	**APPLICATIONS OF SIGNALS AND SYSTEMS**	**12**
Analog to Digital Conversion - Sampling Theorem and its implications –Digital to Analog Conversion – Aliasing and its effects - modulation for communication, filtering		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive	Assignment Online Quizzes Problem-Solving Activities	Descriptive

Upon completion of the course, the students will be able to :

CO 1	Categorize the types of signals , properties and their responses
CO 2	Analyse the continuous time signals and their properties using Fourier series and Fourier Transform
CO 3	Apply continuous time signals in Laplace transform and solve frequency responses in LTI-CT systems
CO 4	Analyse Time invariant system signal using discrete fourier transform and z transform
CO 5	Investigate the real time usage of signal and systems

Text Books

1. B. P. Lathi, Roger Green, "Linear Systems and Signals" Oxford University Press, 3rd Edition, 2017.
2. M. J. , "Signals and Systems: Analysis Using Transform Methods and MATLAB, 2nd Edition"McGraw-Hill Science/Engineering/Math, 2011.

Reference Books

1. A. Nagoor Kani, "SIGNALS AND SYSTEMS" Tata McGraw-Hill, 2010.

2.K. Deergha Rao, "Signals and Systems", Publisher: Birkhäuser, 2018 S. Salivahanan,A. Rajalakshmi “Physics for Electronics Engineering and Information Science”- Tata Mc-Graw Hill Education,29 January 2018.

Web Resources

1. https://nptel.ac.in/courses/117101055
2. https://nptel.ac.in/courses/108104100

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3	2	1										3
2	3	3	2	2			1							3
3	3	3		3	3									3
4	3	3	3	3	3									3
5	3	3	3	3	3									3

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	2	3	10
UNDETSTAND	10	10	3	2	10
APPLY	30	30	10	10	30
ANALYZE	50	50	10	10	50
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

(1) Find even and odd components of following signals (**Analyze**)

(i) $x(t) = 1+t+3t^2 + 5t^3 + 9t^4$

(ii) $x(t) = (1+t^3) \cos^3 (10t)$

(iii) x(t) = Cos (t) +Sin (t) + Sin (t) Cos (t)

(2) Exponential function unit step convolution. Evaluate Continuous Time (CT) convolution integral given below: (**Apply**)

$y(t) = e^{-2t} u(t) * u(t+2)$

(3) Sketch the following signals(i)

(i) u(t) = u(-t+2)
(ii) r(-t+3)

(iii) 2δ[n+2] + δ[n] - 2δ[n-1] + 3δ[n-3]

(iv) u[n+2] u[-n+3]

Where, u(t), r(t), u(n) represent continuous time unit step, continuous time ramp, discrete time impulse and discrete time step functions respectively. (**Analyze**)

COURSE OUTCOME 2 (CO 2) :

(1) Realize the following by direct form - II (**Analyze**)

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 8y(t) = 5\frac{d^2x(t)}{dt^2} + 4\frac{dx(t)}{dt} + 7\,x(t)$$

(2) Draw the direct form-I and II implementations of the system described by thefollowing differential equation. (**Analyze**)

$$7\frac{dy(t)}{dt} + 12y(t) = \frac{dx(t)}{dt} + x(t)$$

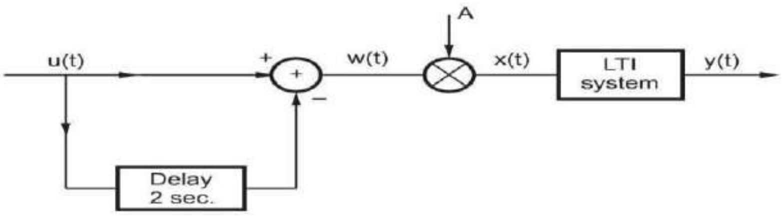
COURSE OUTCOME 3 (CO 3) :

Find the response of y(t) for the following system and refer the

(1) block diagram.Where, (**Apply**)

h(t)= e^{-2t} for t > 0

0 elsewhere



(2) Analyze the convolution integral and its real time applications in real time. (**Analyze**)

COURSE OUTCOME 4 (CO 4) :

(1) Find the Nyquist rate and Nyquist interval for following signals. (**Analyze**)

(i) 1/2π cos(4000 π t) cos(1000 π t)

(ii) m(t) = sin 500 π t / π t

(2)Determine z-transform of x(n) = cos ('Ω0 n) u(n) (**Analyze**)

COURSE OUTCOME 5 (CO 5) :

(1) Elucidate & analyze the process of signal filtering in the designed system.

(**Analyze**)

(2) Investigate the process of Analog to Digital signal conversion (**Analyze**)

(3) Emphasize the systematical relation between continuous and discrete time systems(**Analyze**)

21EE3611	Analog and Integrated Circuit Design Laboratory	L	T	P	C
		0	0	4	2

Prerequisites for the course

- Basic Electronics
- Principle of Digital Electronics

Objectives

1. To impart knowledge on Semi-Conductor Devices.
2. To Introduce different configuration of Transistors and differential amplifier
3. To impart knowledge on implementation of Op-amp in different Applications.
4. To study the Design, testing and characterizing of circuit behavior with digital and analog ICs.
5. To impart knowledge on Design and implementation of timer circuit using specific timer ICs.

S.No	List of Experiments	CO
1	Characteristics of P-N Junction diode and Zener diode.	**1**
2	Characteristics of MOSFET.	**2**
3	Input and Output characteristics of Transistor in CE configuration	**2**
4	Design and Frequency response characteristics of a CommonEmitter amplifier.	**2**
5	Differential amplifiers using BJT	**2**
6	Application of Op-Amp: inverting and non-inverting amplifier.	**3**
7	Application of Op-Amp: Integrator and Differentiator.	**3**
8	Implementation of Boolean Functions, Adder and Subtractor circuits.	**4**
9	Timer IC application: Study of NE/SE 555 timer in Astability operation.	**5**
10	Variability of Voltage Regulator using IC LM317.	**5**

	Test Project	Requirement	**Mapping of project with experiment (Give Serial Number)**	

1.	Design a simple circuit to control the 12V,200rpm, 0.3A DC Motor speed using MOSFET IRF 540 Specification: Input – 12V Battery DC Motor – 12V, 200rpm, 0.3A	MOSFET - IRF540 Potentiometer – 10KΩ Resistor – 470 Ω, 1MΩ	1,2,3,6,7,8,9	
	Design a circuit to control 12V DC Motor speed using MOSFET as a high potentiometer. Specification: Input : 230V AC DC Motor – 12V, 1.5kW, 3000rpm	Transformer : 230/12V, Centre Tapped Transformer Diode : 1N5408, 1N4148 MOSFET : IRF540 Resistor : 2.2MΩ, 680kΩ Potentiometer :2.2M Capacitor :47nF		
	Design a circuit for PWM DC Motor control with IC 555 Specification: Input : 12V DC Supply Motor : 12V DC, 1.2kw,3000rpm	IC 555 Diode : 1N4148 MOSFET : IRF540 Potentiometer: 100k Capacitor : 0.1uF,0.01uF Resistor : 10k		
	Design a circuit to control the speed of DC Motor using OP-Amp Specification: Input : 15V DC Supply Motor : 15V DC, 1.2kw	RCA30471 TIP122 Resistor - 22k, 100k, 10k Potentiometer – 2.2k Diode 1N4148		

	Design a circuit to improve the torque at low speed using CMOS PWM control Specification: Input : 230V AC DC Motor – 12V, 1.5kW, 3000rpm	Transformer – 230v/18V, Centre tapped Diode 1N4001,1N4148 Fuse 1A IC4001, VN66AF Potentiometer – 2.2M Resistor – 680k,220k Capacitor-10nF, 1000uF		
2.	Design a circuit of automatic water pumb controller for overhead tank. Specification: Input : 12V DC Supply Motor : 230V AC, 0.5 HP	**Resistor** 33kΩ-1 1MΩ-2 100kΩ-1 1KΩ-1 **ic-** 555-1 LM 317 - 1 **Relay–** 12v 25A-1 **Transistor–** BC547(for small pcb mount relay), 2N2222 for high current Load relay **Diode** 1N4007	1,3,4,5,9,10	
	Design a circuit of water level warning indicator using a transistor BC547. Specification: Input : 9V Battery	Transistor-BC547- 4 Resistor- 220Ω- 6 Buzzer -1 LED-4 nos (Red, Green &Yellow) 9V Battery - 1		
3.	Design a circuit of mobile	CA3130 Op-Amp		

	phone detector using CA3140 & 555 tImer IC. Specification: Input – 12V DC supply	Resistors – 2.2MΩ x 2, 100KΩ, 1KΩ Capacitors – 22pF x 2, 0.22nF, 47pF, 100μF BC548 NPN Transistor LED Antenna 9V Battery		
	Design a circuit of mobile phone detector using Schottky Diode Specification: Input – 12V DC supply	Resistor – 1kΩ, 100kΩ, 3kΩ, 10Ω, 100Ω ,200Ω IC- LM339 Transistor – BC547 Inductor – 10uH Capacitor – 100nF 12V Battery	1,3,4,5,9,10	
4.	Design a circuit of rain fall detection using 555 Timer IC. Specification : Input : 9V Battery	Rain Sensor 555 Timer IC Transistor BC147 Buzzer Capacitor – 10uF Resistors – 470E, 1k,4.7k,10k,100k(2 nos) 9V Battery IC 741 LED (RED)	3,4,5,6,7,9	
	Design a circuit of rain fall detection using 555 Timer IC. Specification : Input : 9V Battery			

5.	Design a circuit of 12V audio power amplifier. Specification: Input : 12V	1. TIP35C Power transistor. 2. Heat sink for TIP35C. 3. 1k resistor. 4. 470uF 25V capacitor. 5. Audio Input Jack (Depending on the required input source connector). 6. Breadboard. 7. 12V Power supply unit 8. Loudspeaker	3,4,5,6,7,8	
	Design a circuit of simple microphone amplifier Specification: Input : 12 V Speaker : 8Ω/ 0.5W	1. LM386 2. 10uF / 16V capacitor 3. 470uF / 16V 4. 0.047uF / 16V Polystar Flim Capacitor 5. 10R ¼ Watt 6. 12V Power Supply unit 7. 8 Ohms / 0.5 Watt Speaker 8. Capsule or Electret Microphone 9. .1uF capacitor 10. 10k 1/4th WattResistor 11. Bread Board 12. Hook up wires		

	Design a Audio Voice over circuit using LM 386 Specification: Input : 12 V Speaker : 8Ω/ 0.5W	1. LM386 2. 10uF / 16V capacitor 3. 470uF / 16V 4. 0.047uF / 16V Polystar Flim Capacitor 5. 10R ¼ Watt 6. 12V Power Supply unit 7. 12V Relay 8. Tactile switch 9. 3.5mm Audio Jack 10. 8 Ohms / .5 Watt Speaker 11. Capsule or Electret 12. .1uF capacitor 13. 10k 1/4th Watt Resistor 14. Bread Board 15. Hook up wires 16. 10k 1/4th Watt Resistor 17. Bread Board 18. Hook up wires		
6.	Design a Automatic vehicle Headlight Dimmer circuit using Transistor. Input : 12V Battery Design a Automatic vehicle Headlight Dimmer circuit using 555 timer IC and MOSFET. Input : 12V Battery	R1=1KΩ, 1MΩ, 2MΩ, 100KΩ P1=10KΩ, LDR = With resistance @ around 10 to 50 K when illuminated in daylight (under shade). T1 = BC547,		

	Design a Automatic vehicle Headlight Dimmer circuit using 555 timer IC and MOSFET with cell phone charger. Input : 12V Battery	D1 = 1N4007 Relay = coil 400 Ohms, DPDT, 12 volts Head Light -2 Transistor -BC547 Capacitor – 1uF,25V 12V Battery MOSFET - IRF540 IC 555 IC7805 Photo Transistor L14C1 Diode 1N4007 Switch	1,2,3,4,5,9	
7.	Design a Laser Trip alarm circuit Input : 9V DC	Laser diode/pointer 5V, 650nm, 5mW Timer IC NE556 LDR 5mm Electrolytic Capacitor 100uF, 470uF Ceramic Capacitor 0.1uF Resistor 1K, 10K, 22K Transistor 2n3904 DC Battery 9V Speaker 8 ohms/0.5w	1,3,4,5,9	

Suggestive Assessment Methods		
Lab Components Assessments (60 Marks)		**End Semester Exams (40 Marks)**
Experiments		**Experiments + Test Project**
Outcomes		
Upon completion of the course, the students will be able to:		
CO1	**Understand the characteristics of Semi-Conductor Devices.**	
CO2	**Implement different configuration of Transistors and differential amplifier**	
CO3	**Apply Operational amplifiers in different electronic circuits.**	
CO4	**Design circuit with digital and analog ICs.**	
CO5	**Design timer circuit using specific timer ICs.**	
Laboratory Requirements		

Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photo diode, Photo Transistor – 10

Resistors, Capacitors and inductors –
10Necessary digital IC 8 – 10

Function Generators – 10

Regulated 3 output Power Supply 5 +_ 15V – 10

CRO – 10

Storage Oscilloscope –
1Bread boards – 10

Digital Multimeter – 10

IC Tester (Analog) – 2

IC 741/ IC NE555/566/565 – 10

Digital IC types – 10

LM317, LM723, ICSG3524 / SG3525 – Each 10

Potentiometer -10

Step-down transformer 230V/12-0-12V – 5Single Strand Wire -10

Reference Books
Lab Manual
Web Recourses
1. https://nptel.ac.in/courses/117/103/117103063/ 2. https://nptel.ac.in/courses/108/108/108108112/ 3. https://nptel.ac.in/courses/108/108/108108111/ 4. https://nptel.ac.in/courses/108/106/108106069/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3								2				3	
2	3	3	2						2				3	
3		3	2						2				3	
4		3	3						2				3	
5		3	3						2				3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

Students will be able to Predict the suitable method for................. (Apply)

1. What is meant by breakdown voltage?
2. Write the applications of Zener diode.

COURSE OUTCOME 2:

Students will be able to Predict the suitable method for... (Apply)

1. Derive the equation of MOFET Characteristics equation.
2. Explain the frequency response of CE Amplifier.

COURSE OUTCOME 3:

1. Define OPAMP.
2. Define the summing Amplifier.

COURSE OUTCOME 4:

1. Analyze the Boolean expression and simplify
2. Explain the function of Full adder and full subtractor.

COURSE OUTCOME 5:

1. Write the applications of 555 timer ICs.

2 What is the function of voltage regulator?

		L	T	P	C
21EE3612	**DC MACHINES AND TRANSFORMERS LABORATORY**	**0**	**0**	**4**	**2**

Preamble

Electrical Machines Lab provides the essential facilities to the students to augment their concepts about the fundamentals of transformers and rotating machines. The lab is equipped with DC series/shunt motor, compound motor, universal motor, single-phase induction motor, single-phase transformer, three-phase induction motor, three-phase synchronous motor and Three-phase transformer. The lab is equipped with various tests and monitoring equipment also.

Prerequisites for the course

1. Basic Electronic Circuits
2. Principle of Digital electronics

Objectives

1. To determine the performance characteristics of DC Generator.
2. To examine the self-excitation in DC generators.
3. To impart knowledge in load characteristics of DC Motor.
4. To study the need of starters in DC motors.
5. To analyse the performance characteristics of transformers and various connections

S.No	List of Experiments	CO
1	Open circuit and load characteristics of separately excited DC generators	**1**
2	Open circuit and load characteristics of self-excited DC generators	**1**
3	Load characteristics of DC series motor	**2**

4	Load characteristics of DC shunt and DC compound motor.	**2**	
5	Speed control of DC shunt motor.	**3**	
6	Swinburne's test	**3**	
7	Hopkinson's test on DC motor – generator set	**4**	
8	Load test on single-phase transformer	**4**	
9	Open circuit & short circuit test on single phase transformer	**5**	
10	Separation of no-load losses in single phase transformer	**5**	
11	Sumpner's test on Single phase transformer	**5**	
12	Load Test on three phase transformer	**5**	
S.No.	**List of Projects**	**Related Experiment**	**CO**
1.	Mini E-bike Using DC Motor	**1,3,4,5**	**2**
2.	Automatic Fan with Entry Detection	**1,2,4,6,8**	**2**
3.	3D Rotating Laser Disco Lamp	**1,5,6,8,9**	**4**
4.	Rotating Product Marketing Platform	**1,3,5,6,7**	**5**
5.	Hand Cranked DC Motor Torch	**2,3,6**	**1**
6.	Automatic Cat Feeder	**7,8,9,10**	**2**
7.	Design and testing of small DC Motor/Generators	**2,4,6,9**	**3**
8.	Power Generation from Footpaths	**1,2,3,8,9**	**5**
9.	Electricity generating speed breaker	**1,2,6,9,10**	**5**
10.	Power Supply Circuit	**1,2,6,9**	**4**
11.	Automatic Solar tracker	**4,5,8,9**	**3**
12.	Voice controlled Robot	**1,7,8,9**	**4**
13.	Voice based speed control of DC motor	**1,2,3,7,8**	**2**
14.	Solar panel belt conveyor	**1,2,3,8,9**	**1**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**

Outcomes	
Upon completion of the course, the students will be able to:	
CO1	Ability to understand the basic construction of DC Generator
CO2	Ability to understand and analyse self-excitation in DC generators.
CO3	Ability to understand and analyse DC Motor characteristics
CO4	Ability to understand concept of starters in DC Machines.
CO5	Ability to analyse the equivalent parameters using Transformer and 3-phase transformers
Laboratory Requirements	
1.	Laboratory Manual

Reference Books
1. Electrical Technology Vol-II, Theraja, B.L., S. Chand, New Delhi, 2016
2. Electrical Machines, Despande, M.V., PHI Learning, New Delhi, 2002
3. Electrical Technology, Uppal, S.L., Khanna Publication, New Delhi, 2014
4. Electrical Machine, Nagrath, I.J. and Kothari, D.P, Tata McGraw Hill, New Delhi, 2016
5. Electrical Machine-I, Gupta, J. B. S. K. Kataria & Sons, New, 2011
Web Recourses
1. https://www.ee.iitb.ac.in/course/~emlab/lab-manual.html
2. https://www.youtube.com/watch?v=rDqbCEA2Qfc

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1								1	3	3
2	2	2	1	1					1	1	1		2	2
3	2	3	2	1					1	1			2	3
4	3	2	2	1		1	1		1	2	1	1	3	2
5	3	2	1	1					1				3	2

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: UNDERSTAND

1. Derive an equation for emf in a DC Generator.
2. How can induced emf in the armature conductors of a DC generator be made unidirectional?

COURSE OUTCOME 2: apply

1. What is Self-Excitation in a DC Shunt generator?
2. What are the advantages of a separately excited generator?

COURSE OUTCOME 3: understand

1. Explain the various methods of excitation of DC Motor.
2. Explain the method of speed control of dc motors with field control.

COURSE OUTCOME 4: analyse

1. Why is starter needed to start the DC motor?
2. Why Is The Starting Current High In A DC Motor (or) Why Do We Use A Starter?

COURSE OUTCOME 5: understand

1. Explain the various types of losses occur in a transformer.
2. Define an Ideal transformer. Draw and explain the no load phasor diagram of an ideal single phase transformer.

21PT3901	SOFTSKILLS -APTITUDE I	L	T	P	C
		1	0	0	1
Prerequisites for the course					
1. Basic Maths					
Objectives					
1. Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.					
2. Students will be able to reason, model, and draw conclusions or make decisions with mathematical, statistical, and quantitative information.					

UNIT I	**MODULE I**	**3**
Number system, Number series, HCF and LCM of Numbers, Factors and Decimals.		
UNIT II	**MODULE II**	**3**
Square roots and cube roots, Indices and surds, Simplification and approximation, problems on ages and numbers.		
UNIT III	**MODULE III**	**3**
Percentage, Profit, loss and discount, Average, Ratio and Proportion.		
UNIT IV	**MODULE IV**	**3**
Partnership and share, Alligation and mixtures, Time, work and wages.		
UNIT V	**MODULE V**	**3**
Pipes and cisterns, simple interest, Compound interest, Growth and depreciation.		
Total Periods		**15**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
1 DESCRIPTIVE QUESTIONS **2. FORMATIVE MULTIPLE CHOICE QUESTIONS**	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**1. DESCRIPTIVE QUESTIONS** **2. FORMATIVE MULTIPLE CHOICE QUESTIONS**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Solve real-life problems requiring interpretation and comparison of complex numerical summaries which extend beyond simple measures of center.
2	Solve real-life problems requiring interpretation and comparison of various representations of ratios
3	Distinguish between proportional and nonproportional situations and, when appropriate, apply proportional reasoning.
4	Develop an answer to an open-ended question requiring analysis and synthesis of multiple calculations, data summaries, and/or models.
5	Justify and communicate their conclusions in ways appropriate to the audience.

Text Books
1. Quantitative Aptitude for Competitive Examinations | 7th Edition (Paperback, AbhijitGuha)
Reference Books
1 https://myupsc.com/wp-content/uploads/2020/11/Quantitative-Aptitude-for-Competitive-Examinations-by-Dinesh-Khattar-z-lib.org .pdf 2 Quantitative Aptitude for Competitive Examinations - Quantitative Aptitude by rs agarwal with 0 Disc. (English, Paperback, Aggarwal R. S.) Revised, 2021
Web Recourses 1. https://pdf.bankexamstoday.com/raman_files/Quant%20Formula.pdf 2. https://ugcportal.com/raman-files/QT-TRICKS.pdf 3. https://www.javatpoint.com/aptitude/quantitative#speed-and-distance 4. https://www.indiabix.com/aptitude/questions-and-answers/

SEMESTER IV

21EE4601	MEASUREMENTS AND MODERN INSTRUMENTS	L	T	P	C
		3	0	0	3

Preamble

This course is designed to impart fundamental knowledge of analog measuring instruments characteristics. This course exposes the knowledge about the construction, principle and applications of analog and digital measuring instruments. Students will get the fundamental knowledge of DC and AC null measurement methods along with its behaviors on it's various applications.

Prerequisites for the course

2. Physics for Engineers
3. Electric Circuits and Network Analysis
4. Analog and Integrated Circuits

Objectives

1. To impart knowledge on Basic functional elements of instrumentation
2. To learn about the Fundamentals of electrical and electronic instruments
3. To study the Comparison between various measurement techniques.
4. To discuss about storage and display devices
5. To introduce Various transducers and the data acquisition systems

UNIT I	CHARACTERISTICS, ERRORS & STANDARDS OF INSTRUMENTS	9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration-Principle and types of analog and digital voltmeters, ammeters.

UNIT II	ELECTRICAL AND ELECTRONIC INSTRUMENTS	9

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements –Measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III	**COMPARATIVE METHODS OF MEASUREMENTS**	**9**
D.C potentiometers, D.C Bridges: Wheatstone Bridge, Kelvin's bridge, Kelvin's double bridge - A.C bridges: Maxwell bridge, Anderson bridge, Hays bridge, Schering bridge, Wein's bridge. transformer ratio bridges, self-balancing bridges.		
UNIT IV	**STORAGE AND DISPLAY DEVICES**	**9**
Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.		
UNIT V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**	**9**
Classification of transducers – Selection of transducers –Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors- Thermal Imagers.		
Total Periods		**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**3. ASSIGNMENT** **4. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Illustrate the Basic functional elements of instrumentation.
2	Compare the operation of various types of measuring instruments.
3	Determine the unknown values of R, L, C using bridges
4	Analyse the operations of storage and display devices
5	Apply the suitable transducers and the data acquisition systems

Text Books

2. **A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2010.**
3. **J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2013.**

Reference Books

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, ' Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc19_ee44/preview
2. https://nptel.ac.in/courses/112107242

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2											3	
2	3	3	3										3	
3	3												3	
4	3												3	
5	3												3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	00	00	10
UNDETSTAND	20	20	05	05	20
APPLY	40	40	10	10	40
ANALYZE	30	30	10	10	30
EVALUATE	00	00	00	00	00
CREATE	0	0	0	0	0
Total	100	100	25	25	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS COURSE OUTCOME 1:

3. The true value of a voltage is 100V. The values indicated by a measuring instrument are 104, 103,105,103 and 105V. Examine the Accuracy and Precision of the measurement. (Analyze)
4. Compare Resolution and Precision. (Analyze)

COURSE OUTCOME 2:

1. A basic D'Arsonval movement with a full deflection of 50 micro amps and internal resistance of 500 ohm is used as voltmeter. Formulate the necessary equation and Solve the value of multiplier resistance needed to measure a voltage range of 0- 10V. (Apply).
2. The Coil of instrument has 42.5 turns. The mean width of the coil is 2.5cm and the axial length of the coil is 2 cm. If the flux density is 0.1 Wb/m2, Solve the torque on the moving coil in NM. (Apply)

COURSE OUTCOME 3:

1. Which bridge is used to measure incremental inductance? Develop the expression. (Apply)
2. Construct single phase energy meter and explain the principle. (Apply)

COURSE OUTCOME 4:

1. Measure the features of FM recording with PDM Recording. (Analyze)
2. Compare the dual trace and dual beam CRO. (Analyze)

COURSE OUTCOME 5:

1. A 5-plate transducer has plates of dimensions 20mm*20 mm and separated 0.25mm apart. The arrangement is to be used for measuring displacement. Solve the sensitivity of the arrangement. Assume air medium. (Apply)
2. Construct the piezo-electric transducer and give the formula for coupling coefficient. (Apply)

21EE4602	CONTROL THEORY	L	T	P	C
		3	0	0	3

Preamble

This course is to impart in students a good understanding of fundamental principles in control engineering. The course includes: Mathematical Modelling of Linear Continuous Time Invariant Single Input - Single Output Dynamical Systems, Transfer Functions and State Space Models, Performance Specifications, Analysis and Design of Closed Loop Control Systems.

prequisites for the course

1. Matrices and Advance Calculus
2. Partial Differential Equation and Application of Fourier Series
3. Electric Circuits and Network Analysis

Objectives

1. To introduce the use of transfer function models for analysis physical systems and the control system components.
2. To provide adequate knowledge in the time domain analysis of the systems.
3. To discuss the frequency domain analysis of the systems
4. To study the stability analysis.
5. To learn the design of compensators and state variable representation of physical systems.

UNIT I	SYSTEMS COMPONENTS AND THEIR REPRESENTATION	9+3

Control system: Terminology and Basic Structure-Feed forward and Feedback control theory. Electrical and Mechanical transfer function models- Electrical analogy of mechanical system - Block diagram reduction technique - Signal flow graph.

UNIT II	TIME RESPONSE ANALYSIS	9+3

Transient response-steady state response-Measures of performance of the standard first orderand second order system- Time domain specifications-Steady state response - Static error constants - steady state error - Effects of proportional derivative, proportional integral systems.

UNIT III	FREQUENCY RESPONSE ANALYSIS	9+3

Closed loop frequency response-Performance specification in frequency domain- Correlation between frequency domain and time domain specifications Frequency response of standard second order system- Bode Plot-Polar Plot- Nyquist plots

UNIT IV	STABILITY ANALYSIS OF CONTROL SYSTEM	9+3

Concept of stability-Bounded-Input Bounded-Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion

UNIT V	COMPENSATOR DESIGN AND STATE VARIABLE ANALYSIS	9+3

Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead analog lead compensator using bode plots. - Concept of state, state variable, state model, Controllability and observability.

Total Periods	**60**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Develop various representations of system based on the knowledge ofMathematics, Science and Engineering fundamentals.
2	Determine time domain analysis of various models of linear system.
3	Analysis frequency domain for various models of linear system.
4	Determine the stability of different control systems.
5	Construct appropriate compensator for the given specifications.

Text Books

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2018.

Reference Books

1. atsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education, 2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System

4. Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.

Web Recourses

1. https://nptel.ac.in/courses/107106081
2. https://www.youtube.com/watch?v=RcuGxWc0HyQ

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3											3	
2	3	3											3	
3	3	3	2										3	
4	3	3	2										3	
5	3	3	2										3	

1-Low , 2- Medium, 3- High

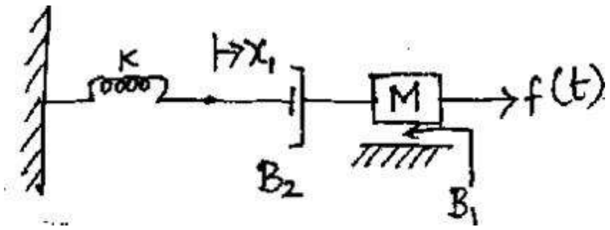
BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	05	05	10
UNDETSTAND	20	20	05	05	20
APPLY	30	30	15	15	30
ANALYZE	30	30	00	00	30
EVALUATE	10	10	00	00	10
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

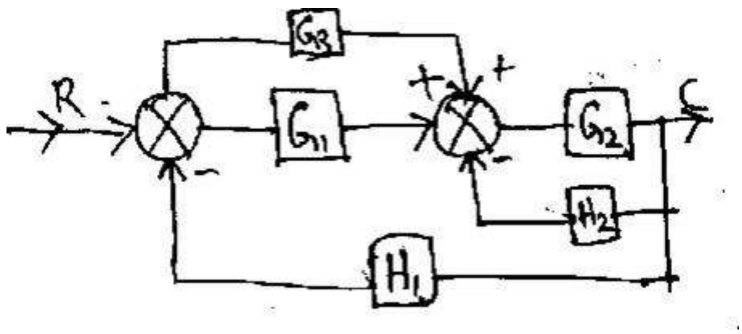
1. Develop the equations of motion in 's' domain. Determine the transfer function of the system. (Apply)



2. Develop C(S)/R(S) using block diagram reduction rules. (Apply)

COURSE OUTCOME 2:

1. Develop the response of under damped second order system for unit step input. (Apply)



2. The unity feedback system is characterized by an open loop transfer function is G(S)= K / S(S+10). Examine the gain K ,so that the system will have a damping ratio of 0.5.For this value of K, determine settling time, Peak overshoot and time to Peak overshoot for a unit-step input. (Analyze)

COURSE OUTCOME 3:

1. Construct the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies G(S) =KS^2 / (1+0.2S) (1+0.02S).Determine the value of K for a gain cross over frequency of 20 rad/sec. (Apply)

2. Report on the polar plot of an open loop transfer function of a unity feedback system given by G(S) =1/[S (1+S)(1+2S)]. Construct the polar plot. (Apply)

COURSE OUTCOME 4:

1. Examine the value of K of the open loop transfer function given by G(S) = K/(S+1) (S+5) (S^2+6S+25), which will cause sustained oscillations in the closed loop system. Find out the corresponding oscillating frequencies. (Analyze)

2. Construct the root locus of the system whose open loop transfer function is G(s)

=K/[S (S+2) (S+4)]. Find the value of K so that damping ratio of the closed loop system is 0.5. (Apply)

COURSE OUTCOME 5:

1. Analyze a phase lead compensator for the system G(S) = K/[S (S+1)] to satisfy the phase margin ≥ 45^o ,steady state error for a unit ramp input ≤ 1/15 and gain crossover frequency < 7.5 rad/sec. (Analyze)

2. Examine whether the system is completely (i) Controllable (ii) Observable (Analyze)

$$\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \\ \dot{x}3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}$$

21EE4603	AC MACHINES	L	T	P	C
		3	1	0	4

Preamble

It is an introductory course which emphasizes the fundamental concepts and overview of Electrical Machines. The concepts discussed herein are intended to provide clarification on basic electrical engineering for Electrical Engineering graduates. Rotating electrical machines are widely used for the purpose of converting energy from one form to another. AC machines are becoming more and more attractive in many applications such as those requiring variable speed and flexible control. Alternating Current (AC) machines are the most preferred for generation of electric power. AC motors are the commonly used in industry for motive power for applications. There are three families of rotating machines one of which is the synchronous machine commonly in the form of the AC synchronous generator such machines are widely used in power stations for electric power generation. The synchronous motor has limited application.

Prerequisites for the course		
1. Electric Circuits and Network Analysis 2. Fundamentals of Applied Electromagnetics 3. DC Machines and Transformers		
Objectives		
1. To study the construction principle of operation and performance of induction motor		
2. To learn the starters and speed control methods of three phase induction motor		
3. To impart knowledge on Operation of AC generator and motors (Both three phase and single phase)		
4. Analyze the performance characteristics of synchronous motor		
5. To introduce the special electrical machines.		
UNIT I	**THREE PHASE INDUCTION MACHINES**	**9**
Constructional details – Types of rotors – Principle of operation – Slip– Slip- torque characteristics - Condition for maximum torque - No load and blocked rotor tests - Equivalent circuit-– Losses and efficiency – Load test- Circle diagram – Separation of no load losses – Cogging – Crawling - Double cage rotors –Induction generator – Doubly fed induction generator – Synchronous induction motor		
UNIT II	**SINGLE PHASE INDUCTION MOTOR AND CONTROL OF THREE PHASE INDUCTION MOTOR**	**9**
Constructional details of single phase induction motor – Double revolving field theory and operation – Equivalent circuit –– Starting methods of single-phase induction motors. Need for starters – Types of starters: Primary resistor, Autotransformer and Star-delta starters and Rotor resistance – Speed control: Change of voltage, frequency, number of poles and V/f control – Cascaded connection – Slip power recovery scheme- Applications.		
UNIT III	**SYNCHRONOUS GENERATOR**	**9**
Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF, ZPF and ASA methods – Synchronizing and parallel operation – Synchronizing torque - Operating characteristics - Capability curves– Salient pole Machine: Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test.		
UNIT IV	**SYNCHRONOUS MOTOR**	**9**
Principle of operation - Methods of starting - Phasor diagram - V and Inverted V curve - Power angle characteristics - Hunting in synchronous motor - Application of Synchronous motor		
UNIT V	**SPECIAL ELECTRICALMACHINES**	**9**
Constructional features- Switched Reluctance motors- PMBLDC and PMSM -Shaded poleinduction motor - Linear induction motor- Magnetic levitation - reluctance motor – Repulsion motor – Hysteresis motor-AC series motor -Applications		
	Total Periods	**45**
Suggestive Assessment Methods		

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Apply the fundamental Knowledge of Induction motor in Determining the Motor parameters, equivalent circuit parameters and test the Induction motor using direct and Indirect loading methods
2	Discuss the starting and speed control methods for three phase induction motor.
3	Determine the generator Parameters regulation Characteristics phasor and capability curves.
4	Solve Problems in phasor diagrams, equivalent circuits and Synchronous motor parameters
5	Summarize the features of special machines

Text Books

1. Text of Electrical Technology; Vol -4; B. L. Theraja, and A. K. Theraja; S. Chand Publication
2. Vincent Del Toro, ‘Basic Electric Machines’ Pearson India Education, 2016

Reference Books

1. B.R.Gupta, ’Fundamental of Electric Machines’ New age International Publishers,3rd Edition ,Reprint 2015
2. D.P. Kothari and I.J. Nagrath, ‘Electric Machines’, McGraw Hill Publishing Company Ltd, 2017
3. M.N. Bandyopadhyay, ‘Electrical Machines Theory and Practice’, PHI Learning PVT LTD., New Delhi, 2019.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc22_ee06/preview
2. https://archive.nptel.ac.in/courses/108/105/108105131/
3. https://www.btechguru.com/courses--nptel--electrical-engineering--electrical-machines- ii-video-lecture--EE--EE10009W.html
4. https://onlinecourses.nptel.ac.in/noc22_ee06/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3												3
2	3	3												3
3	3	3	1											3
4	3	3												3
5	3	3	1											3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDETSTAND	30	30	10	10	30
APPLY	30	30	10	10	30
ANALYZE	20	20	10	10	15
EVALUATE	10	10	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1

1. Sketch and Explain the torque slip characteristics of 3 phase cage and slip-ring induction motors. Show the stable region in the graph (Analyze)

2. Develop an equivalent circuit for three phase induction motor. State thedifference between exact and approximate equivalent circuit. (Analyze)

COURSE OUTCOME 2:

1. With neat diagrams explains the working of any two types of starters used for squirrel cage type 3 phase induction motor. (Analyze)

2. Explain the different methods of slip power recovery schemes. (Understand)

COURSE OUTCOME 3:

1. Generalize the Equivalent circuit and phasor diagrams of a Synchronousgenerator for different power factor loading (Evaluate)

2. Formulate clearly the A S A method of determining the regulation of an alternator. (Evaluate)

COURSE OUTCOME 4:

1. Explain in detail the V curve and inverted V curve of a synchronous motor (Apply)

2. A 5kW, three-phase Y-connected 50 Hz, 440V, cylindrical rotor synchronous motor operates at rated condition with 0.8 pf leading. The motor efficiency excluding field and stator losses is 95% and Xs=2.5Ω. Calculate: i) Mechanical power developed ii) Armature Current iii) Back emf iv) Power angle v) Maximumor pull out torque of the motor. (Apply)

COURSE OUTCOME 5:

1. Explain the working of linear induction motor and also write its applications.(understand)

2. Summarize the constructional details, principle of operation and the application of Hysteresis motor and AC Series motor.(Analyze)

21EE4604	**Transmission and Distribution in Power Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

It is an introductory course which emphasizes the fundamental concepts and overview of transmission elements and the concepts discussed herein are intended to provide clarification on basic power transmission and distribution for Electrical Engineering graduates.

Prerequisites for the course

1. Fundamentals of Electromagnetics
2. Electric Circuits and Network Analysis

Objectives

1. To impart knowledge on the structure of electric power system and the computation oftransmission line parameters

2. To learn the equivalent circuits for the transmission lines based on distance and todetermine voltage regulation and efficiency.		
3. To understand the mechanical design of transmission lines and to analyze the voltagedistribution in insulator strings to improve the efficiency.		
4. To familiarize the types, construction and the computation parameters of cables.		
5. To study about distribution systems, types of substations, methods of grounding, EHVAC,HVDC and FACTS.		
UNIT I	**TRANSMISSION LINE PARAMETERS**	**9**
Structure of Power System -Growth of Power System – Indian overview – Interconnections and their advantages – Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects.		
UNIT II	**MODELLING AND PERFORMANCE OF TRANSMISSION LINES**	**9**
Performance of short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance – transmission efficiency and voltage regulation, real and reactive power flow in lines – Power Circle diagrams – Phenomenon of Corona– Ferranti Effect.		
UNIT III	**MECHANICAL DESIGN OF LINES**	**9**
Mechanical design of transmission lines – Line Supports –Tower spotting-Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators		
UNIT IV	**UNDER GROUND CABLES**	**9**
Underground cables - Types of cables – Construction of single core and 3 core cables - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables –Dielectric loss - Power factor and heating of cables – DC cables – Comparison between AC and DC cables - Specification of power cables.		
UNIT V	**DISTRIBUTION SYSTEMS**	**9**
Classification of Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations -Methods of Grounding – Introduction to EHVAC and HVDC- Wireless power transmission.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze the transmission line models and evaluate its performance parameters.
2	Analyze and compute the parameters of the transmission line for different configuration
3	Design the transmission lines under various working conditions and understand the role of insulators
4	Compute the parameters of underground cables.
5	Calculate Distribution systems parameters, substations layouts , and grounding.

Text Books

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-Hill Publishing Company limited, New Delhi, Third Edition, 2019.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2018.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2019.

Reference Books

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, 2016.
2. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2019.
3. Arun Ingole, "power transmission and distribution" Pearson Education, 2017.
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2015.

Web Resources

1. https://www.electrical4u.com/power-system/
2. https://electrical-engineering-portal.com/electric-power-systems

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3				2					2		2	3
2	3	3				2					3		2	3
3	3	3	2			2		2			2		2	3
4	3	3	2			2		2			2		2	3
5	3	3	2		2	2					3	3	2	3

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	0	0	10
UNDETSTAND	30	30	5	5	30
APPLY	60	60	10	10	60
ANALYZE	0	0	10	10	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

1-Low , 2- Medium, 3- High

COURSE LEVEL SSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Derive the expression for calculation the internal and external flux linkages for a conductor carrying current. Use these expressions to derive the equation for the inductance of a single phase transmission line(Analyse)

2. Calculate the loop inductance per km of a single phase line comprising of 2 parallel conductors 1m apart and 1cm in diameter, When the material of conductor is (1) Copper (2)Steel of relative permeability 50.(Evaluate)

3. Derive the expression for capacitance of symmetrical and unsymmetrical double circuitthree phase line (Analyse)

COURSE OUTCOME 2:

1. Derive the expression for receiving end power circle diagram. (Understand)

2. Derive the power flow performance equation of three phase transmission line in the form and sending-end receiving-end power and voltages at the two ends of the line (Analyse).

COURSE OUTCOME 3:

1. Prove that a transmission line conductor between two supports at equal heights takesthe form of a catenary(Understand)

2. What is sag template? Explain how this is useful for location of towers and stringing of power conductors. (Understand)

3. Derive an expression for the insulation resistance, capacitance and the electrostaticstress of a single core cable. (Analyse)

COURSE OUTCOME 4:

1. A 2km long 3 core 3Φ cable has capacitance 0.5 μF/km between two conductors bunched with sheath and the third conductor. The capacitance between the conductors is also measured when bunched together and the sheath and found to be 0.75 μF/km. Determine

   (i) Capacitance between phases (ii) Capacitance between the conductor and the sheath (iii) Effective per phase capacitance (iv) Capacitance between two conductors connecting a third conductor to the sheath (v) Charging current if the supply voltage is 11kv ,50Hz. (Evaluate).

2. Describe an experiment to determine the capacitance of belted cables (Understand).

3. A 33kV single core cable has conductor diameter of 1 cm and a sheath of inside diameter4cm. Find the maximum and minimum stress in the insulation (Evaluate).

COURSE OUTCOME 5:

1. A single phase distributor 'AB' 300m long supplies a load of 200A at 0.8pf lagging at its far end 'B' and a load of 100A at 0.0707 pf lagging at 200m from sending end point A. Both pf are referred to the voltage at far end. The total resistance and reactance per km(go and return) of the distributor is 0.2ohm and 0.1ohm. Calculate the total voltage drop in the distributor. (Evaluate)

2. Explain the following : (a) Stepped or trapped distributor (b) Ring main distributor (c) DC distributor fed at one end (d) DC distributor fed at both ends. (Understand)

21EE4605	DIGITAL ELECTRONICS	L	T	P	C
		2	0	2	3

Preamble

This Theory cum Practical course gives a Theory knowledge and practical exposure to the students to learn the characteristics of logic gates, various digital circuits such as Multiplexers, Demultiplexers, Encoders, Decoders, Code converters, counters and shift registers and their applications. The use of simulation tool (Verilog HDL) for the performance analysis of digital circuits is also introduced.

Prerequisites for the course

1. Physics For Engineers
2. Analog and Integrated Circuits

Objectives

1. To study various number systems and simplify the logical expressions using Boolean functions.
2.To discuss the K-map minimization and design of combinational circuits.
3. To learn the design o f synchronous sequential circuits.
4.To impart knowledge of asynchronous sequential circuits and PLD.
5. To introduce the digital simulation for development of application oriented logic circuits.

UNIT I	DIGITAL FUNDAMENTALS	6

Review of number system—1's and 2's complements-Types and conversion of codes- BCD, Excess 3 code, Gray code-Error detection and correction codes (Parity and Hamming code). Boolean algebra-Logic gates, Universal gates.

UNIT II	COMBINATIONAL CIRCUIT DESIGN	6

K-map representations - minimization using K maps - Implementation of combinational logic circuits-Design of Half and Full Adders, Half and Full Subtractors, Multiplexer,Demultiplexer, code converters, Decoder and Encoder.

UNIT III	SYNCHRONOUS SEQUENTIAL CIRCUITS	6

Flip flops – SR, JK, D, T, Master/Slave FF – operation and excitation tables-Analysis and design of clocked sequential circuits –Moore and Mealy models, state reduction-Design of Synchronous Counters - Modulo counters- Shift registers.

UNIT IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES	6

Asynchronous sequential logic circuits-Transition table, flow table, race conditions-Analysis of asynchronous sequential Circuits-Introduction to Programmable Logic Devices: PROM, PLA and PAL.

UNIT V	**VHDL**	**6**
RTL Design – combinational logic- Adder, Subtractor, Multiplexer, Demultiplexer – Sequential circuit- Flip Flops, Counters – Operators – Introduction to Packages – Test bench.		
	Total Periods	**30**

S.No	**List of Experiments**	**CO**
1	Simplification and Realization of Boolean Functions using logic gates	**CO1**
2	Parity generator and parity checking	**CO1**
3	Implementation of Adder and Subtractor circuits	**CO2**
4	Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa	**CO2**
5	Encoders and Decoders	**CO2**
6	Design and implementation of 3-bit modulo synchronous counters.	**CO3**
7	Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's	**CO3**
	Total Periods	**30 Theory +30 Lab**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. Lab Experiments** **2. Model Examination** **3. Test Project**	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Apply the number systems and simplify the logical expressions using Boolean functions
2	Design and Demonstrate combinational Circuits using logic gates
3	Construct synchronous sequential circuits for the given requirement.
4	Design asynchronous sequential circuits and PLDs
5	Write a program using VHDL and to determine the logic circuits performance using verilog simulation tool

Text Books

2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education,6th Edition 2018.
3. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.

Reference Books

1. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.
2. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
3. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
4. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.

Web Recourses

1. https://nptel.ac.in/courses/108105113
2. https://nptel.ac.in/courses/117106086

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3							2				3	
2	3	3							2				3	
3	3	3	2						2				3	
4	3	3	2										3	
5	3	3	2										3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	05	05	10
UNDETSTAND	20	20	05	05	20
APPLY	30	30	15	15	30
ANALYZE	30	30	20	20	30
EVALUATE	10	10	05	05	10
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Solve seven bit even parity hamming code for the binary word 1011. (Apply)
2. Examine the correct transmitted message for the received even parity hammingcode 00111101010 and also detect & correct errors if any. (Analyze)

COURSE OUTCOME 2:

1. Construct full subtractor circuit and draw its Logic diagram. (Apply)
2. Construct 3*8 Decoder with its truth table and Logic gates. (Apply)

COURSE OUTCOME 3:

1. Develop the Modulus 3 counters using SR flip flop. (Apply)
2. Construct the following shift registers i) Serial in Parallel out ii) Serial in Serialout. (Apply)

COURSE OUTCOME 4:

1. Construct an asynchronous sequential circuit with two inputs X and Y and one output Z whenever Y is 1 input X is transferred to Z when y equal to zero the output does not change for any change X. (Apply)

2. Analyze the fundamental mode of Asynchronous Sequential Circuit with one suitable example. (Analyze)

COURSE OUTCOME 5:

1. Develop the Full Adder circuit and Write VHDL program using BehavioralModeling andStructural modeling. (Apply)

2. Construct the sequential Circuit and write the VHDL code for SR Flip-flop.(Apply)

21GE4M01	**INDIAN CONSTITUTION AND CULTURAL HERITAGE**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

Prerequisites for the course

- Nil

Objectives

1. To acquaint the students with legacies of constitutional development in India and help those to understand the most diversified legal document of India and philosophy behind it.
2. To make students aware of the theoretical and functional aspects of the Indian Parliamentary System.
3. To make students learn about the science management and knowledge system in our Indian Culture
4. To sensitize students towards issues related to 'Indian' culture, tradition and its composite character

UNIT I	**INTRODUCTION AND BASIC INFORMATION ABOUTINDIAN CONSTITUTION**	**8**

Meaning of the constitution law and constitutionalism, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Enforcement of the Constitution, Indian Constitution and its Salient Features, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

UNIT II	**UNION EXECUTIVE AND STATE EXECUTIVE**	**8**

Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Judicial Activism, LokPal, Lok Ayukta, The Lokpal and Lok ayuktas Act 2013, State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions of State Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

UNIT III	SCIENCE, MANAGEMENT AND INDIAN KNOWLEDGE SYSTEM	7
Astronomy in India, Chemistry in India, Mathematics in India, Physics in India, Agriculture in India, Medicine in India ,Metallurgy in India, Geography, Biology, Harappan Technologies, Water Management in India, Textile Technology in India ,Writing Technology in India Pyrotechnics in India Trade in Ancient India/,India's Dominance up to Pre-colonial Times		
UNIT IV	**CULTURAL HERITAGE AND PERFORMING ARTS**	**7**
Indian Architect, Engineering and Architecture in Ancient India, Sculptures, Seals, coins, Pottery, Puppetry, Dance, Music, Theatre, drama, Painting, Martial Arts Traditions, Fairs and Festivals, Current developments in Arts and Cultural, Indian's Cultural Contribution to the World. Indian Cinema and its influence in cultural Heritage		
	Total Periods	**45**

Outcomes:

1. Identify and explore the basic features and modalities about Indian constitution.
2. Differentiate and relate the functioning of Indian parliamentary system at the center and state level.
3. To analyze the science management and knowledge system developed in our Indian Culture
4. To understand, connect up and explain basics of Indian Traditional knowledge and modern scientific perspective.

Continuous Assessment Test (30 Marks)	End Semester Exams (50 Marks)
2. FORMATIVE MULTIPLE CHOICE QUESTIONS 3. CASE STUDY	1. DESCRIPTIVE QUESTIONS 2. FORMATIVE MULTIPLE CHOICE QUESTIONS

CO Vs PO Mapping and CO Vs PSO Mapping

S.no	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							3			3				
2							3			3				
3							3			3				
4							3			3				
5							3			3				

1-Low , 2- Medium, 3- High

21EE4611	**CONTROL AND INSTRUMENTATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Preamble

This lab is to provide sound knowledge in the basic concepts of linear control theory and instrumentation, to understand the methods of representation of systems and getting their transfer function models, to provide adequate knowledge in the time response of systems and steady state error analysis, to give basic knowledge is obtaining the open loop and closed–loop frequency responses of systems and to understand the concept of stability of control system and methods of stability analysis. It helps the students to study the compensation design for a control system.

Prerequisites for the course

- Control Theory

Objectives

- To impart knowledge on Modeling of electrical and mechanical systems using transfer function.
- To demonstrate the Frequency domain specifications from frequency response plots and introduces Stability of the linear-time invariant system.
- To experimentally design the Lag, Lead and Lag-Lead Compensators
- To simulate the Concept of state space modeling of continuous linear-time invariant systems
- To know the basic knowledge of bridges.

S.No	**List of Experiments**	**CO**
1	Transfer function of DC motor	**1**
2	Time response of Second Order systems using MATLAB Simulation.	**1**
3	P, PI and PID controllers	**2**
4	Synchro-Transmitter-Receiver and Characteristics	**2**
5	Design of Lag, Lead and Lag-Lead Compensators	**3**
6	Position Control Systems	**3**
7	Stability analysis of Linear Time Invariant system and check the concepts of controllability and observability using MATLAB Simulation.	**4**
8	Bridge Networks –AC and DC Bridges	**5**

9	Dynamics of Sensors/Transducers a. Temperature b. Pressure c. Displacement d. Optical e. Strain f. Flow	**5**
10	Power and Energy Measurement	**5**
11	Instrumentation Amplifier	**5**
12	Analog – Digital and Digital –Analog converters (ADC and DACs)	**5**

S.No.	**List of Projects**	**Related Experiment**	**CO**
1.	Build a Custom Servo Motor with a DC Motor	Exp 1,2	1
2.	Servo Motor Control by Flex Sensor	Exp 1	1
3.	Reading a Typical Brushed DC Motor Datasheet and Finding the Motor Transfer Function	Exp 2,3	1
4.	DC Motor Control using MATLAB	Exp 2	1
5.	Automatic headlight dim/bright control system	Exp 4,5	2
6.	Transfer Functions in Simulink, - Creating and Using Transfer Functions	Exp 4,5	2
7.	Temperature Control in a Heat Exchanger	Exp 4,5	2
8.	Assessing Gain and Phase Margins	Exp 4,5	2
9.	Automatic tuning of PID, gain-scheduled, and arbitrary SISO and MIMO control systems	Exp 5	2
10.	To simulate a DC position control system and hence to find the step response using MATLAB.	Exp 5	3
11.	Arduino PID based DC Motor Position Control System	Exp 5,7	3
12.	Time Domain responses of MIMO model	Exp 5,7	3
13.	Analog transmitter and receiver: optimization of power dissipation and maximization of bandwidth	Exp 6	3
14.	Study of the bridges by various types of power supply	Exp 8	5
15.	A Comparative Analysis of PID, Lead, Lag, Lead-Lag, and Cascaded Lead Controllers for a Drug Infusion System	Exp 7	3

Suggestive Assessment Methods	
Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**
1. Experiment verification **2. Model Exam**	**1. Experiment verification** **2. Viva Voce**

Outcomes	
Upon completion of the course, the students will be able to:	
CO1	Model the electrical and mechanical systems using transfer function.
CO2	Analyze the stability of systems
CO3	Demonstrate the effect of different types of compensators.
CO4	Determine the Concept of state space modeling of continuous linear-time invariant systems
CO5	Develop the AC and DC bridges

Laboratory Requirements

S.No.	**Description of Equipment**	**Quantity required(R)**
1	DC And AC Servomotor	1
2	Dc Motor Generator Set Up For Evaluation Of Motor Parameter	1
3	Personal Computer With Control System Simulation Packages	10
4	PID Controller Simulation And LearnerKit	1
5	Tachogenerator Coupling Set	1
6	AC Synchro Transmitter And Receiver	1
7	Position Control System Kit	1
8	Experimental setup for Measurement of Linear displacement using Potentiometer and application,	1

9	Strain gauge and Load cell	1
10	LVDT characterisation and application Hall Effect characterisation and application Measurement of Angular displacement	1
11	Thermistor characterisation and application Various types of Thermocouple and RTD	1
12	Measurement of power and energy Sufficient number of power supply,	1
13	Galvanometer	1
14	Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO	1

Reference Books

1. Laboratory Manual

Web Resourses

1. https://www.youtube.com/watch?v=nC71WXm1Rl0
2. https://www.youtube.com/watch?v=kZ8093_Cm4M
3. https://www.youtube.com/watch?v=sFqFrmMJ-sg

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1								1	3	3
2	2	2	1	1					1	1	1		2	2
3	2	3	2	1					1	1			2	3
4	3	2	2	1		1	1		1	2	1	1	3	2
5	3	2	1	1					1				3	2

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. Develop the transfer function of field Controlled DC servomotor and define transferfunction
2. Derive the expression for second order system for under damped case

and when the inputis unit step.

COURSE OUTCOME 2: Students will be able to Predict the suitable method for….(Analyze)

1. Analyze the transfer function of synchros.
2. Explain briefly the PI controller action with block diagram and obtain its transfer functionmodel. List out its advantages and disadvantages

COURSE OUTCOME 3: Students will be able to Predict the suitable method for….(Demonstrate)

1. The open loop transfer function of the uncompensated system is . (2) ( ) + = s s K G s Design a lag compensator for the system so that the static velocity error constant Kv is 10 sec-1 , the phase margin ≥ 600
2. For the given system, (1)(2) ( ) + + = s s s K G s , design a suitable laglead compensator togive, velocity error constant=10 sec-1 , phase margin=500 , gain margin ≥ 10 dB

COURSE OUTCOME 4: Students will be able to Predict the suitable method for….(Determine)

1. For each of the characteristics equation of feedback control system given, determine the range of K for stability. Examine the value of K so that the system is marginally stable and thefrequency of sustained oscillations for second order systems
2. Examine the controllability and observability of a system for second order systems.

COURSE OUTCOME 5: Students will be able to Predict the suitable method for….(Develop)

1. Explain how the inductance is measured in terms of known Capacitance using Maxwell'sbridge. Compose the conditions for balance.
2. Draw a neat diagram of Kelvin double bridge and explain how to measure low resistance.
3.

21EE4612	AC MACHINES LABORATORY	L	T	P	C
		0	0	4	2
Preamble					
This laboratory gives a practical exposure to the students to fundamental concepts regarding AC Machines that are currently used in Electrical Systems. The students also learn to select the suitable AC Electrical Machines for an application based on its characteristics, perform suitable capacitor additions to improve power factor and to familiarize the standard testing procedures of AC Machines.					

Prerequisites for the course

- Circuit Theory
- Transformers
- Electro Magnetic theory

Objectives

1. To study the need of AC Machine Starter.
2. To impart knowledge on three Phase Induction Motor and its ?Applications.
3. To expose the operation of Single Phase Induction Motor.
4. To impart knowledge on AC Generator.
5. To expose the operation of synchronous machines

S.No	List of Experiments	CO
1	Study of AC machine Starters	1
2	No load and blocked rotor tests on three-phase induction motor (Determination of Equivalent circuit parameters).	2
3	Separation of No-load losses of three-phase induction motor.	2
4	Load test on single-phase induction motor.	3
5	Load test on three-phase induction motor.	2
6	No load and blocked rotor test on single-phase induction motor.	3
7	Regulation of three phase alternator by EMF and MMFmethods.	4
8	Regulation of three phase alternator by ZPF and ASAmethods	4
9	Regulation of three phase salient pole alternator by slip test	4
10	V and Inverted V curves of Three Phase Synchronous Motor.	5

S.No.	List of Projects	Related Experiment	CO
1.	Polarity test of Synchronous machine windings	**Exp 9**	**5**
2.	Soft starter for 3 phase induction motor using microcontroller	**Exp 4,5**	**2,3**
3.	Single Phase Induction Motor With Smooth Start	**Exp 4,5**	**2,3**
4.	Induction Motor Speed & Direction Controller	**Exp 4,5**	**2,3**
5.	Tests for Transient and Sub-transient reactance	**Exp 6,7,8**	**3,4**

6.	Three Phase connection for harmonic elimination in Synchronous machines	**Exp 9**	**5**
7.	Determination of Positive sequence resistance for synchronous machine	**Exp 9**	**5**
8.	Induction Motor Speed Controller Project	**Exp 4,5**	**2,3**
9.	Simulation of an Electrical Machine: With Superconducting Magnetic Bearings	**Exp 3,4,5,6**	**2,3**
10.	Slip Power recovery of Wound rotor Induction motors	**Exp 3,4,5**	**2,3**
11.	Induction Motor Starter Using Auto Delta Star Starter	**Exp 1, 2,3,4**	**1,2,3**
12.	Insulation resistance, winding resistance measurement, current balance, NL current and power measurement of Induction motor	**Exp 3,4,5**	**2,3**
13.	Shaft voltage test of induction motor	**Exp 5,6**	**2,3**
14.	Simulation of 3 Phase Induction Motor in MATLAB With Direct and Soft Starting Methods	**Exp 1,2,3,4,5,**	**1,2,3**
15.	Design of weedeater 12V generator with an Alternator	**Exp 7,8,9**	**4**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**
Experiments, Viva Voce , Model Exam	**Experiments, Viva Voce**

Outcomes

Upon completion of the course, the students will be able to:

CO1	Ability to understand the basic concept of AC machine Starters
CO2	Ability to understand and analyze Three phase induction motor
CO3	Ability to understand and analyze Single phase induction motor
CO4	Ability to analyse the characteristics of Alternator
CO5	Ability to understand the importance of synchronous machines

Laboratory Requirements

S.No.	**Description of Equipment**	**Quantity Required(R)**

1.	Synchronous Induction Motor 3HP	1
2.	DC Shunt Motor Coupled With 3 Phase Motor	4
3.	DC Shunt Motor Couples With 3 Phase Slip Ring Induction Motor	1
4.	3 Phase Induction Motor With Loading Arrangement	2
5.	Single Phase Induction Motor With Loading Arrangement	2
6.	Tachometer Digital Analog	8
7.	Single Phase Auto Transformer	2
8.	3 Phase Auto Transformer	3
9.	Single Phase Resistive Loading Bank	2
10.	Capacitor Bank	2

Reference Books

1. Lab Manual

Web Recourses

1. https://nptelmooc2013.appspot.com/noc19_ee01/announcements
2. https://www.btechguru.com/courses--nptel--electrical-engineering--electrical machines-ii-video- lecture--EE--EE10009W.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1								1	3	3
2	2	2	1	1					1	1	1		2	2
3	2	3	2	1					1	1			2	3
4	3	2	2	1		2	2		1	2	1	1	3	2
5	3	2	1	1					1				3	2

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT

QUESTIONSCOURSE OUTCOME 1

(CO 1) : Understand

1. Why is starter needed to start the Ac motor
2. Explain the various methods of AC Starter

COURSE OUTCOME 2 (CO 2) : Apply

1. Derive an equation for emf in Ac machine.
2. Why emf method is called as pessimistic method

COURSE OUTCOME 3 (CO 3) : Understand

1. In comparison with transformer Induction motor is having high efficiency or low efficiency
2. Is Short circuit and Open circuit test is Possible for both type of Induction motors.

COURSE OUTCOME 4 (CO 4) : Analyze

1. Explain the principle operation of a synchronous motor with circuit diagram.
2. What is the application of Synchronous Motor?

COURSE OUTCOME 5 (CO 5) : understand

1. What is the phase displacement in space between the two windings?
2. How is the starting winding disconnected from the supply?

21PT3902	**SOFT SKILLS-VERBAL ABILITY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Preamble:

This course is developed to enhance the Verbal competency of the students as Verbal Ability is commonly a part of the various competitive exams conducted. This course equips the students in all the aspects of grammar and helps to enhance comprehensive abilities and Analytical skills.

Prerequisites for the course

- Foundational English

Objectives

1. To help the student understand the importance of having his language skills kept ready for effective use.
2. To provide a host of varied opportunities for the student to hone his acquired language skills basic components, namely, Grammar, Vocabulary, Spelling and Comprehension.

Module I	**Error Identification**	**6**
Articles, Tenses, Voices, Preposition, Conjunctions, Subject-verb agreement, Adverbials.		
Module II	**Sentence Structure**	**6**
Parts of speech, Simple, Complex & Compound Sentences, Direct & Indirect Speech, Kinds of Sentences, Degrees of Comparison, Clauses.		
Module III	**Verbal Reasoning**	**6**
Reading Comprehension, Analogies, Synonyms & Antonyms, Idioms, One word substitutes.		
Module IV	**Coherence and Cohesion**	**6**
Para-jumbles, Phrasal verbs, Modifiers, Punctuations, Misspelled words.		
Module V	**Rhetorical reasoning**	**6**
Verbal syllogism, figures of speech.		
Suggested Assessment Activities: • MCQ test through Google forms or other online test platforms. Eg. JavaPoint - Verbal Ability https://www.javatpoint.com/verbal-ability		
	Total Periods	**30**

Suggestive Assessment Methods

Formative Assessment Test (20 Marks)	**Continuous Assessment Test 1 (40 Marks)**	**Continuous Assessment Test 2 (40 Marks)**
MCQ	MCQ	MCQ

Outcomes

Upon completion of the course, the students will be able to:

CO1: Identify the grammatical errors in a sentence.
CO2: Frame sentences using the correct syntax.
CO3: Understand the concepts stated in a sentence or paragraph and analyze using verbal reasoning.

CO4: Construct sentences logically and make the texts semantically meaningful as a whole.

CO5: Interpret and analyze texts on a deeper level.

Text Books

1. Wren, P.C., Martin, H, Prasada Rao, N.D.V. (1973–2010). High School English Grammar & Composition. New Delhi: Sultan Chand Publishers
2. Kumar, Sanjay, Pushp Latha. (2018) English Language and Communication Skills for Engineers, India: Oxford University Press.

Reference Books

1. Guptha S C, (2012) Practical English Grammar & Composition, 1 st Edition, India: Arihant Publishers
2. Steven Brown, (2011) Dorolyn Smith, Active Listening 3, 3 rd Edition, UK: Cambridge University Press.

Web Resources:

1. Indiabix : https://www.indiabix.com/online-test/verbal-ability-test/
2. All India Exams : https://www.allindiaexams.in/online-test/online-verbal-ability-test/all
3. faceprep: https://www.faceprep.in/verbal-ability/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1										3				
2										3				
3										3				
4										2		1		
5										2		1		

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	10	5	5	10
UNDERSTAND	40	20	10	10	20
APPLY	30	50	5	5	50
ANALYSE	10	20	5	5	20
EVALUATE					
CREATE					

SEMESTER – V

21EE5601	MICROCONTROLLERS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Preamble

Microprocessor and microcontroller have become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, assembly language programming and interfacing of 8051 microcontroller and its application in industry are also covered in this course.

Prerequisites for the course

- Analog and Integrated Circuits
- Digital Electronics

Objectives

- To study the basics of 8085 Processor
- To educate the concepts on Hardware structure of µC 8051.
- To impart knowledge on functions of µP8085
- To understand the Programming & instruction set of 8085 & 8051.
- To enlighten the Interfacing of 8051.

UNIT I	BASICS OF 8085 & 8086 PROCESSOR	9

Hardware Architecture of 8085 and 8086 Processor, Pin Diagram– Functional Building Blocks of Processor – Addressing Modes, Instruction set: Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II	INTRODUCTION OF MICROCONTROLLERS	9

Block diagram of microcontroller: CPU, input device, output device, memory and buses, common features of Microcontrollers: On-chip Oscillator, program and data memory, I/O Ports, Watchdog- timer reset, SFRs, Timers, Counters, Interrupts.

UNIT III	8051 HARDWARE	9

Blocks of Microcontroller 8051, Ports, Functions of each pin of 8051, Clock circuit, reset Circuit, phase and state in machine cycle of 8051, Memory organization of 8051.Stack operation, Timers/Counters logic diagram and its operation in various modes, I/O Ports structure, Serial Communication in various modes, Interrupt structure, vector address, priority and operation.

UNIT IV	**8051 PROGRAMMING**	**9**
Addressing Modes, Instruction set: Data Transfer, Arithmetic, Logical, Branching, and Machine Control, Looping, Counting, sorting and Indexing, Data manipulation, Masking, Conditional programming, Configuration and programming of Timer/Counter using SFRs: TMOD, TCON, THx, TLx.		
UNIT V	**8051 INTERFACING**	9
Switch: Push button, DIP, Tilt, Relay, Keyboard & LED,7 segment LED, LCD, ADC0804, Temperature sensor LM35, DAC0808, ADC0804, Stepper motor, Serial communication using MAX 232,		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1. Illustrate the functions of each block diagram of a generic digital computer and identify the addressing mode, instruction set.
2. Enlighten functions of each block of 8051 microcontroller and timer.
3. Select appropriate 8051 instructions based on size, exemplify the memory and ports of 8051.
4. Clarify the programming concepts of 8051 microcontrollers.
5. Interface Input & Output Devices with 8051 microcontrollers.

Text Books

1. Sunil Mathur & Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

Reference Books

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2017.
2. B.RAM," Computer Fundamentals Architecture and Organization" New Age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu, 2016.
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu, 2016.
6. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D. Kinely 'The 8051 Microcontroller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2013.

Web Resources

1. https://nptel.ac.in/courses/108105102
2. https://www.udemy.com/course/8051-architecture-bharat-acharya/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	3	2	2		2						1		3	
2	3	2	2		2						1		3	
3	3	2	2		2						1		3	
4	3	2	2		2						1		3	
5	3	2	2		2						1		3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. State any four pins of 8085 processor which are used to generate control and status signals.(Understand).
2. If the memory address of the last location of a 1Kbyte memory chip is FBFFH, What is the starting address? (Apply)

COURSE OUTCOME 2:

1. Summarize the functions of TMOD register in 8051 microcontroller. (Remember)
2. What are I/O instructions in 8051 microcontroller? (Understand)

COURSE OUTCOME 3:

1. Compare microprocessor and microcontroller. (Analyze)
2. Examine, how the microcontrollers respond to any interrupt request? (Understand)

COURSE OUTCOME 4:

1. Differentiate CALL and JUMP instruction. (Apply)
2. Discuss how time delay is generated using subroutines? (Understand)

COURSE OUTCOME 5:

1.Find the Pushbutton is configured as output in mode 0. (Apply)

2..What are the steps in interfacing peripherals with the microprocessor? (Understand)

21EE5602	POWER ELECTRONICS AND DRIVES	L	T	P	C
		3	0	0	3

Preamble

Power electronics involves the study of electronic circuits intended to control the flow of electrical energy. It deals with the processing and control of 'raw' electrical power from an electrical source such as an AC mains supply, a battery bank, a photovoltaic array, or a wind turbine into a form and quality suitable for a particular electrical load. It is an enabling technology with a very wide range of applications.

Prerequisites for the course

1. Electric Circuits and Network Analysis
2. Analog and Integrated Circuits

Objectives

- To impart knowledge on different types of power semiconductor devices and their switching operation characteristics.
- To introduce the performance parameters of controlled rectifiers operation.
- To familiarize the switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to discuss the operation of AC voltage controller.
- To explain the basics of electric drives and design 1 phase and 3 phase controlled rectifier based dc drives.

UNIT I	POWER SEMI-CONDUCTOR DEVICES	8

Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGBT-Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.

UNIT II	PHASE-CONTROLLED CONVERTERS	8

2-Pulse, 3-pulse and 6-pulse converters – performance parameters - Effect of source inductance – Firing Schemes for converter–Dual converters, Applications-light dimmer and Excitation system.

UNIT III	DC TO DC CONVERTERS	8

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulator, Applications-Battery operated vehicles.

UNIT IV	INVERTERS AND AC TO AC CONVERTERS	9
Single phase and three phase voltage source inverters (both120° mode and 180°mode)- Voltage & harmonic control-PWM techniques-Multilevel Inverters-Single phase and Three phase AC voltage controllers–Cyclo converters-Matrix Converters		
UNIT V	**INTRODUCTION TO DRIVES**	**12**
Essential components of Electric drive – Equations governing motor load dynamics -typical load torque characteristics -Single and three phase converter fed separately excited DC motor drive– Chopper controlled DC drives-slip power recovery drives-Margin angle control and power factor control -Three phase voltage/current source fed synchronous motor		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Understand different power semiconducting devices and their characteristics.
2	Analyze operation and performance parameters of phase-controlled rectifiers and their applications.
3	Analyze operation, Switching techniques and topologies of Switched mode regulators and resonant Converters.
4	Apply voltage controlled and Harmonic control of single phase and three phase inverters and Perform the operation of AC - AC Converters.
5	Explain the basics of electric drives and design 1 phase and 3 phase controlled rectifier-based dc drives.

Text Books

1. M.H. Rashid, ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, Fourth Edition, New Delhi,2017.
2. P.S. Bimbra ‘Power Electronics’ Khanna Publishers, 7th Revised Edition, 2022.

Reference Books

1. Joseph Vithayathil, 'Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2. Philip T. Krein, 'Elements of Power Electronics' Oxford University Press, 2nd Edition 2017.
3. L. Umanand, 'Power Electronics Essentials and Applications', Wiley, 2020.
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2017
5. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint,2013.

Web Recourses

1. https://swayam.gov.in/nd1_noc19_ee37/preview
2. https://nptel.ac.in/courses/108101038/
3. https://archive.nptel.ac.in/courses/108/105/108105066/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	3	3	2										3	
2	3	3	3										3	
3	3	3	3										3	
4	3	3	3										3	
5	2		3										3	

1. Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	5	5	20
UNDETSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	30	30	0	0	30
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. With a neat diagram explain how the snubber circuit protects the MOSFET. (Analyse)
2. Examine the structure and different modes of operation of TRIAC with its characteristics. (Apply)

COURSE OUTCOME 2:

1. Classify the various modes of operation of single phase fully controlled bridge converter. (Analyse)
2. A two-pulse converter is fed with a 230V, 50 Hz supply. The load on the converter is a pure resistance of R=10 Ω. Obtain the average output voltage for a firing angle of α =135° (Analyze)

COURSE OUTCOME 3:

1. A step-up chopper is operated with a duty ratio of 0.6 for a dc input of 100 V. Determine the output voltage for a load resistance RL of 5 ohms. (Apply)
2. Briefly state the working of four quadrant DC chopper (Apply)

COURSE OUTCOME 4:

1. Evaluate the disadvantages of the harmonics present in the inverter system? (Apply)
2. Give the expression for RMS and average output voltage of single-phase half wave ac voltage controller. (Understand)

COURSE OUTCOME 5:

1. Draw the block diagram of Electric Drive. (Remember)
2. A 220V shunt Motor has an armature resistance of 0.062 Ω and with full field has an emf of 215V at a speed of 960 rpm, the motor is driving an overhauling load with a torque of 172 Nm. Calculate the minimum speed at which the motor can hold the load by means of regenerative braking. (Apply)

21EE5603	POWER GENERATION SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

The aim of this course is to help the student to attain the industry identified competency through various teaching learning experiences and also to maintain the efficient operation of various electric power generating plants.

Prerequisites for the course

- Power System Engineering
- Fundamentals of Electrical and Electronics Engineering

Objectives

1. To provide an overview of thermal power plant and detailing the role of Engineers in their operation and maintenance.
2. To familiarize in nuclear power plants and detailing the role of Engineers in their operation and maintenance.
3. To Impart an overview of hydroelectric power plants and detailing the role of Engineers in their operation and maintenance
4. To learn Renewable energy power plants and detailing the role of Engineers in their operation and maintenance.
5. To familiarize applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

UNITI	COAL BASED THERMAL POWER PLANTS	9

Rankine cycle - improvisations, Layout of modern coal power plant, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems

UNIT II	NUCLEAR POWER PLANTS	9
Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.		
UNIT III	**HYDRO ELECTRIC POWER PLANT**	**9**
Hydrology, Hydrographs, Flow duration curve, Hydro electric power plants- classification, Layout, auxiliaries and working of a hydro station.		
UNIT IV	**ALTERNATIVE SOURCES OF ENERGY**	9
Solar power generation-Photo-voltaic and solar thermal generation, Windpower generation, Geo Thermal, Biomass, Fuel Cell power systems, micro-hydro power plants, tidal power generation and MHD generation.		
UNIT V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**	**9**
Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.		
	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. 3.PROBLEM-SOLVING**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Demonstrate the layout, construction and working of the components inside a thermal power plant.
2	Illustrate the layout and construction and working of the components inside nuclear power plants.
3	Construct the layout and working of the components inside hydroelectric power plants.
4	Construct the layout, and working of the components inside Renewable energy power plants.
5	Apply the knowledge in the field of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

Text Book
1. Wiley (1 January 2019) Power Plant Engineering,– 1 January 2019 by Dipak Kumar Mandal (Author), Somnath Chakrabarti (Author), Arup Kumar Das (Author), Prasanta Kumar Das (Author)
Reference Books
1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010. 2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004. 3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998
Web Resources 1. swayam.gov.in › nd1_noc20_me10 › preview 2. npti.gov.in › graduate-engineers-course-power-plant-engineering

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	3	1	2				1							
2	2	1	2				1							
3	2	1	1				1							
4	2	2	1				1							
5	2	3	2				3							

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	5	5	20
UNDETSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	30	30	0	0	30
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Draw the schematic layout of coal fired power station. Explain briefly four main circuit of the plant.
2. Give the thermal efficiency of steam power station.

COURSE OUTCOME 2:

1. Draw the schematic diagram of nuclear power plant. State the factors to be considered for selection and of site for NPS.
2. Write down one gram of uranium will produce how much energy produced by coal?

COURSE OUTCOME 3:

1. Surge tanks are usually provided in high or medium head hydroelectric power plants when considerably long penstock is required?
2. A large hydro power station has head of 324 meter and an average flow of 1370 m3 / sec. The available hydraulic power from the station will be?

COURSE OUTCOME 4:

1. Give the Standard value of solar constant adopted from by the world radiation center 1367 W/m2
2. In a wind Turbine, which measures the wind direction and drives and guides the yaw drive to position the rotor to face the wind Vane.

COURSE OUTCOME 5 :

1. A consumer having lower power factor contributes towards which factor?
2. Which tariff is also known as the average power factor tariff

		L	T	P	C
21EE5611	**POWER ELECTRONICS LABORATORY**	**0**	**0**	**4**	**2**

Preamble

This laboratory gives a practical exposure to the students to learn the power electronics and drives. The students will be able to design and analyze power converters such as AC-DC converters, DC-DC converters, DC-AC converters, AC- to AC converters and their control circuits for real world applications.

Prerequisites for the course

- Analog and Integrated Circuits
- Analog and Integrated Circuit Design Laboratory
- Power Electronics

Objectives

1. To introduce about switching characteristics of various switches.
2. To familiarize the knowledge on AC to DC converter circuits.
3. To learn knowledge on DC to DC.
4. To design and impart knowledge on AC-AC converter circuits and Multilevel Inverter.
5. To learn knowledge on simulation software.

S.No	List of Experiments	CO
1	Gate Pulse Generation using R, RC and UJT	**1**
2	Characteristics of SCR and TRIAC	**1**
3	Characteristics of MOSFET and IGBT	**1**
4	Characteristics of GTO & IGCT.	**1**

5	AC to DC half controlled converter	**2**
6	AC to DC fully controlled Converter	**2**
7	Step down and step up MOSFET based choppers	**3**
8	IGBT based single phase PWM inverter.	**4**
9	IGBT based three phase PWM inverter	**4**
10	Simulation of a five-level cascaded multilevel inverter with R load.	**4**
11	Switched mode power converter.	**5**
12	Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, AC voltage controllers).	**5**
		Total Periods :60

S.No.	**List of Projects**	**Related Experiment**	**CO**
1.	Design and development of Industrial battery charger of voltage 230V ,50Hz using thyristor with firing angle control of $\alpha=45^0,60^0,90^0,120^0$	1,2,3,4	1
2.	Modern Home Automation (DC Motor) Control using thyristor with a range of gate triggering circuit current from 5 mA to 15 mA	1,2,4,5,6	1,2
3.	A product development of Industrial based automatic Boiler controller with DIAC triggering voltage varies from 25V to 40V and SCR gate current ranges from 200uA to 60mA	1,2,5,6	1,2
4.	Design an Industrial DC motor Controller using MOSFET based Chopper for various load R, RL, and RLE with various duty cycles.	3,6,7,8,9, 12	1,2,3
5.	Design and fabrication of Border Security high beam flasher and Proclaimer Circuit using the capacitor 100µF and 22nF with the battery supply of 9V	1, 5, 6, 10	1,2,4
6.	12V to 220V inverter at home using UPS Transformer IGBT	1,8,9,10	1,4

7.	Operation Theatre Doctor friendly luminosity controller for Medical surgery with potentiometer of (0-10K)and a battery of 12 V supply	1,10,11	1,4,5
8.	Simulation of 3 phase,24 Pulse GTO Converter for flow control of transmission system	1,4,5,6, 8,12	1,2,5

Suggestive Assessment Methods	
Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**
• Record Note • Viva • Model Examination	• Experiment • Viva

Outcomes

Upon completion of the course, the students will be able to:

CO1	Experiment about switching characteristics various switches.
CO2	Analyze about AC to DC converter circuits.
CO3	Analyze about DC to DC converters.
CO4	Analyze about AC to AC converters and Multilevel Inverter.
CO5	Simulate PE circuits on simulation software.

Laboratory Requirements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. MOSFET Based Step-up and Step-down Chopper – 1 No.
2. Switched Mode Power Converter Module- 2 No.
3. Cyclo Converter Kit With Firing Module- I No.
4. LCR Meter- 3 No.
5. Rheostats of Various Ranges- 2 No.
6. SCR And TRIAC Based 1 Phase AC Controller Along With Lamp or Rheostat Load- 2 Nos.
7. Components Inductance Capacitance 3 Set For Each -3 Nos.
8. IGPT Based Three Phase PWM Inverter Module Discrete Component -2 Nos.
9. Dual Regulated Dc Power Supply With Common Ground -5 Nos
10. Multimeter -5 Nos.
11. DC And AC Meters of Required Ranges – 20 Nos.
12. Single Phase SCR Based Half Controlled Converter and Fully Controlled Converter Along With Built In Separate Firing Circuit Module and Meter – 2 Nos.
13. Cathode Ray Oscilloscope -10 Nos.
14. IGPT Based Single Phase PWM Inverter Module Discrete Component – 2 Nos.
15. Isolation Transformer -5 Nos.
16. Single Phase Auto Transformer -3 Nos.
17. Device Characteristics For SCR ,MOSFET ,TRIAC, GTO, IGPT and IGPT Kit With Built in Discrete Power Supply and Meters -2 Nos.

Reference Books
• Lab Manual
Web Resources
1. https://www.youtube.com/watch?v=rQqb3vcr7KY 2. https://www.youtube.com/watch?v=ekXe7qXYyXM 3. https://www.youtube.com/watch?v=Y9t9uFYxyIo

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
1	3	3	2	2							2		3	
2	3	3	2	2							2		3	
3	3	3	2	2							2		3	
4	3	3	2	2							2		3	
5	3	3	2	2							2		3	

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1.Outline the term pinch off voltage of MOSFET. (Remember)
2.Distinguish between SCR and TRIAC. (Understand)

COURSE OUTCOME 2:

1. Design and explain the operation of AC to DC half controlled converter. (Analyse)
2. Design and explain the operation of AC to DC full controlled converter. (Analyse)

COURSE OUTCOME 3:

1. With neat diagrams, describe the construction and working of step- down and step up chopper and its steady state analysis. Also give its application. (Remember)
2. Explain the different classes of chopper with neat sketch.(Analyse)

COURSE OUTCOME 4:

1. Describe the operation of 3 phase bridge inverter for 120 degree mode of operation with aid of relevant phase and line voltage waveforms. (Apply)
2. State the different methods of voltage control of inverters. Also describe about PWM control. (Remember)

COURSE OUTCOME 5:

1. Design and Develop 1Φ semi converter and derive the output voltage. (Analyze)
2. Design a 3Φ semi converter with appropriate waveform. (Apply)

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Introduction and overview of all experiments	**04**
2	Gate Pulse Generation using R, RC and UJT	**04**
3	Characteristics of SCR and TRIAC	**04**
4	Characteristics of MOSFET and IGBT	**04**
5	Characteristics of GTO & IGCT.	**04**
6	AC to DC half controlled converter	**04**
7	AC to DC fully controlled Converter	**04**
8	Step down and step up MOSFET based choppers	**04**
9	IGBT based single phase PWM inverter.	**04**
10	IGBT based three phase PWM inverter	**04**
11	AC Voltage controller	**04**

12	Switched mode power converter.	**04**
13	Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, AC voltage controllers).	**04**
14	Review of all experiments	04
15	Model Laboratory Examination	04
	Total	**60 Hrs**

21EE5612	**MICROCONTROLLERS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Preamble

Microcontroller has become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, assembly language programming and interfacing of 8051 microcontroller and its application in industry are also covered in this course.

Prerequisites for the course

- Microcontrollers and its applications

Objectives

1. To introduce programming logics for arithmetic operations control instructions and code conversion
2. To acquire knowledge on A/D and D/A.
3. To impart the I/O interfacing concepts for developing real time embedded systems.
4. To impart knowledge in DC and AC motor interfacing.
5. To acquire knowledge on software simulators.

S.No	**List of Experiments**	**CO**
1	Simple arithmetic operations: addition / subtraction / multiplication / division.	**CO1**
2	Programming with control instructions: (i)Ascending / Descending order (ii)Maximum / Minimum of numbers	**CO1**

3	Code conversion: Hex to Decimal/ASCII to Decimal and vice versa.	**CO1**
4	Interface Experiments i. ADC interface ii. DAC interface with wave form generation.	**CO2**
5	Traffic light controller.	**CO4**
6	Programming Practices with Simulators/Emulators/open source.	**CO5**
7	Read a key interface display.	**CO3**
8	Demonstration of basic instructions with 8051 Micro controller execution, including: Conditional jumps & looping Calling subroutines	**CO1**
9	Stepper motor and DC motor interface.	**CO4**
10	Application hardware development using embedded processors.	**CO5**

S.No.	**List of Projects**	**Related Experiment**	**CO**
1	Digit Up Down Counter	**2,7,8**	**CO1**
2	A Basic 8-bit calculator	**1,2,8**	**CO1**
3	Boolean Algebra Calculator	**1,2,8,9**	**CO4**
4	5 Channel IR Remote Control System using Microcontroller	**4,5,8,9**	**CO2**
5	Automatic Railway Gate Controller with High Speed Alerting System	**4,7,10**	**CO2**
6	Digital Temperature Sensor	**1,2,3,8**	**CO3**
7	Bipolar LED Driver Circuit	**5,7,8**	**CO5**
8	Water Level Indicator	**1,2,3,9**	**CO3**

9	Delay using 8051 Timers	**1,4,10**	**CO3**
10	3 LED Bike Light using PIC	**3,4,5,7**	**CO2**
11	Temperature Controlled Fan (DC Motor based with PWM)	**6,9,10**	**CO3**
12	Real time Car Battery Monitoring and Low Voltage Alert System	**6,9,10**	**CO5**
13	Real Time Burglar Alarm System	**6,9,10**	**CO3**
14	Automatic College Bell System	**4,6,10**	**CO3**
15	Auto Intensity Control of Street Lights	**4,6,9,10**	**CO4**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**
• Record Note • Viva • Model Practical	• End Semester Lab

Outcomes

Upon completion of the course, the students will be able to:

CO1	Program and run logics for arithmetic operations control instructions and code conversion.
CO2	Perform the operations in A/D and D/A.
CO3	Analyse the basics of serial communication.
CO4	Do the interfacing in DC and AC motor.
CO5	Simulate basics programs using software simulators.

Laboratory Requirements

Hardware

- Interfacing Units – Each 5 nos
- Microcontroller –1nos

Software:

- Intel Desktop Systems with Keil – 15 nos

Reference Books

1. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
2. DouglasV.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH, 2012.

Web Resources

1. http://www.vlab.co.in/ba-nptel-labs-electrical-engineering

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO2
1	3	3	3		2				1					3
2	3	3	3		2				1					3
3	3	3	3		2				1					3
4	3	3	3		2				1					3
5	3	3	3		2				1					3

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Write an 8051 ALP to perform the following:
   Get 5 numbers starting from location 4200H. Arrange them in such a manner that the greatest number occupies the last position

2. Write an 8051 ALP for performing 16 bit multiplication

COURSE OUTCOME 2:

1. Interface different I/O switch processor.

2. Interface 8255 with 8051 and write a program to show that the input -10101010 by the switches connected with port A are read in the LEDs connected with port B.

COURSE OUTCOME 3:

1. Generate wave forms using Microprocessors.
2. Write an 8051 ALP to generate a saw tooth wave at the output of DAC.

COURSE OUTCOME 4:

1. Write an 8051 ALP to find the area of a rectangle whose length is 12cm and breadth is 6cm.
2. Write an ALP to perform logical AND operation.

COURSE OUTCOME 5:

1. Explain the difference between simulator and Emulator.

2. Write an 8051 ALP to pick out the smallest number in an array of 5 numbers.

3. Write an 8051 ALP to calculate the Quotient and Reminder using Emulator.

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Basic arithmetic and Logical operations	2
2	Programming with control instruction	1
3	Code conversion	1
4	Programming with rotate instruction	1
5	Traffic light controller	1
6	Stepper motor control	1
7	Keyboard and Display	1
8	D/A interface and Waveform Generation	1
9	Programming Practices with Simulators	1

10	Demonstration of conditional jump, looping instruction	1
11	Demonstration of calling instruction	1

21PT3903	SOFT SKILLS- APTITUDE II	L	T	P	C
		0	0	2	1

Preamble

It is an introductory course which emphasize the fundamental concepts and Quantitative Aptitude .The concepts discussed herein are intended to provide clarification on basic Logical Reasoning

Prerequisites for the course

- Quantitative Aptitude
- Logical Reasoning

Objectives

- To learn about arithmetical operations with complex numbers
- To enlighten the meanings of a relation defined on a set, an equivalent relation and a partition of a set
- To impart knowledge how to Calculate percentages in real life contexts , find any percentage of a given whole using their knowledge of fraction multiplication and increase / decrease a given whole by a percentage
- To familiarize the situations like motion in as straight line, Boats and Streams, Trains, Races and clocks
- To study about the Counting techniques, Permutation and Combination, Recursion and generating functions

UNIT I	NUMBER SYSTEMS	5

Introduction - definition- classification on Numbers -power cycles and remainders - short cut process -concept of highest common factor - concept of least common multiple - divisibility - number of zeros in an expression-Percentages-Introduction - definition and Utility of percentage - importance of base/denominator for percentage calculations - concept of percentage values through additions - fraction to percentage conversion table

UNIT II	AVERAGES	5

Introduction - average of different groups - addition or removal of items and change in average placement of some of the items. Ratio, Proportions And Variation-Introduction- Ratio- properties-dividing a given number in the given ratio - comparison of ratios - proportions - useful results on proportion- continued proportion - relation among the quantities more than two– variation.

UNIT III	**PROFIT AND LOSS**	**5**
Gain/Loss and percentage gain or percentage loss-multiplying equivalents to find sale price – relation among cost price, sale price, gain/loss and percentage gain or percentage loss - an article sold at two different selling price - two different articles sold at same selling price - percentage gain or percentage loss on selling price - percentage gain or percentage loss on whole property		
UNIT IV	**TIME AND WORK**	**5**
Introduction - Basic concepts -Concepts on working with different efficiency - Pipes and Cisterns– Work Equivalence (Man Days) -Alternative approach. Time, Speed And Distance- Definition - Basics of Time, Speed and Distance - Relative speed - Problems based on Trains? Problems based on Boats and Streams -Problems based on Races - time taken with two difference modes of transport - time and distance between two moving bodies		
UNIT V	**PERMUTATION AND COMBINATION**	**5**
Definition - Fundamental rules - Theorems on Permutation - Theorems on Combination Probability-Concept and importance of probability - underlying factors for Real- Life estimation of probability -Basic facts about probability - some important consideration while defining event. Mixtures and Allegation- Definition - allegation rule - mean value (cost price) of the mixture - some typical situations where allegation can be used		
	Total Periods	**25**
Suggestive Assessment Methods		
Continuous Assessment Test (50 Marks)	**Formative Assessment Test (50 Marks)**	**End Semester Exams**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**NA**

SEMESTER – VI

21EE6601	POWER SYSTEM ANALYSIS	L	T	P	C
		3	1	0	4

Preamble

The course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, solution technique, formation of Z bus, optimal power flow and its importance are covered in this course. It also deals with short circuit analysis and analysis of power systems for steady state and transient stability.

Prerequisites for the course

- Transmission and Distribution power system

Objectives

- Impact knowledge on need for operational studies, and to model the power system under steady state operating condition.
- To understand and apply iterative techniques for power flow analysis.
- To model of carry out short circuit studies for power system during symmetrical fault.
- To model of carry out short circuit – studies during Unsymmetrical fault.
- To study about the various methods for analyzing power system stability.

UNIT I	POWER SYSTEM	12

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

UNIT II	POWER FLOW ANALYSIS	12

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

UNIT III	SYMMETRICAL FAULT ANALYSIS	12

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV	UNSYMMETRICAL FAULT ANALYSIS	12

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system.

UNIT V	**STABILITY ANALYSIS**	**12**
Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method - Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis – modified Euler method.		
	Total Periods	**60**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**4. ASSIGNMENT** **5. ONLINE QUIZZES** **6. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1. Ability to model the power system under steady state operating condition
2. Ability to carry out power flow analysis using iterative techniques.
3. Ability to infer the significance of short circuit studies in designing circuit breakers.
4. Ability to analyze the state of the power system for various unsymmetrical faults.
5. Ability to analyze the stability of power system using different methods.

Text Books

1. John J. Grainger, William D. Stevenson, Jr, ‘Power System Analysis’, Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Kothari D.P. and Nagrath I.J., ‘Power System Engineering’, Tata McGraw-Hill Education, 3rd edition 2019.
3. Hadi Saadat, ‘Power System Analysis’, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

Reference Books

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), second edition - 2017
4. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, Reissue edition 2005.
5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

Web Resources

1. https://archive.nptel.ac.in/courses/108/107/108107127/
2. https://onlinecourses.nptel.ac.in/noc20_ee88/preview
3. https://archive.nptel.ac.in/courses/108/107/108107028/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	3	3	3										3	
2	3	3	3										3	
3	3	3	3		2								3	
4	3	3	3		2								3	
5	3	3	3		2								3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30

APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. The single line diagram of an unloaded power system is shown in fig. The generators and transformers are rated as follows:

Generator 1 : 20 MVA, 13.8 KV, Xd''=0.20 p.u
Generator 2 : 30 MVA, 18 KV, Xd''=0.20 p.u
Generator 3 : 30 MVA, 20 KV, Xd''=0.20 p.u
Transformer 1: 25 MVA, 220/13.8 KV , X=0.1 p.u
Transformer 2: 3 Single phase units, each rated 10 MVA, 127/18 KV, X=0.1 p.u
Transformer 3 : 35 MVA, 220/22 KV , X=0.1 p.u
Draw the Reactance diagram using a base of 50 MVA and 13.8 KV on the Generator 1. (Apply)

2. Draw the reactance diagram for the power system shown in figure. Neglect resistance and use a base of 100 MVA, 220 KV in 50 Ω lines. The ratings of the generator, motor and transformer are given below.
   Generator : 40 MVA, 25 KV, X" = 20 %.
   Synchronous motor : 50 MVA, 11 KV, X" = 30 %.
   Y – Y Transformer (T1): 40 MVA, 33 / 220 KV, X = 15 %,
   Y – Δ Transformer (T2): 30 MVA, 11 / 220 KV (Δ / Y), X = 15 %. (Analyse)

COURSE OUTCOME 2:

1. Draw the flow chart and explain the algorithm for Gauss seidel iterative method for load flow analysis.(Apply)

2. Draw the flow chart and explain the algorithm for Newton Raphson iterative method for load flow analysis.(Apply)

COURSE OUTCOME 3:

1. With the help of a detailed flowchart, explain how a symmetrical fault can be analysed using $Z_{bus.}$ (Analyse)

2. A synchronous generator and motor are rated 30,000KVA, 13.2KV and both have sub transient reactance of 20%. The line connecting them has reactance of 10% on the base of machine ratings. The motor is drawing 20,000KW at

0.8PF leading and terminal voltage of the motor is 12.8KV.When a symmetrical 3-Φ fault occurs at the motor terminals, find the sub-transient current in the generator, motor and at the fault point.(Apply)

COURSE OUTCOME 4:

1. Derive the necessary equation to determine the fault current for a single line to ground fault. Draw a diagram showing the interconnection of sequence networks. (Apply)
2. A 25MVA, 11KV, three phase generator has a sub transient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in one line diagram a of figure. The motors have rated inputs of 15 and 7.5 MVA both 10KV with 25% sub transient reactance. The three phase transformers are rated 30MVA, 10.8/121KV, and connection delta-star with leakage reactance of 10% each. The series reactance of the line is 100 ohms. Label the positive and negative sequence networks of the system with reactance marked in per unit . (Analyse)

COURSE OUTCOME 5:

1. Derive swing equation for a single machine connected to infinite bus system. State the usefulness of this equation. State the reasons for non-linearity of this equation. (Apply)
2. Discuss in detail about the method of improving transient stability. (Understand)

21EE6501	EMBEDDED SYSTEM DESIGN AND DEVELOPMENT	L	T	P	C
		2	0	2	3

Preamble

This advanced course embraces the microcontroller and computer programming to design & operate large, medium and small scale electronic devices. This embedded platform deals with system design and real time operating systems.

Prerequisites for the course

- 21EE5601 - Microprocessor & Microcontroller and its application
- 21EE5612 - Microprocessor & Microcontroller Lab
- 21CS1511 - Programming Practice Laboratory using C

Objectives

- To provide knowledge on the basics, building blocks of Embedded Systems
- To understand Interfacing & Bus Communication with processors
- To perform automation using scheduling algorithms and Real time operating system
- To design a new embedded software and hardwares
- To analyse new advancements of real-time embedded systems

Syllabus		
UNIT - 1	**INTRODUCTION TO EMBEDDED SYSTEMS**	**9**
Introduction to Embedded Systems - selection of Embedded processor – DMA-memory devices – Memory management methods-memory mapping - Timer and Counting devices, Watchdog Timer - Software Development tools-IDE, assembler, compiler, linker, simulator, debugger and emulator		
UNIT - 2	**EMBEDDED NETWORKING BY PROCESSORS**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses – Serial Bus communication protocols -RS232 standard–RS485 –Inter Integrated Circuits (I2C) – Wireless protocol based on Wifi , Bluetooth - Function of Arduino and Raspberry Pi		
UNIT - 3	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9**
Introduction to basic concepts of RTOS- Need, Task, process & threads - interrupt routines in RTOS - Multiprocessing and Multitasking - Scheduler, - interrupt latency - shared data memory - Inter-process Communication		
UNIT - 4	**MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES**	**9**
Modelling of embedded systems- embedded software development approach - Overview of UML modeling with UML, UML Diagrams - Single-processor Architectures & Multi-Processor Architectures - design approach on parallelism in uniprocessors & Multiprocessors		
UNIT - 5	**EMBEDDED SYSTEM APPLICATION DEVELOPMENT**	**9**
Embedded Application Development for Control Dominated system, Data Dominated Systems-Case studies on Digital Camera, Electric Vehicles, Mobile Phones, ATM machine		

S.No.	List of Experiment	CO
1	Read input from switch and Automatic control/flash LED. (soft-ware delay)	CO1
2	Interrupts programming example using GPIO.	CO1
3	Configure watchdog timer in watchdog mode & interval mode.	CO2
4	Read Temperature of MSP430 with the help of ADC.	CO2
5	Test various Power Down modes in MSP430.	CO3
6	Speed Control of DC Motor using embedded program.	CO4
7	Networking MSPs using Wi-Fi.	CO5

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Lab Components Assessments (20 Marks)**	**End Semester Exams (50 Marks)**
Written Examination	1. Lab Experiments 2. Model Examination	Written Examination
Outcomes		

Upon completion of the course, the students will:

CO1: Able to gain the knowledge on embedded system operations

CO2: Able to understand the embedded networking and processor control

CO3: Able to perform automation using real-time Kernel algorithm

CO4: Able to solve the design issues in embedded systems

CO5: Able to analyse the new advancements in real-time embedded systems

Text Books

1. Jorgen Staunstrup, Wayne Wolf , Hardware / Software Co- Design Principles and Practice, Springer, 2021.
2. Rajkamal, 'Embedded system-Architecture, Programming, Design', TMH, 2021.

Reference Books

1. Peckol, "Embedded system Design",JohnWiley&Sons, 2020
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson 2019
3. Bruce Powel Douglass,"Real-Time UML Workshop for Embedded Systems, Elsevier, 2019

Web Recourses

1. https://archive.nptel.ac.in/courses/106/105/106105193/
2. https://nptel.ac.in/courses/108102045

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
1	3	2			2				2		2		2	
2	3	2	2		2				2		2		2	
3	3	3	3	2	3				2		2		2	
4	3	3	3		3			1	2		2		2	
5	3	3	3	3	3		2	1	2		2		2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1)

(1) Think - Pair - Share → Model question
Data: Reset, Delete Date, Counter, Timer0, Timer1, Timer2, PIC16xxx, 8-bit, 16-bit, Watchdog, EEPROM

(2) Clarify the concept of ***External Interrupts*** using your mobile phone

COURSE OUTCOME 2 (CO 2) :

(1) Differentiate the following → Wifi (vs) Bluetooth (vs) Arduino (vs) Raspberry Pi

(2) Wordle type question → ***Wireless Protocol*** (Find the questions using clues)

COURSE OUTCOME 3 (CO 3) :

(1) Elaborate the interrupt latency in details.

(2) Find the coding errors in the Embedded C → Smart Home Automation

COURSE OUTCOME 4 (CO 4) :

(1) Explain the basic functions of a real-time kernel.

(2) Differentiate the design approach on parallelism in uniprocessors & Multiprocessors

COURSE OUTCOME 5 (CO 5) :

(1) Compare the Normal Camera and Embedded based Digital Camera. Discuss about the major design implementation

(2) Case studies on features of Mobile Phones in the view of embedded system

21GE2M02	ENVIRONMENTAL AND SUSTAINABLE ENGINEERING	L	T	P	C
		2	0	0	0

Preamble

To inculcate knowledge on the environment and all sorts of biotic and abiotic components related to its ecosystem, climate changes and challenges faced due to global warming and the importance of renewable sources of energy. Inspire students to find ways in contributing personally and professionally thereby rectifying environmental and social problems.

Prerequisites for the course

- Basic theoretical concepts of biological science in higher secondary level.
- Basic theoretical concepts of Engineering Chemistry.

Objectives

- To make the students conversant with the interdisciplinary and holistic nature of the environment.
- To make the students understand the impacts of environmental degradation and to minimise vulnerability to future disasters.
- To enrich the students with the significance of natural resources and environment on the quality of life.
- To have an increased awareness among students to create a quest on issues in areas of sustainability.
- To have a thorough understanding of the concepts of sustainable habitat.

UNIT I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY	7

Environment: Definition, Scope and Importance of environment studies. Ecosystem: Structure and function of an ecosystem - Producers - Consumers – Decomposers- Types – Characteristic features: Forest ecosystem - Desert ecosystem - Pond ecosystem-Ocean ecosystem. Biodiversity - Value of biodiversity - Hot-spots of biodiversity- Threats to biodiversity - Endangered and Endemic species - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II	ENVIRONMENTAL POLLUTION & DISASTER MANAGEMENT	6

Pollution: Definition - Causes - Effects - Control measures of air pollution - Water pollution: (Sewage water treatment by activated sludge and trickling filter process) - Marine pollution - Noise pollution.

Disaster management: Causes - Effects - Control measures of Floods - Earthquake -

Cyclone. Field study of local polluted sites – Urban / Rural / Industrial / Agricultural.

UNIT III	NATURAL RESOURCES	6

Forest resources: Use - Overexploitation - Deforestation - case studies. Water resources: Use - Overutilization of surface and groundwater - Water conservation: Rainwater harvesting-Conflicts over water. Mineral resources: Use - Exploitation -Environmental effects of extracting and using mineral resources - Case studies. Food resources: Effects of Modern Agriculture - Fertilizer- Pesticide problems (Eutrophication, Blue baby syndrome, Biomagnification) - Water logging - Salinity - case studies. Energy resources: Renewable (Solar, Wind) - Non renewable energy sources.

UNIT IV	SUSTAINABILITY	6

Introduction, Need and concept of sustainability, Social- Environmental and Economic Sustainability Concepts, Sustainable Development, Challenges for Sustainable Development. Environmental legislations in India - Water Act, Air Act.

UNIT V	SUSTAINABLE HABITAT	5

Basic concepts of sustainable habitat, Environment Impact Assessment (EIA) - Procedures of EIA in India, Green Engineering, Social and technological change, Industrial Processes: Pollution Prevention, Industrial Ecology.

	Total Periods	**30**

Suggestive Assessment Methods

Continuous Assessment Test (100 Marks)	Formative Assessment Test	End Semester Exams
WRITTEN TEST	N A	N A

Outcomes

Upon completion of the course, the students will be able to:

1	Demonstrate the knowledge on the interdisciplinary and holistic nature of the environment. (Remember)
2	Identify the problems related to environmental degradation.

3	Understand the significance of natural resources on the quality of life.
4	Identify the issues in areas of sustainability.
5	Acquire knowledge on the concepts of sustainable habitat

Text Books

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

Reference Books

1. Nibin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw- HillProfessional.

2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

Web Resources

1. NPTEL Lecture: https://www.youtube.com/watch?v=hihFHam_wNE
2. NPTEL Lecture: https://www.youtube.com/watch?v=DNUYxyaYh3g

21PT3904	SOFT SKILLS –REASONING	L	T	P	C
		0	0	2	1

Prerequisites for the course

- Verbal Ability

Objectives

1. To strengthen the social network by the effective use of social media and social interactions.
2. To identify own true potential and build a very good personal branding
3. To develop critical thinking to solve real world problems and competitive exam problems for students

Syllabus

UNIT - 1	Social Media	3

Effective use of social media - Types of social media, Moderating personal information, Social media for job/profession, Communicating diplomatically. Networking on social media - Maximizing network with social media, How to advertise on social media.

UNIT - 2	Social Interaction	3
Event management - Event management methods, Effective techniques for better event management Influencing - How to win friends and influence people, Building relationships, Persistence and resilience, Tools for talking when stakes are high Conflict resolution - Definition and strategies ,Styles of conflict resolution		
UNIT - 3	**Non Verbal Communication**	**3**
Proximecs - Types of proximecs, Rapport building. Reports and Data Transcoding - Types of reports. Negotiation Skill - Effective negotiation strategies. Conflict Resolution - Types of conflicts.		
UNIT - 4	**Interpersonal Skill**	**3**
Social Interaction - Interpersonal Communication, Peer Communication, Bonding, Types of social interaction. Responsibility - Types of responsibilities, Moral and personal responsibilities. Networking - Competition, Collaboration, Content sharing. Personal Branding - Image Building, Grooming, Using social media for branding. Delegation and compliance - Assignment and responsibility, Grant of authority, Creation of accountability		
UNIT - 5	**Reasoning Ability**	**3**
Analytical Reasoning Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzle test, Selection Decision table		
	Total Periods	**15**

Suggestive Assessment Methods	
Continuous Assessment Test	**Formative Assessment Test**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. 3.PROBLEM-SOLVING ACTIVITIES**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Understanding the various strategies of conflict resolution among peers and supervisors and respond appropriately
2	Acquire wide knowledge on social interaction

3	Improve speaking skills in academic and social contexts
4	Improve interpersonal communication through proper pronunciation.
5	Interpret the analytic reasoning ability which would help them in their professional career.

Text Books

1. ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt.Ltd.
2. Mark G. Frank, David Matsumoto, Hyi Sung Hwang, Nonverbal Communication: Science and Applications, 2012, 1 st Edition, Sage Publications, New York.

Reference Books

1. Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Crucial Conversations: Tools for Talking When Stakes are High, 2001,1st edition McGraw Hill Contemporary, Bangalore.
2. Dale Carnegie, How to Win Friends and Influence People, Latest Edition,2016. Gallery Books, New York

Web Recourses

1. https://www.fresherslive.com/online-test/logical-reasoning-test/questions-and-answers
2. https://www.indiabix.com/non-verbal-reasoning/questions-and-answers/
3. https://www.indiabix.com/logical-reasoning/questions-and-answers/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
1	1	2	2											
2		2		2		2			1		3			
3	1			1	1		2			1	2	2		
4	1	2	2		3			3	2					
5	2		2	2		2			2		1			

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2
REMEMBER	20	10	5	5
UNDERSTAND	40	20	10	10
APPLY	40	50	5	5
ANALYZE	-	20	5	5
EVALUATE	-	-	-	-
CREATE	-	-	-	-

21EE6911	COMPREHENSION	L	T	P	C
		0	0	4	2

OBJECTIVES:

To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise

METHOD OF EVALUATION:

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics.

TOTAL: 30 PERIODS

COURSE OUTCOME(S):

Ability to review, prepare and present technological developments

21EE6912	MINI PROJECT CUM INTERNSHIP	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop their own innovative prototype of ideas
- To train the students in preparing mini project reports and examination

The students in a group of 3 to 4 work on a topic approved by the head of the department and prepare a comprehensive mini project report after completing the work to their satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

GUIDELINES:

- Students should select a problem which addresses some basic home, office or other real life applications.
- Students should understand testing of various components.
- Soldering of components should be carried out by students.
- Students should develop a necessary PCB for the circuit.
- Students should see that the final circuit submitted by them is in working condition.
- Group of maximum four students can be permitted to work on a single mini project.
- The mini project must have hardware parts. The software part is optional.
- Department may arrange demonstrations with poster presentations of all mini projects developed by the students at the end of semester.
- It is desirable that the electronic circuit/systems developed by the students have some novel features.
- 20-30 pages report to be submitted by students

TOTAL: 45 PERIODS

COURSE OUTCOME(S):

At the end of the course the student will be able to

CO.1 Take up their final year project work and find a solution by formulating proper methodology.

CO2 Design of electrical and electronics projects

CO.3 Evaluate the process of implementation of electrical and electronics projects

CO.4 Implement the principles of project design, reporting and progress monitoring

CO.5 Implement the principles of Evaluation of mini project complete work

Semester VII

21GE7101	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Preamble

This course is an intensive and comprehensive introductory study and analysis of the management process and the concepts of strategic and tactical organizational planning; organizational design and structure to achieve company objectives, leadership skills, employee motivational approaches; conflict management; interpersonal communication, the staffing and supervising processes; performance appraisal, management ethics and the concepts of controlling and control systems. QM is customer oriented management philosophy and strategy. TQM demands organizations in every sector to focus on customer satisfaction, by involving every employee in their process improvement projects. The tools and techniques of total quality management leads all manufacturing and service oriented organization do excellence in their process by control cost and improve quality.

Prerequisites for the course

NIL

Objectives

1. To understand the need for quality and its evolution over time.
2. To understand the need for quality and its evolution over time.
3. To equip with a thorough understanding of quality management tools and techniques
4. To enable them to effectively implement these tools and techniques to optimize quality management practices.
5. To understand the need for quality and its evolution over time.

UNIT I	INTRODUCTION	9
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.		
UNIT II	**TQM PRINCIPLES**	**9**
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen.		
UNIT III	**TQM TOOLS AND TECHNIQUES I**	**9**
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.		
UNIT IV	**TQM TOOLS AND TECHNIQUES II**	**9**
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.		
UNIT V	**QUALITY MANAGEMENT SYSTEM**	**9**
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards— ISO 9001 Requirements—Implementation— Documentation—Internal Audits—Registration. **ENVIRONMENTAL MANAGEMENT SYSTEM**: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001— Benefits of EMS.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	To familiarized with the basic concept and framework of Total Quality management.
2	To Understand the contribution of Quality Gurus in TQM Journey
3	To provide a comprehensive understanding of the traditional tools and equipping with the

	knowledge and skills to drive quality improvement initiatives effectively.
4	To Explain the various types of Techniques and foster their ability to drive organizational improvement and enhance quality management practices.
5	To Apply various Quality Systems and Auditing on implementation of TQM.

Text Books

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Poornima M., Pearson publication, rd Edition, Total Quality Management 2017

Reference Books

1. Subburaj Ramasamy, Total Quality Management, Mc Graw Hill Publications
2. Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla, Total Quality Management (TQM): Principles, Methods, and Applications, Publisher: CRC Press, 2020; ISBN 1000194493,
3. D.R. Kiran, Total Quality Management: Key Concepts and Case Studies, Publisher Butterworth-Heinemann, 2016, ISBN 0128110368,
4. W. Edwards Deming, The Essential Deming: Leadership Principles from the Father of Quality, Editors Joyce Orsini, Diana Deming Cahill, Publisher: McGraw Hill Professional, 2012, ISBN: 0071790217, 9780071790215

Web Recourses

1. http://www.notesengine.com/dept/cse/7sem/anna-university-7-sem-cse-notes.html
2. http://www.vidyarthiplus.com/vp/Thread-GE2022-Total-Quality-Management-Lecture-Notes- Lonely-Edition
3. http://freshupdates.in/lecture-notes/anna-university-total-quality-management-lecture-notes/
4. http://www.iannauniversity.com/2012/06/ge2022-total-quality-management-lecture.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3		2					3					2
2						3			3	2	3			2
3	3	3		3		2								2
4		3		3						2				2
5	1	3		3		3		2	3	3	3	3		2

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDETSTAND	30	30	10	10	30
APPLY	30	30	10	10	30
ANALYZE	20	20	10	10	15
EVALUATE	10	10	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Describe Deming's philosophy for quality management.
2. Elaborate on TQM framework and importance of each element.

COURSE OUTCOME 2:

1. Briefly explain about recognition and reward system along with its effects.
2. Enumerate the Japanese 5S as applicable to services and manufacturing company.

COURSE OUTCOME 3:

1. Evaluate the purpose and methodology of construction of an Ishikawa diagram with an example.

2. Analyze the three main types of benchmarking. In what circumstances would each type be more appropriate?

COURSE OUTCOME 4:

1. Draw the house of quality for a product of your choice and describe the QFD methodology.
2. List and explain the various measures of performance in evaluating the success of an organization.

COURSE OUTCOME 5:

1. Discuss the various elements of ISO 9000-2000 quality system.
2. Estimate the role of audit checklist for quality management system.

21EE7601	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

Large scale shift to renewable energy resources from fossil fuels is needed in order to limit and reduce the greenhouse gases released by the human use of fossil fuels. Among the renewable energy options available, solar energy represents a promising and major energy resource. This course focuses on solar photovoltaic (PV) energy systems, Wind energy system. Students will be posed to the status of energy resources, its interaction with environment, different renewable energy sources technologies, different techniques and technologies for energy management and energy conservation along with the economic aspects of renewable energy based power generation.

Prerequisites for the course

1. Power Generation systems

Objectives

To impart knowledge on the following Topics

1. Awareness about renewable Energy Sources and technologies.
2. Understanding of technical and commercial aspects of Wind and Alternative Sources of Energy
3. Adequate inputs on a Solar PV and Thermal systems
4. Recognize current and possible future role of Bio mass Energy
5. Tidal, wave Energy and other renewable energy resources and technologies and their applications.

UNIT I	RENEWABLE ENERGY (RE) SOURCES	9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Role of renewable energy in sustainable development, global potential for solar electrical energy systems, Types of RE sources, Limitations of RE sources, renewable energy availability in India and international energy scenario of conventional and RE sources.

UNIT II	WIND ENERGY	9
Properties of wind, availability of wind energy in India, Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.		
UNIT III	**SOLAR PV AND THERMAL SYSTEMS**	**9**
Solar Radiation, Radiation Measurement, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of Solar PV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency &Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.		
UNIT IV	**ENERGY STORAGE DEVICES**	**9**
Energy Storage Parameters-Lead-Acid Batteries-Ultra Capacitors-Flywheels -Superconducting Magnetic Storage System-Pumped Hydroelectric Energy Storage – Compressed Air Energy Storage -Storage Heat -Energy Storage as an Economic Resource.		
UNIT V	**OTHER ENERGY SOURCES**	**9**
Biomass energy - Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types -construction and applications. Energy Storage System- Hybrid Energy Systems.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Get knowledge about renewable Energy Sources and technologies
2	Get adequate inputs on a variety of issues in harnessing renewable Energy.
3	Recognize current and possible future role of renewable energy sources.
4	Explain the various renewable energy resources and technologies and their applications.

5	Understand basics about biomass energy.

Text Books

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHILearning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, RakeshRanjan "Renewable Energy Sources and EmergingTechnologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning,USA, 2016

Reference Books

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design",PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited,Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig, AdebayoA.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning IndiaPrivate Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. ShobhNath Singh, 'Non-conventional Energy resources' Pearson Education,2015.

Web Recourses

1. https://nptel.ac.in/courses/103103206
2. https://archive.nptel.ac.in/courses/115/105/115105127/
3. https://archive.nptel.ac.in/courses/103/103/103103206/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	1		1				1				1			3
2	1		2				1				1			3
3	2		2				2				2			3
4	2	2	2				2				2			3
5	3	3	2				3							3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDETSTAND	30	30	10	10	30
APPLY	30	30	10	10	30
ANALYZE	20	20	10	10	15
EVALUATE	10	10	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Demonstrate the importance of renewable sources of energy.
2. Compose the necessity of sustainable design and development for the prosper growth of human life in the world. (Analyze)

COURSE OUTCOME 2:

1. Explain about the various types of Wind Power Plant (WPPs). (Remember)
2. Summarize the environmental impact due to installation of Wind power plant. (Analyze)

COURSE OUTCOME 3:

1. Discuss the construction and working principle of Central Receiver power plants.(Understand)
2. Summarize the maximum power point tracking in the Solar Photo voltaic system and discuss the advantages and disadvantages (Analyze)

COURSE OUTCOME 4:

1. Discuss the following methods of biogas generation
   (i). Gasification
   (ii) Anaerobic Digestion
2. Discuss with a neat sketch the bioenergy generation through fermentation.

COURSE OUTCOME 5:

1. Discuss, what is the minimum tidal range required for the working of tidal plant. Explain how much the potential in tides is. (Analyze)

2. Explain the 'single-basin' and 'two-basin' systems of tidal power harnessing. Further, discuss their advantages and limitations (Analyze)

Compiled By: Mr.S.Selvakumar,AP/EEE Verified By

21EE7611	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

Preamble

The aim of this course is to train the students for solving the power system problems using MATLAB coding. The formation of bus admittance matrix followed by power flow solutions using various numerical methods is introduced. Students get the exposure in short circuit analysis and stability analysis under steady state and transient state. Economic load dispatch problem is also performed using MATLAB coding. Also, understanding different types of power system protection modules are introduced using protective relay test benches.

Prerequisites for the course

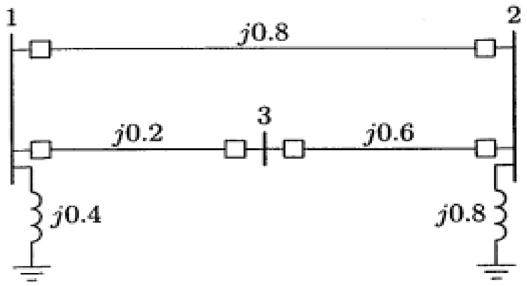
- Transmission and Distribution in Power Systems
- Power System Analysis
- Power System Operation and Control

Objectives

1. To understand the modelling of transmission lines in impedance and admittance forms.
2. To study the techniques for power flow analysis and to carry out short circuit and stability studies on power system.
3. To enhance the model of single machine infinite bus system and transient conditions and to find Symmetric and Unsymmetrical fault.
4. To analyze the load – frequency and voltage controls.
5. To apply state estimation and understand the economic dispatch problem.

S.No	List of Experiments	CO
1	Computation and modelling of transmission Lines	**CO1**
2	Formation of Bus Admittance and Impedance Matrices	**CO1**
3	Power Flow Analysis Using Gauss-Seidel Method.	**CO2**
4	Power Flow Analysis Using Newton Raphson Method.	**CO2**
5	Symmetric and Unsymmetrical Fault Analysis.	**CO3**
6	Transient Stability Analysis of SMIB System.	**CO3**
7	Electromagnetic Transients in Power Systems : Transmission Line Energization	**CO3**
8	Load – Frequency Dynamics of Single- Area and Two-Area Power	**CO4**

	Systems	
9	Economic Dispatch in Power Systems.	**CO5**
10	State estimation: Weighted least square estimation.	**CO5**

S.No.	**List of Projects**	**Related Experiment**	**CO**
1.	Simulate the Fault Detection circuit for a 150 km three Phase Transmission Line Using MATLAB.	1,2	1
2.	Design a Three-dimensional admittance matrix Using MATLAB for the given diagram. 	1,2,5	1,3
3.	Transmission line three phase fault analysis using MATLAB Simulink.	1,2,5,6	1,3
4.	GA Optimized PI controller for Load Frequency Control	1,2,8	1,4
5.	Design and implementation of Automatic Generation Control of Two Area System Using MATLAB/SIMULINK	1,2,3,8	1,2
6.	BUS Network Load Flow Analysis using MATLAB Simulink	1,2,3	1,2
7.	50 Watt rating Solar Power Generation for Home Appliance using MATLAB Simulink.	1,2,5,6,7	1,3
8.	Economic Dispatch of BESS and Renewable Generators in DC Microgrids Using Voltage-Dependent Load Models	1,9,10	1,5
9.	Design a 5 MW, 1500 RPM, 50 Hz, 540 V Synchronous Generator using MATLAB.	1,2,4,7	1,2,3
10.	A 60 kW, 400 V, 4 Pole, wave connected DC Motor Speed Control Design with MATLAB and Simulink.	1,2,4,8,10,	1,2,4,5
11.	Simulate the ALFC loop parameters using MATLAB Simulink for a control area having Total area capacity= 3000 MW, Normal operating load= 1500 MW, Inertia constant= 5.0, Regulation= 2.4Hz/pu MW.	1,2,8	1,4
12.	Load frequency control in a hybrid thermal wind photovoltaic power generation system with the rated capacity of 2000 MW.	1,2,8	1,4

Suggestive Assessment Methods	
Lab Components Assessments **(60 Marks)**	**End Semester Exams** **(40 Marks)**
Outcomes	
Upon completion of the course, the students will be able to:	
CO1	Provide a better understanding of modelling of transmission lines in impedance and admittance forms.
CO2	Apply iterative techniques for power flow analysis and to carry out short circuit and stability studies on power system.
CO3	Simulate the model of single machine infinite bus system and transient conditions and to find Symmetric and Unsymmetrical fault.
CO4	Analyze the load – frequency and voltage controls.
CO5	Simulate and Analyze state estimation and understand the economic dispatch problem.

Laboratory Requirements

Personal computers (Intel i3, 80GB, 2GBRAM)- 30
Printer laser – 1
Dot matrix - 1
Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor)- I
Software: any power system simulation software with 5 user license
Compliers: C, C++, VB, VC++ - 30

Reference Books

1. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013.
2. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
4. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.

Web Recourses

1. https://nptel.ac.in/courses/108104051
2. https://www.youtube.com/watch?v=2vOwntegb2A

CO Vs PO Mapping and CO Vs PSO Mapping

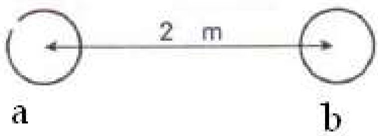
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3			2				3				3	
2	3	3							3				3	
3	3	3			2				3				3	
4	3	3			2				3				3	
5	3	3			2				3				3	

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

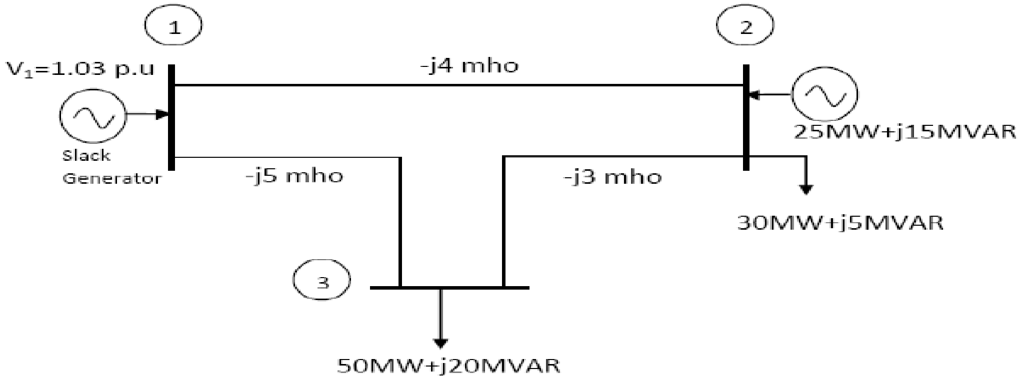
1. Calculation of inductance and capacitance of single-phase line has two parallel conductor 2m apart and diameter of each conductor is 1cm. Also, verify the obtained result with calculated value. (Evaluate)



2. Examine the applications of Y-bus (Evaluate)

COURSE OUTCOME 2:

1. For the three bus system shown in figure. The relevant per unit line admittances on 100 MVA base are indicated on the diagram. Form bus admittance matrix and determine the voltage at bus 2 and bus 3 after the second iteration using Gauss Siedel method. Assume acceleration factor as 1.6. Use available software and print the output of the load flow problem. Using the voltage solution of the converged power flow obtained from the available program compute the sending end and receiving end line flow in each of the transmission line. Solve the power flow problem using the available program for different value of acceleration factors and plot the convergence characteristics.



2. Define Acceleration factor. (Understand)

COURSE OUTCOME 3:

1. Design a Simulink Model for Evaluating the Transient Stability of Single Machine Connected to Infinite Bus.
2. List the different types of fault in Power System. (Understand)

COURSE OUTCOME 4:

1. For an isolated single area consider the following data:

   Area capacity Pr = 1000 MW

   Nominal operating load PD0 = 500 MW

   Inertia constant H =5sec

   Regulation = 5 Hz/p.u. MW

   Nominal frequency = 50Hz

   Load decreases by 1% for a decrease in frequency by 1%.

   Find 1) Gain & Time constant of power system and 2) Change in frequency under static condition. Also, verify the obtained result with calculated value. (Evaluate)

2. A two-area system connected by a tie-line has the following parameters with base MVA for each area.

Area	1	2
Turbine output power	200 MVA	1000 MVA
Nominal frequency	50 HZ	50 HZ
Inertia constant	3%	4%
Power system gain (K_p)	50 Hz/p.u. MW	40 Hz/p.u. MW
Governor time constant	0.3	0.2
Turbine time constant	0.6	0.4

The synchronizing power coefficient is computed from the initial operating condition T_{12}= 2.0 p.u. A load change of 400 MW occurs in area 1. Determine the steady state frequency and the change in the tie-line flow. Also, verify the obtained result with calculated value.

COURSE OUTCOME 5:

1. The fuel cost of two units are given by $F_1 = 0.1\ P_1^2 + 25P_1 + 1.6$ Rs/hr.

   $F_2 = 0.1\ P_2^2 + 32\ P_2 + 2.1$ Rs/hr.

   If the total demand on the generation is 250 MW, find the economic load scheduling of the two units. (Evaluate)

2. Determine the economic generation schedules of three generating units in a power system to meet the system load of 925 MW. The operating limit and cost function is given below:

   Operating limits $250\ MW \leq P_{G1} \geq 450\ MW$

   $200\ MW \leq P_{G2} \geq 350\ MW$

   $125\ MW \leq P_{G3} \geq 225\ MW$

   Cost function is $F_1\ (P_{G1}) = 0.0045\ P_{G1}^2 + 5.2P_{G1} + 580.$

   $F_2\ (P_{G2}) = 0.0056\ P_{G2}^2 + 4.5\ P_{G2} + 640.$

   $F_3\ (P_{G3}) = 0.0079\ P_{G3}^2 + 5.8\ P_{G3} + 820.$

   Also, verify the obtained result with calculated value.

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Computation and modelling of transmission Lines	1
2	Formation of Bus Admittance and Impedance Matrices	1
3	Power Flow Analysis Using Gauss-Seidel Method.	1
4	Power Flow Analysis Using Newton Raphson Method.	1
5	Symmetric and Unsymmetrical Fault Analysis.	1
6	Transient Stability Analysis of SMIB System.	1

7	Electromagnetic Transients in Power Systems : Transmission Line Energization	1
8	Load – Frequency Dynamics of Single- Area and Two-Area Power Systems	1
9	Economic Dispatch in Power Systems.	1
10	State estimation: Weighted least square estimation.	1

Compiled By: Mr.J.Antony Robinson,AP/EEE Verified By

21EE7612	RENEWABLE ENERGY SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

Preamble

This laboratory gives a practical exposure to the students to learn the Matlab Simulink model based solar and wind that are used nowadays in most of the Renewable energy system. Lab consists of solar, wind, hybrid system and intelligent controller This lab also covers the industrial implementation of advanced Renewable energy system via different computer tools such as MATLAB and Simulink. To validate the experimental results, the use of simulation tools for the performance analysis is also introduced to the students.

Prerequisites for the course

- Power Generation systems

Objectives

1. MATLAB simulink for Solar PV Energy System.
2. Basic Knowledge on voltage current characteristic and efficiency of 1KW Solar PV energy Systems and diode based applications
3. Recognize current and possible future role of of micro Wind Energy Generator.
4. Train the students in Assessment of Hybrid (Solar-Wind) Power System Renewable Energy Sources and technologies.
5. Provide better understanding of Intelligent Controllers

S.No	List of Experiments	CO
1	Simulation study on Solar PV Energy System.	CO1
2	VI-Characteristics and Efficiency of 1kWp Solar PV System.	CO1
3	Partial shading of solar PV Systems	CO2
4	Performance assessment of Grid connected and Standalone	CO2

	1kWp Solar Power System	
5	Simulation study on Wind Energy Generator.	CO3
6	Performance assessment of micro Wind Energy Generator.	CO3
7	Performance Assessment of Hybrid (Solar-Wind) Power System.	CO4
8	Simulation study on Bio gas generation.	CO4
9	Simulation study on fuel cell	CO4
10	Experiment on Intelligent Controller.	CO5
11	Simulation study on Hybrid (Solar-Wind) Power System.	CO5

S.No.	List of Projects	Related Experiment	CO
1.	Design and fabrication of solar mobile charging circuit using Li iron battery 1500 mah 3.7V , TP4056 Lithium battery charger and 5V output Usb boost converter	1,2,3	**CO1**
2.	Design of 24v/48v (1500W) DC to DC buck boost converter for solar panel and wind output of 24v to 230V to run BLDC motor	1,2,3,4,5,6	**CO1**
3.	Design and implementation of 24v/12v DC-DC Buck Converter for solar water pumping application using MATLAB	1,2,3,5,6	**CO1**
4.	12V, 20W, Maximum power current 1.04 poly crystalline solar panel based 12v, 1.2A battery charging system	1,2,3,,5,6	**CO2**
5.	Design of 12V Dual Power Generation Solar Plus Windmill Generator using Atmega328 microcontroller, LM320 ac voltage regulator with the battery supply of 12V, 1.2A and continuous current 7.5A servomotor	1,2,3,7,8	**CO2**
6.	A single-Stage Grid Connected 8 A, 500 V H bridge Inverter Topology for 12V,using capacitor Cp=2000uf, Cf=4.4uf inductor L_p=220$_{uf}$, L_f=3.25$_{Mh}$,T_s=100$_{us}$,Vp=150$_V$ and Vp$_v$=80$_v$ Solar PV Systems With Maximum Power Point Tracking Inverter Specification <table><tr><td>S.no</td><td>Parameters Detailed</td><td>Detailed specification</td></tr><tr><td>1</td><td>Nominal voltage 230V/415V</td><td>Nominal voltage 230V/415V</td></tr><tr><td>2</td><td>Voltage</td><td>Band Between 80% and 110% of V nominal</td></tr><tr><td>3</td><td>Nominal Frequency</td><td>50 Hz</td></tr><tr><td>4</td><td>Operating Frequency</td><td>47.5 to 50.5 Hz</td></tr></table>	1,2,3,4,10	**CO3**

		Range	
	5	Waveform	Sine wave
	6	Harmonics	AC side total harmonic current distortion < 3%
	7	Ripple	DC Voltage ripple content shall be not more than 1%
	8	Efficiency	Efficiency shall be >97%
	9	Casing protection levels	Degree of protection: Minimum IP-54 for internal units and IP-65 for outdoor units
	10	Operating ambient Temp range	-10 to + 60 degree Celsius

7. C	A product development of home based Poly Crystalline 10W 12V Solar power Inverter with dual AC output using the capacitor 1000µF and 0.1 µF with the P75N75 & CD4047 iC	1,2,3,	**CO4**
8.	**Case study** 1.Design and analyse the use of Solar power for cellular base stations using Different MPPT Algorithms In MATLAB simulation software 2. Simulation for Wind Turbine Generators—With FAST and MATLAB-Simulink Modules	1,2,3,4,5,6,9	**CO5**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	**End Semester Exams (40 Marks)**

Outcomes

Upon completion of the course, the students will be able to:

CO1	The students can able to create the MATLAB Simulink for Renewable energy systems.
CO2	To acquire knowledge on Shadowing effect & diode based solution in 1kWp Solar PV System and variety of issues in harnessing Renewable energy
CO3	To train the students in assessment of Grid connected and Standalone 1kWp Solar Power System Renewable Energy Sources and technologies.
CO4	The students simulate the model of wind, hybrid and hydel Power and the various

	Renewable energy sources.
CO5	Ability to recognize current and possible future role of Renewable energy sources.

Laboratory Requirements

S.no	Description of Equipment	Quantity required
1	Personal computers (Intel i3, 80GB, 2GBRAM)	15
2	CRO 30MHz	8
3	Digital Multimeter	10
4	PV panels - 100W, 24V	1
5	Battery storage system with charge and discharge control 40Ah	1
6	PV Emulator	1
7	Micro Wind Energy Generator module	1
8	Potentiometer	5
9	Step-down transformer 230V/12-0-12V	5

Reference Books

1. .K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited Delhi, 2015

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc21_ch11/preview
2. http://digimat.in/nptel/courses/video/103103206/L01.html
3. https://www.mathworks.com/videos/commissioning-and-validating-renewable-energy-systems-using-matlab-and-simulink-1651166405798.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2			2				3				3	
2	3	2							3				3	
3	3	2			2				3				3	
4	3	2			2				3				3	
5	3	2							3				3	

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Mention the various wave energy conversion devices. (Understand)
2. Explain the working principle of wind energy conversion systems. (Analyze)

COURSE OUTCOME 2:

1. Explain the I-V characteristics of a solar cell with a neat sketch.(understand)
2. Briefly explain the working of solar PV cell. (Analyze)

COURSE OUTCOME 3:

1. Explain with neat sketch thermal energy storage system with Phase Change Material (PCM) (Analyze)
2. Justify, short circuit power ratio and mention how this ratio affects the grid strength (Evaluate)

COURSE OUTCOME 4:

1. How to do 24h Solar PV System simulation in less time? (understand)
2. Study on simulation of wind load characteristics for photovoltaic generation systems (Analyze)

COURSE OUTCOME 5:

1. List the different types of tidal power plant. Explain the principle of tidal generation with neat sketch.(Analyze)
2. Discuss the performance characteristics of wind mill

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF WEEKS REQUIRED
1	Simulation study on Solar PV Energy System. **1.** Design and implementation of 24v/12v DC-DC Buck	1

<table>
<tr><td></td><td>Converter for solar water pumping application using MATLAB</td><td></td></tr>
<tr><td>2</td><td>VI-Characteristics and Efficiency of 1kWp Solar PV System.
1. Design and fabrication of solar mobile charging circuit using Li iron battery 1500 mah 3.7V , TP4056 Lithium battery charger and 5V output Usb boost converter
2. Design of 24v/48v (1500W) DC to DC buck boost converter for solar panel and wind output of 24v to 230V to run BLDC motor</td><td>1</td></tr>
<tr><td>3</td><td>Shadowing effect & diode based solution in 1kWp Solar PV System
1. 12V, 20W, Maximum power current 1.04 poly crystalline solar panel based 12v, 1.2A battery charging system
2. A product development of home based Poly Crystalline 10W 12V Solar power Inverter with dual AC output using the capacitor 1000μF and 0.1 μF with the P75N75 & CD4047 iC</td><td>1</td></tr>
<tr><td>4</td><td>Performance assessment of Grid connected and Standalone 1kWp Solar Power System
1. A single-Stage Grid Connected 8 A, 500 V H bridge Inverter Topology for 12V,using capacitor Cp=2000uf, Cf=4.4uf inductor $L_p=220_{uf}$, $L_f=3.25_{Mh}$,$T_s=100_{us}$,Vp=150_V and $Vp_v=80_v$ Solar PV Systems With Maximum Power Point Tracking
Inverter Specification
<table>
<tr><th>S.no</th><th>Parameters Detailed</th><th>Detailed specification</th></tr>
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<tr><td>2</td><td>Voltage</td><td>Band Between 80% and 110% of V nominal</td></tr>
<tr><td>3</td><td>Nominal Frequency</td><td>50 Hz</td></tr>
<tr><td>4</td><td>Operating Frequency Range</td><td>47.5 to 50.5 Hz</td></tr>
<tr><td>5</td><td>Waveform</td><td>Sine wave</td></tr>
<tr><td>6</td><td>Harmonics</td><td>AC side total harmonic current distortion < 3%</td></tr>
<tr><td>7</td><td>Ripple</td><td>DC Voltage ripple content shall be not more than 1%</td></tr>
<tr><td>8</td><td>Efficiency</td><td>Efficiency shall be >97%</td></tr>
<tr><td>9</td><td>Casing protection levels</td><td>Degree of protection: Minimum IP-54 for internal units and IP-65 for outdoor units</td></tr>
<tr><td>10</td><td>Operating ambient Temp range</td><td>-10 to + 60 degree Celsius</td></tr>
</table></td><td>1</td></tr>
</table>

5	Simulation study on Wind Energy Generator. 1. **Case study** Simulation for Wind Turbine Generators—With FAST and MATLAB-Simulink Modules	1
6	Performance assessment of micro Wind Energy Generator. 1. Design of 12V Dual Power Generation Solar Plus Windmill Generator using Atmega328 microcontroller, LM320 ac voltage regulator with the battery supply of 12V, 1.2A and continuous current 7.5A servomotor	1
7	Simulation study on Hybrid (Solar-Wind) Power System.	1
8	Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.	1

Compiled By: Mr.S.Selvakumar,AP/EEE Verified By

PROFESSIONAL ELECTIVE – I

21EE5701	DESIGN OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Preamble:

This course is to impart in students a good understanding of fundamental design principles in electrical machines. This course imparts knowledge about the design of magnetic circuits, main dimensions, armature circuit and field circuit of electrical machines.

Prerequisites for the course

1. DC Machines and Transformers
2. AC Machines

Objectives

1. To Introduce Engineering Materials and thermal rating of various types of electrical machines.
2. To impart knowledge on armature and field systems for D.C. machines and its Computer Program.
3. To educate the Armature and field systems for D.C. machines and its Computer Program.
4. To learn the design of stator and rotor of induction machines and the importance of computer aided design method.
5. To understand the design of stator and rotor of synchronous machines and the importance of computer aided design method.

UNIT I	INTRODUCTION	9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – choice of specific electrical and magnetic loadings-Design of Magnetic circuits-thermal considerations-heat flow-temperature rise-rating of machines.

UNIT II	DESIGN OF TRANSFORMERS	9

KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer Aided design of single phase core transformer.

UNIT III	DESIGN OF DC MACHINES	9
Output Equations – Main Dimensions – Choice of specific loadings – Carter's Coefficient – Net length of Iron – Real & Apparent flux densities-Selection of number of poles – Design of Armature – Design of commutator and brushes –Design of lap winding and wave winding- Computer Aided design of Armature main dimensions.		
UNIT IV	**DESIGN OF INDUCTION MOTORS**	**9**
Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current –Computer Aided design of slip- ring rotor.		
UNIT V	**DESIGN OF SYNCHRONOUS MACHINES**	**9**
Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer Aided design of Stator main dimensions.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
1. Descriptive Questions	1.Assignment 2. Online Quizzes	**1. Descriptive Questions**

Outcomes

Upon completion of the course, the students will be able to:

1. Understand basics of design considerations for rotating and static electrical machines
2. Determine overall Dimensions of single and three phase transformers core, windings and cooling systems for transformers.
3. Design armature and field of DC machines.
4. Interpret main dimensions of squirrel cage and Slip ring induction machines.
5. Illustrate enhanced dimensions of synchronous machines.

Text Books

1. Sawhney A.K. and Chakrabarti A, "A Course in Electrical Machine Design", Dhanpat Rai & Sons, 2016.
3. M V Deshpande "Design and Testing of Electrical Machines" PHI learning Pvt Lt, 2021.

Reference Books

1. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International Pvt. Ltd., 2015.
2. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 2016.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2018

Web Resources

1. https://nptel.ac.in/courses/108106023/
2. https://www.udemy.com/course/learn-design-of-electrical-apparatus-in-tamil-language/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											3	
2	3	3	2										3	
3	3	3	3										3	
4	3	3	2										3	
5	3	3	2										3	

1-Low 2-Medium 3-High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	5	20
UNDERSTAND	30	30	10	10	30
APPLY	20	20	5	10	20
ANALYZE	30	30	0	0	30
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. A 350 KW, 500V, 450rpm, 6-pole, dc generator is built with an armature diameter of 0.87m and core length of 0.32m. The lap wound armature has660 conductors. Calculate the specific electric and magnetic loadings. (Apply)
2. Obtain the Temperature rise Equation. (Apply)

COURSE OUTCOME 2:

1. Distinguish between shell type and core type transformer (Understand)
2. Calculate the main dimensions and winding details of a 100 kVA 2000/400 V 50 Hz single phase shell type, oil immersed, self-cooled transformer. Assume voltage per turn 10 V, flux density in core 1.1 wb/m2 , current density 2 A/mm2 , window space factor 0.33. The ratio of window height to window width and ratio of core depth to width of central limb = 2.5, the stacking factor is 0.9. (Apply)

COURSE OUTCOME 3:

1. Write down the expression for output equation of a DC Machine. (Understand)
2. Determine the number of poles, main dimensions, pole pitch and armature mmf/pole of a 92kW, 220Volt; 1480 rpm D.C motor whose full load efficiency is 89.76%.Specific magnetic loading is 0.545 tesla and specific electric loading is 32,750 AC/m. The pole arc to pole pitch ratio is 0.6%.Assume square pole face. (Apply)

COURSE OUTCOME 4:

1. 15KW, 400V, 3 phase, 50Hz, 6 pole induction motor has a diameter of 0.3m and the length of core 0.12m. The number of stator slots is 72 with 20 conductors per slot. The stator is delta connected. Estimate the value of magnetizing current per phase if the length of air gap is 0.55m. The gap contraction factor is 1.2. Assume the mmf required for the iron parts to be 35 percent of the air gap mmf. Coil span = 11 slots. (Apply)
2. Estimate the stator core dimensions and the total number of stator conductor for a 3ϕ, 100kW, 3300V, 50Hz, 12 pole star connected slip ring induction motor. Assume: average gap density=0.4Wb/m2, conductors per metre = 25000 A/m, efficiency = 0.9, power factor = 0.9, winding factor = 0.96. choose the main dimension to give best power factor. (Apply)

COURSE OUTCOME 5:

1. Give Short notes on the effects of large airgap length on the performance of synchronous machine? (Apply)
2. Find main dimension of 100 MVA, 11 KV, 50 Hz, 150 rpm, three phase water wheel generator. The average gap density = 0.65 wb/m2 and ampere conductors / m are 40000. The peripheral speed should not exceed 65 m/s at normal running speed in order to limit runaway peripheral speed. (Apply)

		L	T	P	C
21EE5702	**MODERN CONTROL THEORY**	**3**	**0**	**0**	**3**

Preamble

The study and design of automatic **Control Systems,** has become important in modern technical society. From devices as simple as a toaster or a toilet, to complex machines like space shuttles and power steering, control engineering is a part of our everyday life.

Prerequisites for the course

1. Control Systems
2. Digital Signal Processing

Objectives

1. To understand the fundamentals of physical systems in terms of its linear and nonlinear models.
2. To educate on representing systems in state variable form
3. To educate on solving linear and non-linear state equations
4. To exploit the properties of linear systems such as controllability and observability
5. To educate on stability analysis of systems using Lyapunovs theory

UNIT I	NONLINEAR CONTROL SYSTEM	9
Introduction to Nonlinear systems and their properties, Common Non-linearities, Describing functions, Phase plane method, Lyapounov's method for stability study, concept of Limit Cycle.		
UNIT II	**OPTIMAL CONTROL THEORY**	**9**
Introduction, Optimal control problems, Mathematical procedures for optimal control design: Calculus of variations, Pontryagin's optimum policy, Bang-Bang Control, Hamilton-Jacobi Principle.		
UNIT III	**Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEMS**	**9**
Introduction, Impulse sampling and data hold, Reconstructing original signal from sampled signals, concept of pulse transfer function, Realization of digital controllers.		
UNIT IV	**DESIGN OF DISCRETE-TIME CONTROL SYSTEMS**	**9**
Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the rootlocus method, Design based on the frequency-response method.		
UNIT V	**STATE-SPACE ANALYSIS**	**9**
Introduction, State-space representations of discrete-time systems, Solving discrete-time state-space equations, Pulse transfer function matrix, Discretization of continuous time state space equations, Lyapunov stability analysis, Controllability and Observability, Design via pole placement, State observer design.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Demonstrate non-linear system behavior by phase plane and describing function methods.
2	Perform the stability analysis nonlinear systems by lyapunov method develop design skills in optimal control problems.
3	Apply mathematical models in both time domain (difference equations, state equations) and z-domain (transfer function using z-transform).
4	Analyze transient and steady-state responses and stability and sensitivity of both open-loop and closed-loop linear, time-invariant, discrete-time control systems.
5	Analyze state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.

Reference Books / Text Book?

1. Slotine & Li, Applied Non-Linear Control, Englewood Cliffs, NJ: Prentice-Hall, (1991).
2. Bandyopadhyay, M.N., Control Engineering: Theory and Practice, Prentice-Hall of India Private Limited (2003).
3. Ogata, K., Discrete-time Control Systems, Pearson Education (2005).

Web Recourses

1. https://nptel.ac.in/courses/108/101/108101037/
2. https://freevideolectures.com/course/2337/control-engineering/5

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3			2									2
2	3	3			2									2
3	3	3	2		2									2
4	3	3	3	3	2									2
5	3	3	3	3	2									2

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to predict the suitable method

for

1. Briefly discuss the following:
(i) State modeling of linear systems.
(ii) Linearization of state equation (Understand).

2. Obtain the state space model for a system characterized by the following

differential equation ... y + 6y¨ + 5y˙ + y = u(t). (Apply)

COURSE OUTCOME 2:

1. Given the time invariant system x˙1 x˙2 = 0 α 0 −1 x1 x2 + 0 1 u ; y = [1 0] x1 x2 and that u(t) = e −1 and y(t) = 2 − αte−1 , find x1(t) and x2(t). Find also x1(0) and x2(0). What happen if α = 0 ?
2. Explain the concepts of Controllability and Observability. Mention the conditions for complete state controllability, complete output controllability and complete state observability of continuous time systems. Using these, explain the principle of duality between controllability and observability. (Understand)

COURSE OUTCOME 3:

1. Discuss the basic features of the following non linearities: non linear friction, On-Off controllers, Back lash.(Analyse)
2. With neat sketches, explain (i) ON-OFF relay with dead-zone (ii) saturation (iii) multi variable non-linearity. (Understand)

COURSE OUTCOME 4:

1. What is a phase plane plot? Describe (i) delta method (ii) isocline method (iii) analytical method of drawing phase plane trajectories. (Understand)

2. Explain the properties of non-linear systems. Explain the stability analysis of nonlinear systems by phase plane method. (Remember)

COURSE OUTCOME 5:

1. Explain with a example: Krasovskii's theorem. Briefly explain the Krasovskii method of construction Liapunov functions for nonlinear systems. (Remember)

2. Explain terms: (i) Positive (ii) Negative and (iii) Semi definiteness

Determine the sign definiteness of the quadratic form (Understand).

21EE5703	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Engineering Physics
- Engineering Mathematics

Objectives

- To impart knowledge about the Signals and systems & their mathematical representation.
- To learn about Discrete time systems.
- To understand the transformation techniques & their computation.
- To know about Filters and their design for digital implementation.
- To implement the Programmability of digital signal processor.

Syllabus

UNITI	SIGNALS AND SYSTEMS	9
Review of Discrete -Time Signals and Systems – Classification, Convolution- z- transform: ROC stability/causality analysis, DTFT: Frequency response-System analysis.		
UNIT II	**DISCRETE FOURIER TRANSFORM**	**9**
DFT-Properties. Frequency analysis of signals using DFT-FFT Algorithm-Radix-2 FFT algorithms-Applications of FFT		
UNITIII	**DESIGN OF ANALOG AND DIGITAL FILTERS**	**9**
Design techniques for analog low pass filter -Butterworth and Chebyshev approximations, IIR filter design: Bilinear and Impulse Invariant Techniques		
UNIT IV	**REALIZATION OF DIGITAL FILTERS**	**9**
Design of FIR filters using window functions (Rectangular, Hamming, Hann, Blackmann, and Kaiser) ,Direct, Cascade, Parallel, State space representations, Basic FIR and IIR digital filter structures		
UNIT V	**DIGITAL SIGNAL PROCESSORS**	**9**
Introduction - Architecture - Features - Addressing Formats - Functional modes - Dedicated MAC unit - Multiple ALUs, Pipelining - Introduction to Commercial DS Processors		
	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
(i)Google Form based-on- line Test (ii) Written Test	(i) Google Form based – online Test incorporating Listening, Speaking and Reading	(i) Written Test

Outcomes

Upon completion of the course, the students will be able to:

1. Comprehend, classify and analyze the signals and systems, also, transform the time domain signals to frequency domain for analyzing system response .
2. Analyze the discrete time systems using Z-transform and InverseZ-transform
3. Implement the discrete time systems in Discrete Fourier Transform using Fast Fourier Transform algorithm
4. Design digital filters using delay elements, summer, etc.
5. Apply the architectural overview and addressing modes in DSP processors

Text Books

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI,2007
2. S.K. Mitra, 'Digital Signal Processing - A Computer Based Approach', McGraw Hill Edu, 2013
3. Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press,2015

Reference Books

1. Richard G.Lyons, Understanding Digital Signal processing, Prentice Hall, 3rd Edition, 2012.
2. S.Salivahanan, A.Vallavaraj, Gnanapriya, Digital Signal Processing, McGraw-Hill, 2nd Edition, 2011.

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			1			3				2	1	3	
2	3	2	3	1			3				2	1	3	
3	3	3	3	2			2				1	1	3	
4	3	3	3	3			2				3	2	3	
5	3	3	3	2			1				3	1	3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

1. Classify the types of signals. (Understand)
2. Distinguish between Linear and Nonlinear systems. (Remember)

COURSE OUTCOME 2 (CO 2) :

1. Calculate DFT for the sequence x(n)= {1,1, 0,0}. (Apply)
2. Differentiate DIT radix-2 FFT and DIF radix-2 FFT (Remember)

COURSE OUTCOME 3 (CO 3) :

1. Define the term bilinear transformation? List the advantages of it. (Remember)
2. Obtain the transfer function for a normalized butterworth filter of order 2 (Analyse)

COURSE OUTCOME 4 (CO 4) :

1. Formulate the equation specifying Hamming window (Remember)
2. Distinguish between IIR and FIR filter. (Remember)

COURSE OUTCOME 5 (CO 5) :

1. Mention the role of the MAC unit in DSP? (Remember)
2. List some example of commercial digital signal processor (Remember)

21EE5704	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Preamble

It is an introductory course which emphasizes the fundamental concepts and overview of Electrical Engineering. A Virtual Instrumentation system consists of an industry-standard computer or workstation equipped with powerful application software, cost-effective hardware such as plug- in boards, and driver software, which together perform the functions of traditional instruments The concepts discussed herein are intended to provide clarification on basic industry-standard for Electrical Engineering graduates.

Prerequisites for the course

1. Embedded Systems
2. Microcontroller and its application

Objectives

1. To provide knowledge on design of process control by using virtual instrumentation Techniques
2. To provide knowledge in process analysis by VI tools.
3. To give basic knowledge in describing function analysis.
4. To Get adequate knowledge VI tool sets
5. To analyze and document in the laboratory prototype measurement systems using DAQ interfaces

UNIT I	VIRTUAL INSTRUMENTATION	9

Historical perspective, advantages, blocks diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

UNIT II	**VI PROGRAMMING TECHNIQUES**	**9**
VIS and sub-VIS, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O. Use of spread sheet for data logging.		
UNIT III	**DATA ACQUISITION BASICS**	**9**
Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. ADC, DAC, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.		
UNIT IV	**HARDWARE INTERFACING & STATE MACHINES**	**9**
VI Chassis requirements Common Instrument Interfaces: Current loop, RS 232, GPIB, PCI card communication, NI DAQ MAX. Enumerated Types and Type Definitions, Sequence-Style State Machine, Test Executive-Style State Machine, Classical-Style State Machine, Queued-Style State Machine, Drawbacks to Using State Machines.		
UNIT V	**CASE STUDY**	**9**
Use of RS232 for Data Acquisition and logging system Use of Ethernet for Data Acquisition and logging system Use of Database for data logging and retrieval Use of report generation of logged data.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST **DESCRIPTION** **QUESTIONS**	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Apply the concepts of virtual instrumentation in real world examples.
2	Compare basic knowledge of graphical programming languages
3	Implement Data acquisition techniques and its interface instruments
4	Demonstrate the preparation of RS 232, GPIB, PCI card communication, NI DAQ MAX
5	Demonstrate the real time data acquisition using DAQ device

Text Books

1. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, 'LabVIEW: Advanced Programming Techniques', Second Edition, CRC Press, 2019.
2. National Instruments Malan Shiralkar, 'LabVIEW Graphical Programming Course', National Instruments, 2018.
3. 'Virtual Instrumentation using LabVIEW' by Sanjeev Gupta.
4. Jovitha, Jerome, "Virtual Instrumentation and LABVIEW", PHI Learning, New Delhi, 1st Edition, 2018.

Reference Books

1. Ronald W. Larsen,'LabVIEW for Engineers', Prentice Hall, 2019.
2. LabVIEW Basic 1 & Basic 2 course guide' by National Instruments.

Web Recourses

1. https://www.youtube.com/watch?v=YW0IRNiREi4
2. https://www.youtube.com/watch?v=cSbTp-XjzeY
3. https://www.youtube.com/watch?v=Rzr4EJcaxSo

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3											3	
2	3	3	1										3	
3	3	3											3	
4	3	3	1										3	
5	3	3											3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	30	30	5	5	30
APPLY	60	60	10	10	60
ANALYZE	0	0	10	10	0
EVALUATE	0	0			0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain the essential need for Virtual Instrumentation and compare it with the traditional instruments (Understand)
2. Explain the architecture of virtual instrumentation with neat diagram (Understand)
3. Describe the methods of analyzing the PC Based data acquisition (Apply)

COURSE OUTCOME 2:

1. Write a note on Cardiopulmonary measurement system (Remember)
2. Explain how VI can be used in test, Control and Design process. (Understand)
3. Compare the difference between local variables and global variables (Apply)

COURSE OUTCOME 3:

1. Compare Graphical programming with traditional programming (Apply)
2. Name the different operations of cluster (Remember)
3. What is string? Explain various string functions and formatting functions. (Understand)

COURSE OUTCOME 4:

1. Compare RS232, R488 (Apply)
2. Explain in detail about GPIB or IEEE488 with block diagram, various signals (understand)
3. Summarize the different techniques used to bus protocols of MOD bus and CAN bus (Analyze)

COURSE OUTCOME 5:

1. What are the major components of Windowing and filtering tools (Remember)
2. What is P&I Diagram? Mention the abbreviation meaning for letters used in P&ID tag name (Analyze)
3. Explain how DAQ Assistant is used to acquire and generate signals with procedure for creating, configuring, Test and generate Lab VIEW code using DAQ Assistant. (Apply)

		L	T	P	C
21EE5705	**ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS**	**3**	**0**	**0**	**3**

Preamble

An expert system is a computer program that uses artificial intelligence (AI) technologies to simulate the judgment and behavior of a human or an organization that has expertise and experience in a particular field. Expert systems are usually intended to complement, not replace,

human experts.

Prerequisites for the course

NIL

Objectives

1. To know about basic concepts of intelligent agents and search methods
2. To study about representing knowledge
3. To study the reasoning and decision making in uncertain world
4. To construct plans and methods for generating knowledge
5. To know about various Expert System tools and applications.

UNIT I	**INTRODUCTION**	**9**

Introduction to AI: Intelligent agents – Perception –natural language processing – Problem – Solving agents – Searching for solutions: Uninformed search strategies – Informed search

strategies.

UNIT II	**KNOWLEDGE AND REASONING**	**9**

Adversarial search – Optimal and imperfect decisions – Alpha, Beta pruning – Logical agents: Propositional logic – First order logic – Syntax and semantics – Using first order logic – Inference in first order logic.

UNIT III	**UNCERTAIN KNOWLEDGE AND REASONING**	**9**
Uncertainty – Acting under uncertainty – Basic probability notation – Axioms of probability – Baye's rule – Probabilistic reasoning – Making simple decisions.		
UNIT IV	**PLANNING AND LEARNING**	**9**
Planning: Planning problem – Partial order planning – Planning and acting in non-deterministic domains – Learning: Learning decision trees – Knowledge in learning – Neural networks – Reinforcement learning – Passive and active.		
UNIT V	**EXPERT SYSTEM**	**9**
Definition – Features of an expert system – Organization – Characteristics – Prospector – Knowledge Representation in expert systems – Expert system tools – MYCIN – EMYCIN.		
	Total Periods	**4 5**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Apply the Artificial Intelligence concepts for solving problems
2	Represent knowledge for problem solving and game playing using various logics
3	Apply knowledge inferences over production based and frame based system
4	Investigate the modes to represent and handle uncertainty and vagueness.
5	Develop Expert Systems with case studies for various applications.

Text Books

1. Stuart Russel and Peter Norvig, 'Artificial Intelligence A Modern Approach', Second Edition, Pearson Education, 2021 / PHI.
2. Donald A.Waterman, 'A Guide to Expert Systems', Pearson Education,2017.

Reference Books

1. George F.Luger, 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving', sixth Edition, Pearson Education, 2015.
2. Elain Rich and Kevin Knight, 'Artificial Intelligence', Tata McGraw Hill,2018.
3. Janakiraman, K.Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.
4. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2016

Web Recourses

1. https://nptel.ac.in/courses/106105077
2. https://nptel.ac.in/courses/106102220

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2					2	2			2			2
2	3	3					3	2			3			2
3	3	3					3	2			3			2
4	3	2	3				3	2			3			2
5	3	3	3				3	2			3			2

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	0	0	0	0	0
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	10	10	5	5	10
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. Explain briefly the various problem characteristics? (Analyze)
2. Discuss the memory bounded heuristic search. (Apply)

COURSE OUTCOME 2:

1. Explain the Minimax algorithm in detail. (Apply)
2. State Representation of facts in propositional logic with an example. (Analyze)

COURSE OUTCOME 3:

1. Discuss about Bayesian Theory a Bayesian Network. (Apply)
2. Construct a Bayesian Network and define the necessary CPTs for the given scenario. We have a bag of three biased coins a,b and c with probabilities of coming up heads of 20%, 60% and 80% respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins) and then the coinis flipped three times to generate the outcomes X1, X2 and X3. (Analyze)

COURSE OUTCOME 4:

1. Explain about Adaptive learning with example? (Analyze)
2. Write short notes on the Learning by Parameter Adjustment ((Analyze)

COURSE OUTCOME 5:

1. With neat sketch explain the architecture, characteristic features and roles of expert system. (Understand)
2. Write notes on Meta Knowledge and Heuristics in Knowledge Acquisition (Apply)

21EE5706	INTERNET OF THINGS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

Preamble

The course provides knowledge and skill on Internet of Things (IoT). It includes the overview and building of IoT network.

Prerequisites for the course

1. Microprocessors, Microcontrollers and its applications.
2. Communication Engineering
3. Principles of Sensors and Transducers

Objectives

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I	FUNDAMENTALS OF IoT	9

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack - Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II	**IoT PROTOCOLS**	**9**
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT		
UNIT III	**DESIGN AND DEVELOPMENT**	**9**
Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.		
UNIT IV	**DATA ANALYTICS AND SUPPORTING SERVICES**	**9**
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Lively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG		
UNIT V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**
Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plant wide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control		
	Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes
Upon completion of the course, the students will be able to:

1	Explain the concept of IoT.
2	Explore various protocols for IoT.
3	Design a PoC of an IoT system using Raspberry Pi/Arduino.
4	Apply data analytics and use cloud offerings related to IoT.
5	Analyse applications of IoT in real time scenario.

Text Books

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.

Reference Books

1. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2).

2. Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Elsevier, 2014(for Unit 1 & 3).

3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things, Springer, 2011(for Unit 4).

4. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011(for Unit 5).

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://nptel.ac.in/courses/108108098

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	2	3		1									2
2	2	2	3											2
3	3	2	3	2	3									2
4	3		3	2	2									2
5	3	2	3	3	1									2

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER					
UNDETSTAND	30	30	5	5	30
APPLY	30	30	10	10	30
ANALYZE	40	40	10	10	40
EVALUATE					
CREATE					
	100	100	25	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: The students will be able to explain the concept of IoT. (Understand)

1. Explain the physical and logical design of IoT in detail.
2. Summarize the various IoT enabled technologies.

COURSE OUTCOME 2: The students will be able to explore various protocols for IoT. (Understand)

1. Describe a use case example of M2M and IoT approach.
2. Explain various trends in Information and Communication Technologies.

COURSE OUTCOME 3: The students will be able to design a PoC of an IoT system using Raspberry Pi/Arduino. (Apply)

1. Design a neat sketch, discuss the M2M high-level ETSI architecture.
2. Explain how Information is shared between the devices through IoT.

COURSE OUTCOME 4: The students will be able to apply data analytics and use cloud offerings related to IoT. (Apply & Analyse)

1. List out the various phases of CRISP-DM model and explain each with a diagram.
2. Explain in detail about the Devices and Gateways

COURSE OUTCOME 5: The students will be able to analyse applications of IoT in real time scenario. (Apply & Analyse)

1. Construct the Design of Smart home with Raspberry Pi and other hardware devices with a neat sketch.
2. Formulate the significant use of Raspberry Pi in Smart cities and Industrial appliances.

Professional Elective II

21EE5707	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

Preamble

The aim of the subject is to develop a Power system transient assessments of power systems provide detailed technical information appropriate for power system equipment design and specifications pertaining to a wide variety of phenomena related to power system voltage levels. This subject explores the topic of transient problems on electric utility and industrial power systems. The purpose is to teach students the fundamentals and to enable them to recognize and solve transient problems in power networks and components. The EMTP is a powerful tool used worldwide for the computer simulation of transients in power systems. This subject stresses the physical aspects of the electromagnetic transient phenomena and also broadens the computational treatment of transients.

Prerequisites for the course

1. Electric Circuit and Network Analysis
2. Transmission and Distribution in Power Systems

Objectives

1. To provide knowledge on basic concept of different types of transient in power systems.
2. To provide knowledge in different types of switching transients in power system
3. To analyze the mathematical model of lightning and protection of power system from lighting.
4. To Get adequate knowledge Travelling wave concept
5. Interpret the impacts of transients and EMTP for Transient computations

UNIT I	INTRODUCTION AND SURVEY	9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II	SWITCHING TRANSIENTS	9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping -Capacitance switching -Capacitance switching with a restrike, Illustration for multiple restriking transients - Ferro resonance.

UNIT III	LIGHTNING TRANSIENTS	9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes– model for lightning stroke - factors contributing to good line design –
using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV	TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS	9
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response -Bewely"s lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.		
UNIT V	**TRANSIENTS IN INTEGRATED POWER SYSTEM**	**9**
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines–switching surges on integrated system Qualitative application of EMTP for transient computation.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST DESCRIPTION QUESTIONS	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Ability to understand and analyze switching and lightning transients.
2	Ability to acquire knowledge on generation of switching transients and their control.
3	Ability to analyse the mechanism of lighting strokes
4	Ability to understand the importance of propagation, reflection and refraction of travelling waves.
5	Ability to understand the concept of circuit breaker action, load rejection on integrated power system.

Text Books

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science NewYork, 2ndEdition, 1991.
2. PritindraChowdhari, 'Electromagnetic transients in Power System', John Wiley andSons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

Reference Books

1. M.S. Naidu and V. Kamaraju, „High Voltage Engineering", McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, „Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 1986.
3. Y. Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L. Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use", Wiley, 2012.
5. Akihiro Ametani," Power System Transient theory and applications", CRC press, 2013.

Web Recourses

1. https://www.youtube.com/watch?v=vit8S1YmQiA
2. https://www.youtube.com/watch?v=1IECmlljjp8
3. https://easyengineering.net/ee6002-power-system-transients/
4. https://www.youtube.com/watch?v=UsrR5WtKYL4

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2					2						3	
2	3	3	2	2	2								3	
3	3	3		3	3								3	
4	3	3	2	3	3		2						3	
5	3	3					2						3	

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	**10**	**10**			**10**
UNDETSTAND	**30**	**30**	**5**	**5**	**30**

APPLY	**50**	**40**	**10**	**10**	**40**
ANALYZE	**10**	**20**	**10**	**10**	**20**
EVALUATE	**0**	**0**			**0**
CREATE	**0**	**0**			**0**
	100	**100**	**25**	**25**	**100**

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Derive the expression for RL circuit transient with sine wave excitation (Apply)
2. Enumerate the review and importance of the study of transients (Understand)

COURSE OUTCOME 2:

1. A power transformer draws a heavy magnetizing inrush current. Now this current is suddenly interrupted before it reaches natural zero by means of a circuit breaker. What would happen between the contacts of circuit breaker? What do you call this phenomenon? (Analyze)
2. Analyze in detail the resistance switching with suitable diagram(Analyze)

COURSE OUTCOME 3:

1. If you want to protect the transmission line from the direct and indirect lightning discharge what are steps you will take to protect the transmission line. (Analyze)
2. Analyze and compare the different lightning theories. (Understand)

COURSE OUTCOME 4:

1. Analyze the Transient response of systems with series and shunt lumped parameters in a mathematical way approach. (Analyze)

2. A long transmission line is energized by a unit step voltage 1.0 V at the sending end and is open circuited at the receiving end. Construct the Bewley's lattice diagram and obtain the value of the voltage at the receiving end after a long time. Take the attenuation factor $\alpha = 0.9$ (Apply)

COURSE OUTCOME 5:

1. Explain about line dropping and load rejection in integrated power system (Understand)

2. Discuss in details about the Kilometric Fault with necessary diagrams, expression and recovery voltage wave forms. (Understand)

		L	T	P	C
21EE5708	**PROTECTION AND SWITCHGEAR**	**3**	**0**	**0**	**3**

Preamble

In order to supply power from generating end to receiving end several equipments are connected in to the system. In order to protect the equipments and components against various operating conditions and over voltages protective devices are required to be installed in the system. Topics specified in this subject deal with various types of protective equipments and their working principle including limitations etc.

Prerequisites for the course

- DC machines and Transformers
- AC Machines
- Measurements and Instrumentation
- Power Systems
- Embedded Systems

Objectives

- To impart knowledge on the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- To introduce the characteristics and functions of relays and protection schemes
- To impart knowledge on apparatus protection
- To introduce static and numerical relays
- To impart knowledge on functioning of circuit breakers

UNIT I	**FUNDAMENTALS OF POWER SYSTEM PROTECTION**	**9**

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes

UNIT II	**ELECTROMAGNETIC RELAYS**	**9**

Operating principles of relays - the Universal relay – Torque equation. Electromagnetic Relays – Overcurrent, Directional, Non-Directional, Distance, Differential, Negative sequence relays.

UNIT III	CIRCUIT BREAKERS	9
Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - RRRV- resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, MOCB, SF6 and vacuum circuit breakers – comparison of different circuit breakers.		
UNIT IV	**STATIC RELAYS**	**9**
Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Overcurrent protection, transformer differential protection.		
UNIT V	**APPARATUS PROTECTION**	**9**
Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Understand different protection in power system , faults , grounding method and able to compute fault calculations
2	Understand different types of electromagnetic relays and able to use them in appropriate applications
3	Apply instruments like CTs and PTs in Protection schemes and use them for safety
4	Understand the working of different kinds of static and numerical relays and analyze their behavior in different conditions.
5	Understand the working of different kinds of Circuit breakers and analyze their behavior in different conditions and select them based on the need.

Text Books

1. Sunil S.Rao, ‘Switchgear and Protection’, Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, ‘Power System Protection and Switchgear’, New Age International (P) Ltd., First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, ‘A Text Book on Power System Engineering’, Dhanpat Rai & Co.,1998.

Reference Books

1. Badri Ram, B.H. Vishwakarma, ‘Power System Protection and Switchgear’, New Age International Pvt Ltd Publishers, Second Edition 2011.

2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

Web Resources

1.https://nptel.ac.in/courses/108/101/108101039/

2. https://2ee406gbb.wordpress.com/nptel-lectures/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3												
2	3	3												
3	3				3									
4		3			3									
5		3			3									

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	15	10	20
UNDERSTAND	30	30	15	15	30
APPLY	20	20	10	15	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	0	0	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Summarize the importance of protective schemes employed in power system.(Understand)
2. Explain clearly about the Zones of protection in power system.(Understand)

COURSE OUTCOME 2:

1. Explain impedance relay.(Understand)
2. Develop the different inverse time characteristics of over current relays and mention how the characteristics can be achieved in practice for an EM relay?(Understand)
3. Describe the operating principle, constructional features and area of applications of directional relay.(Understand)

COURSE OUTCOME 3:

1. Describe the principle constructional features of all types of air blast CB. Give its advantages and disadvantages. (Understand)
2. Explain current chopping with suitable diagrams. (Understand)
3. With a neat block diagram, explain the construction, operating principle and applications of SF6 circuit breaker. What are its advantages over other types of circuit breakers? (Understand)

COURSE OUTCOME 4:

1. Explain with a neat block diagram the operation of static relay and list the advantages and disadvantages. (Understand)
2. Describe the Over current protection and explain its types briefly. (Understand)

COURSE OUTCOME 5:

1. A 11 kV, 100 MVA alternator is provided with differential protection. The percentage of winding to be protected against phase to ground fault is 85%. The relay is set to operate when there is 20% out of balance current. Determine the value of resistance to be placed in the neutral to ground connection. (Apply)
2. Describe the types of protective schemes employed for the protection of Bus bar. (Understand)

<table>
<tr><td rowspan="2">21EE5709</td><td rowspan="2">COMMUNICATION ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">Preamble</td></tr>
<tr><td colspan="6">To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues</td></tr>
<tr><td colspan="6">Prerequisites for the course</td></tr>
<tr><td colspan="6">1. Electron Devices and Circuits</td></tr>
<tr><td colspan="6">Objectives</td></tr>
<tr><td colspan="6">1. To Study about Amplitude Modulation and Angle Modulation system.
2. To study the various Pulse modulation techniques
3. To Study modulation schemes relating to Digital Communication systems
4. To Analyse Information about information theory and coding
5. To Gain knowledge on Spread spectrum and multiple access.</td></tr>
<tr><td>UNIT I</td><td>ANALOG MODULATION</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Super heterodyne receivers</td></tr>
<tr><td>UNIT II</td><td>PULSE MODULATION</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel coder - Time Division Multiplexing, Frequency Division Multiplexing</td></tr>
<tr><td>UNIT III</td><td>DIGITAL MODULATION AND TRANSMISSION</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers</td></tr>
<tr><td>UNIT IV</td><td>INFORMATION THEORY AND CODING</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding</td></tr>
<tr><td>UNIT V</td><td>SPREAD SPECTRUM AND MULTIPLE ACCESS</td><td colspan="4">9</td></tr>
<tr><td colspan="6">PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA</td></tr>
<tr><td colspan="2">Total Periods</td><td colspan="4">45</td></tr>
</table>

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
1 WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING	1. WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Apply information on the various types of communication systems and the possibilities of Amplitude Modulation and Angle Modulation system
2	Illustrate the layout of Pulse modulators and demodulators
3	Apply modulation schemes relating to Digital Communication systems and assessing its performance through bit error rate
4	Analyze Information about information theory and coding
5	Analyze Source and Error control coding.

Text Book

1. H Taub, D L Schilling, G Saha, ‘Principles of Communication Systems’, 3rd Edison, Tata McGraw Hill, 2007
2. S. Haykin, ‘Digital Communications’, John Wiley, 2005.

Reference Books

1. B.P.Lathi, ‘Modern Digital and Analog Communication Systems’, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – ‘Analog and Digital Communications’, Tata McGraw Hill, 2006
3. B.Sklar, ‘Digital Communications Fundamentals and Applications’, 2nd Edison, Pearson Education 2007.

Web Recourses

1. https://swayam.gov.in/nd1_noc20_ee17/preview
2. https://nptel.ac.in/courses/117101051/
3. https://www.youtube.com/watch?v=ZKro5e2Q1dU

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	2	1			1								2	
CO 2	2	1			1								2	
CO 3	2	1			1								3	
CO 4	2	1			1								3	
CO 5	2	1			1								3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1):

1. Design a envelope detector for the input $E(t)= E(1+ m \sin\omega t) \sin\omega t$ and time constant $1/fc<1/Rc<1/fm$.

2. Solve the expression for Am wave and its power relation and give the time and frequency domain representation of AM wave.

3. Derive an expression for the amplitude modulated wave and its power relations. Also give its time and frequency domain representation

COURSE OUTCOME 2 (CO 2):

1. With neat block diagram explain PAM modulation demodulation process and derive an expression for PAM wave and depth of modulation.

2. With a neat block diagram explain the principle of DPCM. How does it differ from DM?

3. For an AM DSBSC modulator with fc=50KHZ and fm(max)=1KHZ .Determine i) Frequency limits for upper side bands ii)Bandwidth iii) upper and lower side band frequencies produced modulating signal is a single frequency 4 KHz tone iv) Draw the output frequency spectrum

COURSE OUTCOME 3 (CO 3) :

1. Draw the block diagram of BPSK transmitter and receiver. Explain the same digital modulation scheme with appropriate constellation diagram.

2. How does ADM differ from DM? Support your answers with block diagram and waveforms?

3. Explain QPSK with a block diagram an spectrum. Also discuss the phasor diagram for sinusoidal.

COURSE OUTCOME 4 (CO 4):

1. Illustrate how interference is avoided by using Code division Multiplexing.

2. The generator polynomial of a (15, 11) Hamming code is given by(X) = 1 + X + X2. Evaluate encoder and syndrome calculator for this code using systematic form.

3. Summarize the functioning of convolution codes with example. (8)

4. Interpret the importance of convolution codes.

COURSE OUTCOME 5 (CO 5):

1. Discuss the concept of TDMA techniques and mention its merits and demerits.
2. Describe CDMA techniques in detail.
3. Explain about TDMA and FDMA system.

21EE5710	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

Preamble

This course builds the basic concepts and the design of advanced CMOS analog Integrated Circuit. The course is intended to teach undergraduate and graduate students. This course focuses on the concepts of MOSFETs and design of amplifiers including non-linear effects. The course will give practical aspect of CMOS analog IC design.

Prerequisites for the course

- Network theory
- Signals and System
- Control Theory

Objectives

- To Analyze analog IC design and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To plot and analyse the characteristics of noise and frequency response of the amplifier
- To apply the concepts of Op-Amp frequency compensation, capacitor switches and PLLs in analog integrated circuits
- To determine the switching operation in the PLLs

UNIT I	INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS	9

Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors- Large and Small signal analysis- Common mode properties.

UNIT II	AMPLIFIERS AND FEEDBACK	9

Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.

UNIT III	FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE	9

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

UNIT IV	**OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION**	**9**

General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multiple system- Frequency compensation- Compensation of two stage op Amps.

UNIT V	**SWITCHED CAPACITOR CIRCUITS AND PLLS**	**9**

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops- Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its applications.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM - SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Realize the concepts of Analog MOS devices and current mirror circuits.
2	Design different configuration of Amplifiers and feedback circuits
3	Analyze the characteristics of frequency response of the amplifier and its noise
4	Analyze the performance of the stability and frequency compensation techniques of Op- Amp Circuits
5	Construct switched capacitor circuits and PLLs

Text Books

1. Behzad Razavi, ―Design of Analog CMOS Integrated Circuits‖, Tata McGraw Hill, 2001, 33rd re-print, 2016.

Reference Books

1. Phillip Allen and Douglas Holmberg ―CMOS Analog Circuit Design|| Second Edition, Oxford University Press, 2004.

2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009

3. Grebene, ―Bipolar and MOS Analog Integrated circuit design||, John Wiley & sons, Inc., 2003

Web Recourses

1.https://nptel.ac.in/courses/108/101/108101039/

2. https://2ee406gbb.wordpress.com/nptel-lectures/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	3	2		2								3	
2	3	3	2		2								3	
3	3	3	2		2								3	
4	3	3	2		2								3	
5	3	3	2		2								3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	0	0	20
UNDERSTAND	30	30	5	5	30
APPLY	20	20	10	10	20
ANALYZE	30	30	10	10	30
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Apply MOS transistors modeling in saturation and cutoff high frequency equivalent circuit. (Apply)
2. Analyze MOS transistor characteristics under enhancement mode and depletion mode. (Analyze)

COURSE OUTCOME 2:

1. Explain about two stage CMOS operational amplifier. (Understand)
2. What do you infer from dominant pole compensation in operational amplifiers? (Apply)

COURSE OUTCOME 3:

1. Explain the correlated double sampling techniques with suitable example. (Understand)
2. Explain what is meant by channel charge injection error and how it is minimized. (Understand)
3. Explain the function of folding and pipelining. (Understand)

COURSE OUTCOME 4:

1. Explain the parameters quantization noise and Nyquist rate with respect to an ideal D/A &A/D converter. (Understand)
2. Explain the design procedure for successive approximation type DAC. (Understand)

COURSE OUTCOME 5:

1. Explain about multi bit oversampling converters. (Understand)
2. Define the term over sampling ratio (OSR) in data converters. Explain how oversampling improves the signal to noise ratio of a data converter. (Understand)

		L	T	P	C
21EE5711	**NEURAL NETWORKS AND FUZZY LOGIC CONTROL**	**3**	**0**	**0**	**3**
Preamble					
The objective of this course is to introduce basic concepts and applications of soft computing tools such as neural networks, fuzzy logic systems, and genetic algorithms. Also it covers soft computing based solutions for real-world Electrical Engineering problems.					
Prerequisites for the course					
1. Control Theory					

Objectives		
1. Explore the Basics of artificial neural network. 2. Develop the Concepts of modelling and control of neural and fuzzy control schemes. 3. Familiarize the Features of hybrid control schemes. 4. Understand the Modelling and control of fuzzy control schemes 5. Enlighten knowledge on the hybrid control schemes.		
UNIT I	**ARTIFICIAL NEURAL NETWORK**	**9**
Review of fundamentals – Biological neuron, artificial neuron, activation function, and singlelayer perceptron – Limitation – Multi layer perceptron – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.		
UNIT II	**NEURAL NETWORKS FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox.		
UNIT III	**FUZZY SET THEORY**	**9**
Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Mamdani and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions.		
UNIT IV	**FUZZY LOGIC FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller– Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox.		
UNIT V	**HYBRID CONTROL SCHEMES**	**9**
Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine– Case study – Familiarization with ANFIS toolbox.		
	Total Periods	**45**
Suggestive Assessment Methods		

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM - SOLVING ACTIVITIES	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Understand the concepts of ANN, different features of fuzzy logic and their modelling, control aspects and different hybrid control schemes.
2	Recognize the basics of artificial neural network.
3	Identify modelling and control of neural network.
4	Aware of modelling and control of fuzzy control schemes.
5	Realize the hybrid control schemes.

Text Books

1. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood Cliffs, N.J., 1992
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 2000.

Reference Books

1. EthemAlpaydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)', MIT Press, Second Edition, 2010.
2. Zhang Huaguang and Liu Derong, "Fuzzy Modeling and Fuzzy Control Series: Control Engineering", 2006

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc21_ge07/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	2	2	1									1	
2	1	2	1	2	1								2	
3	2	1	1	2	1								1	
4	1	2	1	2	1								2	
5	2	2	2	1									1	

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER					
UNDETSTAND	30	30	5	5	30
APPLY	30	30	10	10	30
ANALYZE	40	40	10	10	40
EVALUATE					
CREATE					
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Understand the concepts of ANN, different features of fuzzy logic and their modelling, control aspects and different hybrid control schemes. (Understand)

1. Explain the role of soft computing tools in building intelligent systems.

2. Explain the architecture of perceptron neural network.

3. Contrast between conventional logic and fuzzy logic.

4. Compare the performance of conventional optimization technique and GA in solving real-world optimization problem.

5. Explain where fuzzy logic can be used with a suitable example.

6. Compare the performances of soft computing tools.

COURSE OUTCOME 2: Recognize the basics of artificial neural network. (Understand)

1. Define Fuzzification and defuzzification.
2. Explain the working of fuzzy logic controller with a neat block diagram.
3. List the steps involved in the design of fuzzy logic controller.
4. Compare the two types of fuzzy logic controller.

COURSE OUTCOME 3: Identify modelling and control of neural network. (Apply)

1. How will you control the temperature and pressure in a thermal power plant by the control of throttle action using the concept of fuzzy logic? Assume the triangular membership functions for input and output.

2. Consider the speed control of induction motor problem, apply fuzzy logic to exercise this. Let change in speed and error in change in speed as inputs and output as switching frequency of the inverter.

COURSE OUTCOME 4: Aware of modelling and control of fuzzy control schemes. (Apply).

1. Explain supervised and unsupervised learning.

2. List the different types of activation functions used in ANN.

3. Describe BPN architecture with a neat sketch and explain the steps involved in the training of the network.

4. Develop a suitable perceptron neural network model to perform the following classification problem. The vectors (1,1,1,1) and (-1,1,-1,-1) for belonging to the class (target value 1) vectors (1,1,1,-1) and (1,-1,-1,1) for not belonging to the class (target value -1).

COURSE OUTCOME 5: Realize the hybrid control schemes. (Analyse)

1. Apply the concept of neural network to model and control the speed of an induction motor.

2. Apply the concept of neural network to model and control the speed of a DC Motor.

3. Perform two generations of simple binary coded genetic algorithm to solve the following optimization problem. Maximize $f(x) = x_2$ $0< x> 31$, x is an integer. Use proportionate selection, single point crossover, binary mutation and population size of six.

4. Perform simple binary coded and real coded genetic algorithm to solve the following optimization problem. Maximize $f(x) = |x| \sin(x)$ $-5>x < 5$, x is real number.

21EE5712	BIOMEDICAL ENGINEERING	L	T	P	C
		3	0	0	3
Preamble					
With the advance technology, various biomedical equipment are being used by doctors, hospitals as well as industries. Even people are having the measuring devices to monitor blood pressure, glucose level, SPO_2 level monitoring, Heart beat level etc. With the huge demand of such devices, biomedical industries require more trained and certifies manpower.					

Prerequisites for the course

- Basic Human Anatomy
- Operation and Characteristics of Sensors - Transducers
- Introduction of Robotics

Objectives

- To study about the basic anatomy and operation of human physiology
- To analyze the possibilities of human organ support and replacement by the Bio-Material
- To know importance of engineering in artificial organ implantation process
- To learn about the contribution of Sensors and Transducers in biomedical field
- To understand the contribution of Robots in Medical field

Syllabus

UNIT – 1	ANATOMY AND HUMAN PHYSIOLOGY	9

Structure and functions of cell - Specialized tissues and its functions - **Respiratory**: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration - **Cardiovascular:** Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure - **Nervous:** Mechanisms of Nerve impulse – Brain – Spinal Cord - **Digestive:** Organs of Digestive system – Digestion and Absorption.

UNIT – 2	BIO-MATERIALS	9

Definition and classification of **Bio-materials**, mechanical properties, visco elasticity, biomaterial performance - **Implants:** Metallic implants, Stainless steels, CO-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant, body response to implants, - **Biocompatibility**, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests

UNIT - 3	ARTIFICIAL ORGANS AND IMPLANTS	9

Transplants: Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea – **Implant Design**: Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement - heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

UNIT – 4	SENSORS AND TRANSDUCERS	9

Transducer: Classification, Characteristics and Instrumentation - Capacitive transducer, Inductive transducer, Piezoelectric active transducer - RTD materials – Thermistor- Photo diodes – Phototransistor - Optical displacement sensors and Optical encoders – **Calibration:** - Errors in Measurements – Primary and secondary standards of Calibration

UNIT – 5	ROBOTICS IN MEDICINE	9
Robots: Introduction Automation and Robots, Pick and place robot, Continuous path motion robot, Interpolated motion robot, Straight-line motion robot - Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynecology, Orthopedics, Neurosurgery		

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
Written Test	Google Form based Online Test, Assignment, Slip Test	Written Test

Outcomes

Upon completion of the course, the students will:

CO1: Able to know about the basic anatomy and operation of human physiology

CO2: Able to analyze the significance of engineering materials in medical field.

CO3: Able to know the importance of engineering in the process of human organ implantation

CO4: Able to Diagnose the disease and infection of human using Sensors and Transducers

CO5: Able to understand the contribution of Robots in Medical field

Text Books

1. Guyton & Hall, “Medical Physiology”, 13th Edition, Elsevier Saunders, 2018
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. “Implant biomaterials: A comprehensive review”, World Journal of Clinical Cases, 2019.

Reference Books

1. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, “Clinical Engineering”, CRC Press, 1st edition, 2019.
2. A.K.Sawhney, “Electrical & Electronics Measurement and Instrumentation”,10th edition, DhanpatRai& Co, New Delhi, 19th Revised edition 2014, Reprint 2018
3. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2016

Web Recourses

1. https://zlibrary.to/pdfs/guyton-and-hall-textbook-of-medical-physiology-1
2. https://zlibrary.to/pdfs/biomaterials-science-third-edition-an-introduction-to-materials-in-medicine-pdf
3. https://zlibrary.to/pdfs/the-biomedical-engineering-handbook-third-edition-3-volume-set-biomedical-engineering-fundamentals-the-biomedical-engineering-handbook-fourth-edition
4. https://zlibrary.to/pdfs/industrial-automation-and-robotics-an-introduction

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	3	3	-	-	-	-	-	-	-	2	-
CO 3	3	3	3	2	3	-	-	-	-	-	-	-	-	-
CO 4	3	2	3	-	3	-	-	-	-	-	-	-	3	-
CO 5	3	2	3	-	3	-	3	-	2	-	-	-	3	-

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT-1	CAT-2	FAT -1	FAT-2	
REMEMBER	0	0	5	5	0
UNDERSTAND	20	20	5	5	20
APPLY	30	30	5	5	30
ANALYZE	50	50	10	10	50
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

(1) Give Brief notes on,

(i) Structure and function of cells

(ii) Nerves System

(2) Analyze the critical relation between human respiratory system and Cardiovascular System in medical science

COURSE OUTCOME 2 (CO 2) :

(1) Suggest and analyze the best Bio-Material for the Heart Transplantation.

(2) Discuss about the various testing methodologies for choosing Bio-Material.

COURSE OUTCOME 3 (CO 3) :

(1) Discuss about various human parts implantation and its design.

(2) Analyze the medical methodology which is useful for Kidney failure Patients.

COURSE OUTCOME 4 (CO 4) :

(1) Compare the Capacitive transducer, Inductive transducer, Piezoelectric active transducer which is used in medical industry.

(2)Draw and Explain the single channel telemetry system suitable for ECG.

COURSE OUTCOME 5 (CO 5) :

(1) Explain the different types of pacemakers with neat diagram.

(2) Discuss the roles of Robots in Gynaecology, Orthopaedics, Neurosurgery operations.

(3) How the robots used in Rehabilitation process of patients.

Professional Elective III

21EE6701	**INDUSTRIAL DRIVES AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

The electrical engineering applications in many industries use small and large AC and DC motor in some crucial application system. Further electrical speed control in almost all industrial applications is incomplete without the use of the specific electric drive. This course will empower the students with the necessary skills to identify operate and maintain the AC and DC drives

Prerequisites for the course

1. DC Machines and Transformer
2. AC Machines
3. Power Electronics

Objectives		
1. To identify the relevant electric drive for the required speed torque characteristics. 2. To maintain and functioning of DC Motor Drive 3. To maintain and functioning of Induction Motor Drive 4. To maintain and functioning of synchronous drive 5. To maintain and functioning of BLDC and Switched Reluctance Motor Drive.		
UNIT I	**BASICS OF ELECTRIC DRIVES**	**9**
Electric Drive : Types and choice of electric dives, Parts of electrical drives- Source, Power modulator, Electric Motor and control Unit, Thermal model of motor for heating and cooling - Classes of duty, Selection of Motor Power rating -Control of Electric Drives- Closed loop control of drives		
UNIT II	**DC MOTOR DRIVES**	**9**
DC motor and their performance - Speedcontrol and Braking methods - Single phase and Three phase SCR Drives – Power factor in SCR motor drives – Reversible SCR Drives - Chopper controlled DC Drives – Application of chopper control drive in solar and battery powered vehicles.		
UNIT III	**INDUCTION MOTOR DRIVES**	**9**
Speed Control – Inverter fed induction motor drives- Rotor resistance control and slip power recovery scheme - Static control of rotor resistance using DC chopper - Vector control of induction motor - Speed Estimation methods – Slip calculation – Direct Synthesis from state equations – Direct Vector control without Speed signal		
UNIT IV	**Synchronous Motor Drives**	**9**
Speed control of three phase synchronous motors - Voltage and current source inverter fed synchronous motors- Vector control of Synchronous motor - Sensorless control - Trapezoidal SPM machine – Sinusoidal PM Machine		
UNIT V	**BLDC and Switched Reluctance Motor Drives**	**9**
BLDC motor drives and its applications - Speed control of BLDC motor - Reluctance torque development - Operation and control of switched reluctance motor		
	Total Periods	**45**
Suggestive Assessment Methods		

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Explain the basics and advantages of electric drives
2	Design 1 phase and 3 phase controlled rectifier based dc drive
3	Illustrate the operation of VSI and CSI drive in induction motor drives
4	Explain the operation of Inverter fed synchronous motor
5	Describe the working of SRM and BLDC motor drive system

Text Books

1. G. K. Dubey: Fundamental of Electrical Drives - Narosa Publishing House, Chennai, 2016
2. R.Krishnan - Electric motor drives – Modeling, analysis and control, Pearson Education, New Delhi, 2003

Reference Books

1. Bimal K.Bose – Modern Power Electronics and AC Drives – Pearson Education Asia Publication, 2003
2. Subrahmanyam, Vedam – Electrical Drives Concepts and Applications – Mcgraw- Hill Publishing New Delhi 2016
3. Ned Mohan, Tore Undeland & William Robbins, Power Electronics : converters Applications and Design-John Willey and sons 2003.
4. Pillai.S.K – A first course on Electrical Drives- Wiley Eastern Ltd, NewDelhi, 2016.

Web Recourses

1. https://nptel.ac.in/courses/108108077
2. https://www.digimat.in/nptel/courses/video/108104140/L01.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	1											2	
2	1	2	1										2	
3	1	2	1										2	
4	2	1											2	
5	2	1											2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	40	40	10	10	40
APPLY	30	30	10	10	30
ANALYZE	20	20	5	5	20
EVALUATE					
CREATE					
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTION

COURSE OUTCOME 1: Students will be able to Predict the suitable methodfor….(Apply)

1. Illustrate about the basic elements of Electric Drives?
2. List out the advantages of electric drive over mechanical drive?

COURSE OUTCOME 2:

1. A 220V shunt Motor has an armature resistance of 0.062 Ω and with full field has an emf of 215V at a speed of 960 rpm, the

motor is driving an overhauling load with a torque of 172 Nm. Calculate the minimum speed at which the motor can hold the load by means of regenerative braking.

2. A 500V series motor having armature resistance and field resistance of 0.2 Ω and 0.3 Ω respectively runs at 500 rpm when taking 70A. Assuming unsaturated field, find out its speed when field diverter of 0.684 Ω is used constant load torque.

COURSE OUTCOME 3:

1. The input to a chopper is from a 100V dc source. The chopper is switched at a frequency of 100KHz with a pulse width of 4s. What is the average output voltage of the chopper
2. Discuss the effect of the output voltage, duty ratio and the load current in the determination of the inductor and capacitor value of the filter used in buck converter based DC drives.

COURSE OUTCOME 4:

1. Illustrate about the vector control of IM?
2. Discuss the operation of 3 phase VSI fed IM.

COURSE OUTCOME 5:

1. List the advantages and applications of BLDC motor.
2. Evaluate the effect of closed loop speed control of BLDC motor.

		L	T	P	C
21EE6702	**HIGH VOLTAGE DIRECT CURRENT TRANSMISSION**	**3**	**0**	**0**	**3**

Preamble

High voltage direct current transmission has advantages over ac transmission in special situations. With the advent of thyristor valve converters, HVDC transmission became even more attractive. This course deals with the operation, modelling and control of HVDC link in power system. Also, trends for HVDC applications and practical examples are discussed in this course.

Prerequisites for the course

1. Transmission and Distribution in Power Systems
2. Power Electronics

Objectives

1. To Know about the knowledge on Planning of DC power transmission and comparison with AC power transmission.

2. To discuss about the HVDC converters		
3. To discribe about HVDC system control strategies and stability techniques used for HVDC system.		
4. To learn the concept of Harmonics and design of filters used in HVDC system.		
5. To introduce Power flow and Stability analysis in HVDC system under steady state.		
UNIT I	**INTRODUCTION**	**9**
DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission– Components of HVDC transmission Systems –Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC – Schematic diagram of typical HVDC transmission system		
UNIT II	**ANALYSIS OF HVDC CONVERTERS**	**9**
Line commutated converter -Analysis of Graetz circuit with and without overlap -Pulse number–Choice of converter configuration – Converter bridge characteristics– Analysis of a 12 pulse converters– Analysis of VSC topologies and firing schemes.		
UNIT III	**CONVERTER AND HVDC SYSTEM CONTROL**	**9**
Principles of DC link control–Converter control characteristics–System control hierarchy– Firing angle control– Current and extinction angle control–Starting and stopping of DC link –Power control –Higher level controllers –Control of VSC based HVDC link.		
UNIT IV	**REACTIVE POWER AND HARMONICS CONTROL**	**9**
Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM–Generation of harmonics –Design of AC and DC filters– Active filters.		
UNIT V	**POWER FLOW ANALYSIS AND STABILITY ANALYSIS IN AC/DC SYSTEMS**	**9**
Per unit system for DC quantities–DC system model –Inclusion of constraints –Power flow analysis –case study- Basic Concepts: Power System Angular, Voltage and Frequency Stability.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes	
Upon completion of the course, the students will be able to:	
1	Get knowledge about Planning of DC power transmission and comparison with AC power transmission.
2	Analyze and understand the concepts of HVDC converters.
3	Acquire knowledge on DC link control.
4	Understand the concepts of reactive power management, harmonics and power flow analysis.
5	Understand the importance of power flow and stability analysis in HVDC system under steady state.

Text Books

1. Padiyar,K.R.,"HVDC power transmission system", New Age International(P)Ltd. NewDelhi, Second Edition,2010.
2. Arrillaga,J.,"High Voltage Direct Current Transmission", Peter Pregrinus, London,1983.

Reference Books

1. Kundur P.," Power System Stability and Control", McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG," High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Edward Wilson Kimbark," Direct Current Transmission", Vol.I, Wiley inter science, New York, London, Sydney,1971.

Web Recourses

1. https://nptel.ac.in/courses/108104013
2. https://archive.nptel.ac.in/courses/108/104/108104013/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	1											3	
2	3	2							2				3	
3	3	2							2				3	
4	3	2											3	
5	3	2											3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	40	40	10	10	40
APPLY	30	30	10	10	30
ANALYZE	20	20	5	5	20
EVALUATE					
CREATE					
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method

for….

1. Explain the comparison of AC and DC transmission in detail. (Understand)
2. Analyze the components of HVDC Transmission System. (Analyze)

COURSE OUTCOME 2:

1. Draw the schematic circuit diagram of a 6 pulse gratez's circuit and explain its principle of operation. (Apply)
2. Explain the individual characteristics of a rectifier and an inverter with sketches. (Understand)

COURSE OUTCOME 3:

1. Illustrate the principles of DC Link Control (i) Equivalent and Schematic Diagram (ii) Constant Extinction Angle (iii) Current Margin. (Apply)
2. Draw and evaluate the starting and stopping of DC link voltage waveform De-energization, Energization of rectifier and inverter. (Analyze)

COURSE OUTCOME 4:

1. Explain the characteristics and non-characteristics harmonics inHVDC System.(Analyze)
2. Evaluate the criteria for the design of DC Filter. (Apply)

COURSE OUTCOME 5:

1. Analyze the DC System Model with a suitable example (Analyse)
2. Evaluate the active and reactive power equation of converterterminals. (Apply)

21EE6703	FUEL CELL AND HYDROGEN ENERGY	L	T	P	C
		3	0	0	3

Preamble

This course will provide an overall review on hydrogen as future energy resource. Renewable energy has huge potential in the market and hydrogen energy is considered to be one of the complementary energy carriers for future. In this course we will learn about production of hydrogen using different sources and purification as well as separation of hydrogen.

Prerequisites for the course

1. Engineering Chemistry

Objectives		
1. To understand the cell reaction, electrolyte and electrode materials, compatible fuels, typical operating conditions and common applications of the most important fuel cell technologies.		
2. To Explain the fundamental working principle of polymer electrolyte membrane (PEMFC) and solid oxide (SOFC) fuel cells in terms of their structure and underlying physical phenomena.		
3. To Sketch and perform simple design calculations of fuel cell systems for portable, transportation and combined heat and power production.		
4. To Describe the properties of hydrogen as a fuel.		
5. To Describe safety aspects and storage technologies.		
UNIT I	FUEL CELLS	**9**
Concept, key components, physical and chemical phenomena in fuel cells, advantages and disadvantages, different types of fuel cells and applications, characteristics, Nernst equation, relation of the fuel consumption versus current output		
UNIT II	FUEL CELL DESIGN AND PERFORMANCE	**9**
Stoichiometric coefficients and utilization percentages of fuels and oxygen, mass flow rate calculation for fuel and oxygen in single cell and fuel cell stack, total voltage and current for fuel cells in parallel and serial connection, over-potential and polarizations, DMFC operation scheme, general issues-water flooding and water management, polarization in PEMFC		
UNIT III	FUEL CELLS -APPLICATION AND ECONOMICS	**9**
Fuel cell usage for domestic power systems, large scale power generation, automobile, space applications, economic and environmental analysis on usage of fuel cell, future trends of fuel cells		
UNIT IV	**Hydrogen and Production Techniques:**	**9**
Hydrogen – physical and chemical properties, salient characteristics. Production of hydrogen – steam reforming – water electrolysis – gasification and woody biomass conversion – biological hydrogen production – photo dissociation – direct thermal or catalytic splitting of water.		
UNIT V	**Hydrogen Storage and Applications**	**9**
Hydrogen storage options – compressed gas – liquid hydrogen – Hydride – chemical Storage – comparisons. Hydrogen transmission systems. Applications of Hydrogen.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	understand the concepts and characteristics of various types of fuel cell
2	consist and demonstrate the working of fuel cells
3	know the application of fuel cells with economic and environment analysis
4	understand and demonstrate the hydrogen production technologies
5	Understand the hydrogen storage methods and its application.

Text Books

1. Tomorrow's Energy – Hydrogen Fuel Cells and the Prospects for Cleaner Planet, Peter Hoffman, MIT
2. Rebecca L. and Busby, Hydrogen and Fuel Cells: A Comprehensive Guide, Penn Well Corporation, Oklahoma (2005)

Reference Books

1. Fuel cell Fundamentals, John Wiley and sons, Willey
2. Fuel cells: Principles and Applications, Viswanathan B and AuliceScibioh, University Press
3. Hydrogen – A fuel for Automatic Engines, Prashukumar G P, ISTE
4. Fuel Cells: Theory and Applications, Hart A B and Womack G J, Chapman and Hall

Web Recourses

1. https://nptel.ac.in/courses/108108077
2. https://www.digimat.in/nptel/courses/video/108104140/L01.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	1	3	2											2
2	1	2	2											2
3	1	3	2											2
4	1	3	2											2
5	1	3	2											2

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAN D	40	40	10	10	40
APPLY	30	30	30	30	30
ANALYZE	10	10	10	10	10
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable methodfor….(Apply)

1. Obtain the expressions for temperature dependence of the reversible voltageobtained from a fuel cell
2. Illustrate about the different types of fuel cell and its applications.

COURSE OUTCOME 2:

1. Describe the configuration of fuel cell systems with fuel processors.

Illustrate the following: i) Galvani Potential ii) Butler Volmer Equation iii) Tafel
2. Equation

COURSE OUTCOME 3:

1. Illustrate the principle and working of PEM Fuel Cell
2. Analyse the design of a fuel cell stack

COURSE OUTCOME 4:

1. Illustrate the technologies for hydrogen production
2. List the technologies for hydrogen storage.

COURSE OUTCOME 5:

1. Describe the challenges of using ***hydrogen*** as ***fuel***?
2. Identify the technologies are being developed to enable ships touse ***hydrogen*** as ***fuel***?

21EE6704	EHVAC TRANSMISSION	L	T	P	C
		3	0	0	3

Preamble

This course emphasize the basic concepts of EHVAC transmission lines and analyzes theElectrostatic field of AC lines and study about compensation techniques.

Prerequisites for the course

1. Power Generation Systems
2. Power Systems
3. Power System Transients
4. Transmission and Distribution

Objectives

1. To understand the basic concepts of EHVAC Transmission line
2. To analyze electrostatic field and voltage gradients
3. To study about electrostatic induction in unenergized lines
4. To understand about the corona in E.H.V. lines
5. To analyze the steady state and transient limits.

UNIT I	INTRODUCTION	9

Necessity of EHV AC transmission-EHVAC Transmission line trends and preliminary aspect - standard transmission voltages – Estimation at line and ground parameters-Bundle conductors: Properties -Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance

UNIT II	ELECTROSTATIC FIELDS	9

Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines – Effect of high electrostatic field on biological organisms and human beings – Surface voltagegradients and Maximum gradients of actual transmission lines - electromagnetic interference-Examples- voltage gradients on sub conductor

UNIT III	**POWER CONTROL**	**9**
Electrostatic induction in unenergized lines – Measurement of field and voltage gradients for three phase single and double circuit lines – Unenergized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage – Charging currents at power frequency-Voltage control – Shunt and Series compensation – Static VAR compensation.		
UNIT IV	**CORONA EFFECTS AND RADIO INTERFERENCE**	**9**
Corona in EHV lines – Corona loss formulae-Charge voltage diagram- Attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – Frequency spectrum of RI fields – Measurements of RI and RIV.		
UNIT V	**STEADY STATE AND TRANSIENT LIMITS**	**9**
Design of EHV lines based on steady state and transient limits - EHV cable and their characteristics-Introduction six phase transmission – UHV.		
	Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Students learn about the trends in EHV AC Transmission.
2	Students will be able to analyze steady state and transient limits
3	Students can understand power control in EHVAC transmission lines
4	Students will gain knowledge about corona effects and radio interference
5	Students will learn about practical application in EHVAC transmission lines
Text Books	

1. Rokosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering'– Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, 'HVAC and HVDC Transmission, Engineering and Practice', Khanna Publisher, Delhi, 1990.

Reference Books

1. Subir Ray, 'An Introduction to High Voltage Engineering', Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, 'Extra High Voltage AC Transmission Engineering'– New Academic Science Ltd; 4 edition 2011.
3. Edison, 'EHV Transmission line'- Electric Institution, GEC, 1968.

Web Resourses

1. https://nptel.ac.in/courses/108104013/
2. https://nptel.ac.in/courses/108/102/108102047/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	1	2	1									3	
2	2	2	1	2										3
3	2	2	1	1										3
4	3		2	2									3	
5	3		2	1									3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	25	25	15	15	30
UNDETSTAND	30	35	15	15	25
APPLY	25	20	10	10	25
ANALYZE	20	20	10	10	20
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable methodfor….(Apply)

1. Define EHVAC transmission lines.
2. Define HV transmission system with regard to power handling capacity, losses,conductor resistance and electrostatic field associate with HV.

COURSE OUTCOME 2:

1. Explain surface voltage gradient on conductors.
2. Explain how Electrostatic fields to human life, plants and animals.

COURSE OUTCOME 3:

1. Explain electrostatic induction in unenergized lines.
2. Obtain the electrostatic fields of double circuit 3-phase EHV AC line.

COURSE OUTCOME 4:

1. Explain Corona and give the corona loss formulae.
2. Define power loss and audible noise.

COURSE OUTCOME 5:

1. Define six phase transmission systems.
2. Define practical implementation of EHVAC transmission systems.

21EE6705	ENERGY CONSERVATION & AUDITING	L	T	P	C
		3	0	0	3

Preamble

Energy conservation and auditing are critical components of today's sustainability and environmental preservation efforts. With growing concerns about energy consumption and greenhouse gas emissions, individuals and organizations must take steps to promote energy efficiency and reduce their carbon footprint. The Energy Conservation & Auditing course is designed to give participants a thorough understanding of energy conservation and auditing principles and practices. Through a blend of theoretical knowledge and practical skills, participants will gain the ability to assess energy consumption patterns, identify areas of energy wastage, and recommend measures to reduce energy usage.

Prerequisites for course

1. Laws of Thermodynamics and Heat Transfer
2. Knowledge of electrical and mechanical systems
3. HVAC systems
4. Renewable Energy Systems
5. Basic knowledge of environmental regulations and sustainability practices

Objectives

1. To provide a thorough understanding of energy conservation and auditing principles and practices.
2. Develop the skills required to conduct energy audits, identify areas of energy waste, and recommend energy-saving measures.
3. To increase understanding of energy-efficient technologies and best practices in energy conservation.
4. To provide participants with the tools and techniques needed to analyze and interpret energy usage data and develop energy-saving strategies.
5. To raise awareness of environmental sustainability and the environmental impact ofenergy use, as well as to encourage the adoption of energy-efficient practices in daily life and work.

UNIT I	Introduction to Energy Conservation and Auditing	9

Overview of energy conservation and auditing - The impact of energy consumption on the environment - The principles of energy efficiency and energy management - Overview of energy auditing and energy management programs - Key concepts in energy auditing and energy management.

UNIT II	Energy Auditing Fundamentals	9

Types of energy audits - Energy usage patterns and data analysis - Energy data collection and measurement - Energy consumption calculation - Energy modeling and simulation.

UNIT III	**Energy-Efficient Technologies and Best Practices**	**9**
Energy-efficient lighting systems - HVAC systems and their impact on energy consumption - Renewable energy systems and alternative energy sources - Energy-efficient appliances and building materials - Energy management systems and building automation.		
UNIT IV	**Energy Conservation Strategies and Implementation**	**9**
Energy management plan development - Implementation of energy conservation measures - Monitoring and evaluation of energy consumption - Energy savings analysis and return on investment - Reporting and communication of energy conservation results.		
UNIT V	**Regulatory Environment and Sustainability**	**9**
Energy conservation policies and regulations - Environmental sustainability and energy conservation - Corporate social responsibility and energy conservation - Energy labeling and certifications - Energy conservation case studies and best practices.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Conduct thorough energy audits, analyze data on energy usage and identify areas of energy waste.
2	Create and put into action energy-saving strategies and best practices in energyconservation.
3	Evaluating the efficacy of energy-saving technologies and recommending appropriate solutions to reduce energy consumption.
4	Develop data analysis and interpretation skills, as well as the ability to monitor and analyze energy data using computer software and tools.
5	Effective communication with stakeholders is essential, as is raising awareness of environmental sustainability and energy conservation initiatives.

Text Books

1. "Energy Management Handbook" by Wayne C. Turner
2. "The Principles and Practice of Energy Management" by Keith Eaton and David Boaz

Reference Books

1. "Energy Management Handbook" by Wayne C. Turner, published by Fairmont Press, 2009.
2. "Building Energy Management Systems: Applications and Implementation" by Stuart R. Wenham, published by Springer, 2009.
3. "Energy Management Principles: Practices, Calculations, and Applications" by F. Mohammadzadeh, published by Routledge, 2013.
4. "Energy Auditing of Buildings: A Guide to Carbon Footprinting and Energy Conservation" by David M. Beitelman, published by Springer, 2011.
5. "Handbook of Energy Audits" by Albert Thumann, published by Fairmont Press, 2012.
6. "Sustainable Energy Management: A Guide for Energy Managers, Building Owners, and Facility Managers" by Michael D. Starr, published by Fairmont Press, 2010.
7. "Energy Efficiency in Buildings: A Guide to Best Practice in Energy Management" by Peter M. Cusick, published by Routledge, 2014.

Web Resources

1. https://sustainabilityeducationacademy.com/learn/introduction-to-energy-auditing/
2. https://alison.com/careers/stem/energy-conservation-specialist

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2			2			2		1				2
2	3	2			2			2		1				2
3	3	2	1		2			2		1				2
4	3	2	1		2			2		1				2
5	3	2			2			2		1				2

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDERSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. What are energy auditing and conservation, and what effects do they have on theenvironment? What are the foundational tenets of energy management and efficiency?
2. What is energy conservation, why is it vital, and how does energy auditing fit into thescheme of things?

COURSE OUTCOME 2:

1. What types of energy audits are there? How are energy consumption measurements and analyses conducted? What best practices and technology are there for saving energy?

2. What effect do HVAC units have on energy use? How may renewable energy systems and other energy sources be incorporated into energy conservation efforts? What part do energy management systems and building automation play in energy conservation?

COURSE OUTCOME 3:

1. What function can energy management systems and building automation play in energy conservation, and how may energy conservation measures be put in placeand tracked?
2. How do going green and sustainable energy interfere? What are energy conservation rules and regulations, and how do they affect energy conservation efforts?

COURSE OUTCOME 4:

1. Exactly what function does corporate social responsibility play in energy conservation? What are the benefits of energy certification and labelling, and how does it affect energy efficiency? Can you give an example of a successful energy conservation initiative?
2. How does green technology affect a building's or a firm's return on investment?

COURSE OUTCOME 5:

1. What function do energy analysis and design play in energy conservation efforts?How else can energy consumption patterns be examined and deciphered? What function do energy management strategies play in attempts to save energy?
2. Can you talk about the future prospects for energy conservation and energy auditing? What part do energy reporting and communication play in supporting energy conservation efforts?

21EE6706	ELECTRICAL SUBSTATION ENGINEERING	L	T	P	C
		3	0	0	3

Preamble

This course is to impart in students a good understanding of fundamental of electricity generation systems. Electrical substations are supplementary parts of electricity generation systems, where voltage is transformed from high to low and vice versa using transformers. Substations containing step-up transformers increase voltage and decrease current. If the transformer contained within the substation is a step-down, the voltage decreases, and the current increases. There are three main types of substation: transmission, distribution, and collector.

Prerequisites for the course

1. Transmission and Distribution in Power Systems
2. Power Quality

Objectives

1. To provide knowledge about the Distribution systems.
2. To discuss about the Design Consideration of Distribution Feeders and the location of Substations
3. To impart the knowledge on Power factor improvement.
4. To introduce about the Voltage control technique and power loss calculation.
5. To learn the objective of protection and coordination of distribution system.

UNIT I	GENERAL CONCEPTS	9

Introduction to distribution systems, Load modelling and characteristics. Coincidence factor, contribution factor loss factor - Relationship between the load factor and loss factor. Classification of loads Residential, commercial, Agricultural and Industrial and their characteristics

UNIT II	DISTRIBUTION FEEDERS AND SUBSTATIONS	9

Design Considerations of Distribution Feeders: Radial and loop types of primary feeders, voltage levels, feeder loading; basic design practice of the secondary distribution system. Location of Substations: Rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations.

UNIT III	COMPENSATION FOR POWER FACTOR IMPROVEMENT	9

Capacitive compensation for power-factor control. Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), Power factor correction, capacitor allocation - Economic justification - Procedure to determine the best capacitor location.

UNIT IV	VOLTAGE CONTROL AND SYSTEM ANALYSIS	9

Voltage Control: Equipment for voltage control, effect of series capacitors, effect of AVB/AVR, line drop compensation. Voltage drop and power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines.

UNIT V	**PROTECTION AND COORDINATION**	**9**
Objectives of distribution system protection, types of common faults and procedure for fault calculations. Protective Devices: Principle of operation of Fuses, Circuit Reclosures, and line sectionalizes, and circuit breakers. Coordination of Protective Devices: General coordination Procedure.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the Basic concepts distributed system and types of load.
2	Understand the concepts of design of distributed feeders and location of substation.
3	Understand the importance of power factor improvement.
4	Analyze the basic concepts of voltage control and system analysis.
5	Understand the importance of protection and coordination.

Text Books

1. ‘Electric Power Distribution system, Engineering’ – by Turan Gonen, Mc Graw-hill Book Company.
2. ‘Electric Power Distribution’ – by A.S. Pabla, Tata Mc Graw-hill Publishing company, 4th edition, 1997.

Reference Books

1. ‘Electrical Power Distribution and Automation’ by S.Sivanagaraju, V.Sankar, Dhanpat Rai & Co, 2006
2. ‘Electrical Power Distribution Systems’ by V.Kamaraju, Right Publishers.

Web Recourses

1. https://www.youtube.com/watch?v=5Y_XAQMXsC8
2. https://archive.nptel.ac.in/courses/108/107/108107112/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	1										2	3	
2	3	2										2	3	
3	3	2										2	3	
4	3	2										2	3	
5	3	1										2	3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	40	40	10	10	40
APPLY	30	30	10	10	30
ANALYZE	20	20	5	5	20
EVALUATE					
CREATE					
	100	100	25	25	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….

1. Draw a schematic single line diagram of an electrical distribution system and explain its typical parts in detail. (Analyze)

2. Discuss the characteristics of the following categories of loads: (i) Residential (ii) Commercial (iii) Agriculture (iv) Industrial. (Understand)

COURSE OUTCOME 2:

3. Discuss in detail about the basic design practice of the secondary distribution system with necessary schematics. (Understand)
4. Compare the four and six feeder's patterns in substation location. (Apply)

COURSE OUTCOME 3:

1. Discuss the effect of shunt compensation on the distribution system. (Understand)
2. Explain the economic justification of installing a capacitor in a distribution system. (Understand)

COURSE OUTCOME 4:

1. Briefly explain the line drop compensation on voltage control. (Understand)
2. Prove that the power loss due to load currents in the conductors of the 2- phase, 3-wire lateral with multi-grounded neutral is approximately 1.64 times larger than the one in the equivalent 3-phase lateral. (Apply)

COURSE OUTCOME 5:

1. Discuss the procedure for fault current calculation in following faults: i)Three phase Ground fault. (ii) Phase to phase ground fault. (Understand)
2. Discuss the overall coordination procedure employed for protection of distribution systems. (Understand)

PROFESSIONAL ELECTIVE IV

21EE6707	DESIGN OF SMPS AND UPS	L	T	P	C
		3	0	0	3

Preamble

This course is designed to impart knowledge about the characteristics of power semiconductor devices, working principle and Analysis of DC-DC converters, Switched Mode Power Converters, Resonant Converters, DC-AC Converters.

Prerequisites for the course

1. Power Electronics

Objectives

1. To introduce the impart knowledge about state space model for DC – DC converters.
2. To discuss about switched mode power converters.
3. To Discuss about Resonant Converters.
4. To introduce PWM techniques for DC-AC converters.
5. To learn about filters and UPS and its applications in electric power utility.

UNIT I	DC-DC CONVERTERS	9

Principles of step down and step-up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II	SWITCHED MODE POWER CONVERTERS	9

Analysis and state space modeling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT III	RESONANT CONVERTERS	9

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters, ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT IV	DC-AC CONVERTERS	9

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V	POWER CONDITIONERS, UPS & FILTERS	9
Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze the state space model for DC – DC converters.
2	Acquire knowledge on switched mode power converters.
3	Understand the importance of Resonant Converters.
4	Analyze the PWM techniques for DC-AC converters.
5	Acquire knowledge on filters and UPS, modern power electronic converters and its applications in electric power utility.

Text Books

1. Simon Ang, Alejandro Oliva,” Power-Switching Converters”, Third Edition, CRC Press, 2010.
2. Kjeld Thorborg, “Power Electronics – In theory and Practice”, Overseas Press, First Indian Edition 2005.

Reference Books

1. Philip T Krein, "Elements of Power Electronics", Oxford University Press
2. Ned Mohan, Tore.M. Undeland, William. P. Robbins, Power Electronics converters,Applications and design- Third Edition- John Wiley and Sons- 2006
3. M.H. Rashid – Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2007.

Web Recourses

1. https://nptel.ac.in/courses/108102145
2. https://nptel.ac.in/courses/108101038

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3	2						2				3	
2	3	3	2						2				3	
3	3	3	2						2				3	
4	3	3	2						2				3	
5	3												3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	40	40	10	10	40
APPLY	30	30	10	10	30
ANALYZE	20	20	5	5	20
EVALUATE					
CREATE					
	100	100	25	25	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….

1. With circuit summarize the analysis and state space modeling ofboost DC converters. (Analyze)
2. Draw and explain the analysis and state space modeling of CUKconverters with its applications. (Apply)

COURSE OUTCOME 2:

1. Draw the basic control circuit for power converter. (Apply)
2. Explain the analysis and state space modeling of flyback converterwith applications. (Apply)

COURSE OUTCOME 3:

1. State the basic concept of resonant converter. (Understand)
2. Explain with circuit working of series resonant converter. (Apply)

COURSE OUTCOME 4:

1. Summarize diode clamped multilevel inverter concept. (Analyse)
2. With circuit explain three phase inverter control using sine PWMtechnique. (Apply)

COURSE OUTCOME 5:

1. Sketch the circuit for voltage filter. (Apply)
2. With circuit diagram explain the working principle of online UPS.(Apply)

21EE6708	DESIGN OF ELECTRICAL INSTALLATIONS	L	T	P	C
		3	0	0	3

Preamble

It is essential for the practicing engineers to identify the basic practices and safety measures in electrical installations. Design of Electrical Installation gives the basic installation of electronic hardware systems familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments.

Prerequisites for the course

1. Design of Electrical Apparatus
2. Transmission and Distribution

Objectives

1. To understand the basic concepts, design and estimation of distribution systems, substation.
2. To enable candidate to design earthing system for residential and commercial.
3. To understand practical aspects of condition monitoring of various electrical equipments.
4. To acquire the knowledge on maintenance of various electrical equipments
5. To learn the testing of various electrical equipments.

UNIT I	INTRODUCTION	9

Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, tender document, net price list, market survey, overhead charges, labour charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements.

UNIT II	ESTIMATING AND COSTING DOMESTIC INSTALLATIONS	8

Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate (single storey and multi-storey buildings having similar electrical load)

UNIT III	ESTIMATING AND COSTING INDUSTRIAL INSTALLATIONS:	8

Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single phase, 3-phase motor load and the light load (3-phase supply system), Service line connections estimate for domestic and Industrial loads (over-head and Under- ground connections) from pole to energy meter.

UNIT IV	ESTIMATING AND COSTING TRANSMISSION AND DISTRIBUTIONLINES	9
Planning and designing of lines with different fixtures, earthing etc. based on unit cost calculations Substation: Types of substations, substation schemes and components, estimate of 11/0.4 KV pole mounted substation up to 200 KVA rating.		
UNIT V	**INSTALLATION PLAN FOR MACHINES**	**11**
Installation plan, single line diagram and prepare the estimate of cost and list of material for the following 2HP 3-phase Induction Motor for screw milling machine,3HP 3-phase Induction Motor for small lathe,5HP 3-phase Induction Motor for milling machine, one 1HP 3-phase Induction Motor for grinder Installation plan, single line diagram and prepare the estimate of cost and list of material for the following machinery.5, 3, 1, 1/2 HP 3-Phase 400v Induction Motor.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Estimation and costing of residential and commercial buildings.
2	Learn Distribution systems, its types and substations.
3	Condition monitoring and Testing of various electrical equipments.
4	Describe substation readings, planning and cost estimation.
5	Identify tools, appliances, special outlets, motors and motor circuits.

Text Books

1. A Course in Electrical Installation, Estimating and Costing by J.B Gupta, S.K Kataria andSons, 2nd edition,2013.
2. Electrical Design: Estimation & Costing by Raina & Battacharya, Wiley Eastern, 2ndedition, 2009.

Reference Books

1. Estimating and Costing by S.K Bhattacharya, Tata McGraw Hill, 3 rd edition, 2006.
2. Estimating and Costing by Surjeet Singh, Dhanpat Rai & Co., 2 nd edition, 2003.
3. Estimating and Costing by S.L Uppal, Khanna Publishers, 2 nd edition, 2004.

Web Recourses

3. https://electrical-engineering-portal.com/design-electrical-installation
4. https://www.udemy.com/course/electrical-installations-design/
5. https://mscelectrical.com/electrical-installation-design-for-beginners/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3		3		2									3
2	3		3		2									3
3	3		3		2									3
4	3		3		2									3
5	3		3		2									3

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for

1. What are the standard color codes for phase, neutral and earth wire? (Apply)
2. What is the importance of wiring diagrams and symbols? (Apply)

COURSE OUTCOME 2:

1. Mention few house wiring rules as per ISI specification. (Understand)
2. What are the different types of earthing methods? (Understand)

COURSE OUTCOME 3:

1. Which test is conducted to determine the healthiness of the domestic wiring?(Apply)
2. Name the instrument used for measurement of insulation resistance. (Understand)

COURSE OUTCOME 4:

1. What are the materials used for manufacturing heating element? (Understand)
2. Mention functions of various parts of motors and pumps. (Understand)

COURSE OUTCOME 5:

1. What are the steps for planning electrical wiring work? (Apply)
2. Mention the criteria for selection of wiring cables(Apply)

21EE6709	SMART GRID TECHNOLOGIES	L	T	P	C
		3	0	0	3
Preamble					
The general goals of Smart Grid are to ensure a transparent, sustainable and environmental-friendly system operation that is cost and energy efficient, secure and safe. Objectives of developing the Smart Grid are quite different from country to country for their various demands and start points.					
Prerequisites for the course					
1. Transmission and Distribution					

Objectives		
To understand concept of smart grid and developments on smart grid.		
To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.		
To have knowledge on smart substations, feeder automation and application for monitoring and protection.		
To have knowledge on micro grids and distributed energy systems.		
To know power quality aspects in smart grid.		
UNIT I	**INTRODUCTION TO SMART GRID**	**9**
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.		
UNIT II	**SMART GRID TECHNOLOGIES**	**9**
Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).		
UNIT III	**MICRO GRIDS AND DISTRIBUTED ENERGY RESOURCES**	**9**
Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.		
UNIT IV	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS**	**9**
Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and cloud Computing to make Smart Grids smarter, Cyber Security for Smart Grid.		
UNIT V	**POWER QUALITY MANAGEMENT IN SMART GRID**	**9**
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.		

	Total Periods	**45**
Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	understand smart grids and analyse the smart grid policies and developments in smart grids.
2	develop concepts of smart grid technologies in hybrid electrical vehicles etc.
3	understand smart substations, feeder automation, GIS etc.
4	analyse micro grids and distributed generation systems.
5	analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Text Books

1. Ali Keyhani, Mohammad N. Marwali, Min Dai “Integration of Green and Renewable Energy in Electric Power Systems”, Wiley

2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”,CRC Press

Reference Books

1. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability:1”, Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson “Control and Automation of Electric Power Distribution Systems (Power Engineering)”, CRC Press
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert “Substation Automation (Power Electronics and Power Systems)”, Springer

Web Recourses

- https://www.youtube.com/watch?v=fojsAvPjgRs
- https://www.youtube.com/watch?v=4L31dHXP6i0
- https://mscelectrical.com/electrical-installation-design-for-beginners/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3		3		2									3
2	3		3		2									3
3	3		3		2									3
4	3		3		2									3
5	3		3		2									3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for

1. Evaluate the necessity of Smart Grid system. (Evaluate)
2. Examine the major global smart grid initiatives in India. (Apply)

COURSE OUTCOME 2:

1. Examine the wide area monitoring system in a transmission network. (Apply)
2. Estimate the distribution SCADA. (Understand)

COURSE OUTCOME 3:

1. Discuss the common information model. (Apply)

2. Integrate the Intelligent Electronic Devices (Understand)

COURSE OUTCOME 4:

1. Analyze the Thyristor-controlled phase shifting transformer. (Understand)
2. Examine the web-based power quality monitoring. (Understand)

COURSE OUTCOME 5:

1. Describe the Mitigation Approach to Cyber Security Risks? (Apply)
2. Explain the real time path rating. (Understand)

<table>
<tr><td rowspan="2">21EE6710</td><td rowspan="2">ELECTRICAL SAFETY AND QUALITY ASSURANCE</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">Prerequisites for the course</td></tr>
<tr><td colspan="6">• Electrical Wiring</td></tr>
<tr><td colspan="6">Objectives</td></tr>
<tr><td colspan="6">• To impart knowledge on the electrical hazards
• To learn about concept of electricity.
• To know about various safety portable tools
• To understand the quality management.
• To implement various accreditation methods.</td></tr>
<tr><td colspan="6">Syllabus</td></tr>
<tr><td>UNIT I</td><td>ELECTRICAL HAZARDS</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity–Human resistance to electricity</td></tr>
<tr><td>UNIT II</td><td>STANDARDS AND REQUIREMENTS</td><td colspan="4">9</td></tr>
<tr><td colspan="6">National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards).</td></tr>
<tr><td>UNIT III</td><td>ELECTRICAL PROTECTION AND MAINTENANCE</td><td colspan="4">9</td></tr>
<tr><td colspan="6">Selection of Environment, Protection and Interlock–Discharge rods and earthing device–Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation (CPR).</td></tr>
</table>

UNIT IV	STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITAL	9
Define Quality- Need for Standardization & Quality Management, QM in Health care organization-Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments		
UNIT V	**REGULATORY REQUIREMENT FOR HEALTH CARE**	**9**
CE and FDA regulations, Accreditation for hospitals-JCI, NABH and NABL, Other regulatory Codes.		
	Total Periods	45

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
(i) Google Form based- on- lineTest (ii) Written Test	(i) Google Form based – online Test incorporating Listening, Speaking and Reading	WRITTEN TEST

Outcomes	
Upon completion of the course, the students will be able to:	
1	Understand the concept of Electrical hazards
2	The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals .
3	Analyze the safety portable tools and First aid.
4	Understand the Quality Management.
5	Understand the concept of electricity act.

Text Books

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P)Ltd.24

Reference Books

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices,Prentice Hall Inc., EnglewoodCliffs,New Jersy,1979.

Web Recourses

- https://youtu.be/x7gr0rctsrE
- https://nptel.ac.in/courses/108105088

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3		3		2	2			2		2	2
2	3	3	3		3		3	2			3		2	2
3	3	3	3		3		3	2			3		2	2
4	3	2	3		3		3	2			3		2	2
5	3	3	3		3		3	2			3		2	2

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1):

1. Describe the basic electronic circuits (Understand)
2. Draw and explain the general rules and parameters in PCB design.(Analyse)

COURSE OUTCOME 2 (CO 2):

1. Design the rules for Digital circuit PCBs (Analyse)
2. Describe the high frequency and fast pulse applications (Understand)

COURSE OUTCOME 3 (CO 3):

1. List the application of Analog circuit PCBs. (Remember)
2. Summarize the different techniques for design rules for Digital circuitPCB(Understand)

COURSE OUTCOME 4 (CO 4):

1. Explain the construction, working principle of Multilayer PCBs. (Understand)
2. Draw and explain the Multiwire PCB (Analyse)

COURSE OUTCOME 5 (CO 5):

1. Explain briefly Subsystem/PCB Placement in an enclosure? (Understand)
2. Describe the Electronic discharge protection. (Understand)

21EE6711	**INTELLIGENT SYSTEMS AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

Intelligent control describes the discipline in which the control methods developed attempt to emulate important characteristics of human intelligence. These characteristics include adaptation and learning, planning under large uncertainty, and coping with large amounts of data.

Prerequisites for the course

1. Control Theory

Objectives

1. To learn the basic concepts of Soft Computing
2. To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
3. To apply soft computing techniques to solve problems.
4. Introduce and use the idea of Neural networks, fuzzy logic and use of heuristics based onhuman experience
5. Introduce and use the concepts of Genetic algorithm and its applications to soft computing

using some applications.

UNIT I	Artificial Neural Networks	9
Basic – concepts - single layer perception - Multi layer perception - Supervised and unsupervised learning back propagation networks, Application.		
UNIT II	**Fuzzy Systems**	**9**
Fuzzy sets and Fuzzy Reasoning - Fuzzy Matrices - Fuzzy Functions – Decomposition - Fuzzy automated and languages - Fuzzy Control Methods - Fuzzy decision making, Applications.		
UNIT III	**Neuro-Fuzzy Modelling**	**9**
Adaptive networks based Fuzzy Interfaces - Classification and Representation Trees - Data dustemp algorithm –Rule base structure Identification – Neuro - Fuzzy controls		
UNIT IV	**Genetic Algorithm**	**9**
Survival of the fittest - pictures computations - cross over mutation – reproduction - rank method - rank space method, Application.		
UNIT V	**Artificial Intelligence**	**9**
AI Search algorithm - Predicate calculus rules of interface – Semantic networks – frames – objects - Hybrid models, applications.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES PROBLEM-SOLVING 3. ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Identify and describe soft computing techniques and their roles in building intelligent machines.
2	Analyse fuzzy system concepts and perform calculations in Fuzzy sets and matrices.
3	Recognize the feasibility of applying a soft computing methodology for a particular problem.

4	Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems, genetic algorithms to combinatorial optimization problems and neural networks to pattern classification and regression problems.
5	Effectively use modern software tools to solve real problems using a soft computing approach and evaluate various soft computing approaches for a given problem.

Text Books

1. N. P. Padhy, S. P. Simon, "**Soft Computing with MATLAB Programming**", Oxford UniversityPress, 2015.
2. S. N. Sivanandham , S. N. Deepa, "**Principles of Soft Computing**", Wiley India Pvt. Ltd., 2ndEdition, 2011.
3. S. Rajasekaran, G. A. Vijayalakshmi Pai, "**Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications** ", PHI Learning Pvt. Ltd., 2017.

Reference Books

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —**Neuro-Fuzzy and Soft Computing**||, Prentice-Hall of India, 2002.
2. Kwang H.Lee, —**First course on Fuzzy Theory and Applications**||, Springer, 2005.
3. George J. Klir and Bo Yuan, —**Fuzzy Sets and Fuzzy Logic-Theory and Applications**||, Prentice Hall, 1996.

Web Recourses

1. https://nptel.ac.in/courses/106105173
2. https://onlinecourses.nptel.ac.in/noc20_cs17/preview
3. https://www.classcentral.com/course/swayam-introduction-to-soft-computing-10053

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	2	1	2	1	2	1							2	2
2	3		2	1	1	1							1	1
3	1	1	2	1	2	1	1						1	1
4	2	1	2	1	1	1	1						1	1
5	1	1	2	1	2	1	1						2	2

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
Total	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. What do you understand by Soft Computing? Explain Difference between Soft Computing and Hard Computing.
2. Explain different techniques used in soft computing.

COURSE OUTCOME 2:

1. Distinguish between Supervised Learning and Unsupervised Learning.
2. Explain ADALINE and MADALINE Network.

COURSE OUTCOME 3:

1. Explain the working of Back propagation neural network.
2. Explain in brief Counter Propagation network.

COURSE OUTCOME 4:

1. How does Genetic Algorithm is differing from traditional algorithms? Give the advantages of GA over traditional algorithms.
2. Explain different types of crossover functions in Genetic Algorithm.

COURSE OUTCOME 5:

1. What is Fuzzy Logic? Distinguish between Fuzzy Set and Crisp Set.
2. Explain different types membership functions used in Fuzzification process.

21EE6712	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

Preamble

- Over the past few decades, the discipline of Low Power VLSI Design has advanced quickly due to the rising demand for energy-efficient electronics in a society where energy consumption has emerged as a major issue.
- The demand for low-power electronic circuits has increased with the development of portable electronic devices like smartphones and laptops.
- The goal of low-power VLSI design is to create circuits with acceptable performance, cost, and reliability while using less power.
- This industry aims to create energy-saving gadgets that will help preserve natural resources and lessen our planet's carbon imprint.

Prerequisites for course

1. Analog and Digital Circuit
2. Circuit Analysis
3. Basic Electronics
4. Mathematics

Objectives

1. To impart knowledge of the various low-power design strategies and techniques for VLSI circuits.
2. To develop the ability to analyze and optimize digital circuit power consumption using various power reduction techniques such as power gating, clock gating, and voltage scaling.
3. To familiarize students with CAD tools and methodologies for low-power VLSI design, including power analysis, timing analysis, and logic synthesis.
4. To enable students to apply low-power design concepts to real-world problems, including the design of low-power VLSI circuits for portable electronic devices.
5. To provide an understanding of the trade-offs between power consumption, performance, and cost in low-power VLSI design, and the impact of these trade-offs on the overall design process.

UNIT I	Low Power Microelectronics	9
Retrospect and Prospect - Fundamentals of power dissipation in microelectronic devices - Estimation of power dissipation due to switching, short circuit, subthreshold leakage, and diode leakage currents.		
UNIT II	**Device & Technology Impact on Low Power**	**9**
Dynamic dissipation in CMOS - Transistor sizing & gate oxide thickness - Impact of technology Scaling - Technology & Device innovation.		
UNIT III	**Simulation Power and Probabilistic power analysis**	**9**
SPICE circuit simulators, gate-level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems. Monte Carlo simulation. Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.		
UNIT IV	**Low Voltage Technologies and Circuits**	**9**
Threshold Voltage Scaling and Control, Multiple Threshold CMOS (MTCMOS), Substrate Bias Controlled Variable Threshold CMOS, Testing Issues: Design and test of low-voltage CMOS circuits.		
UNIT V	**Algorithm and architectural level methodologies**	**9**
Introduction, design flow, algorithmic level analysis and optimization, Architectural level estimation and synthesis.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze and reduce the power consumption of VLSI circuits.
2	Critically analyze low power design methodologies and techniques.
3	Evaluate performance and power consumption of VLSI circuits.
4	Apply low power concepts to real-world problems.

5	Understand trade-offs between power, performance, and cost..

Text Books

1. "Low Power Design Essentials" by Sanjiv K. Arora and Sreedhar Natarajan.
2. "Low Power Design Methodologies" by Massoud Pedram.
3. Chandrakasan, A.P. and Broderson, R.W., “Low Power Digital CMOS Design”, Kluwer, 2000
4. Roy, K. and Prasad, Sharat C., “Low Power CMOS VLSI: Circuit Design”, John Wiley, 2009.

Reference Books

1. "High-Performance Digital VLSI Circuit Design" by Keith D. Jackson and Robert W. Brodersen
2. "VLSI Design Techniques for Analog and Digital Circuits" by Eugene D. Fabricius
3. "Low-Power Design Techniques and CAD Tools" edited by Abdellatif Bellaouar and Abdussalam Alawini
4. "Low-Power and High-Speed Chips" by Kiat-Seng Yeo.
5. "Low Power Electronics Design" edited by R. Saleh and A. R. Newton.
6. "Analog Circuit Design: Discrete & Integrated" by Alan Hastings
7. "Power Management for System-on-Chip Design" edited by N. K. Jha and S. Ha

Web Resources

1. https://www.classcentral.com/subject/vlsi
2. https://archive.nptel.ac.in/courses/106/105/106105034/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2			2			2		1				2
2	3	2			2			2		1				2
3	3	2	1		2			2		1				2
4	3	2	1		2			2		1				2
5	3	2			2			2		1				2

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDERSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

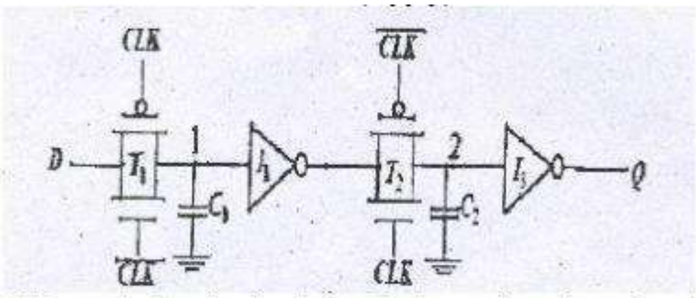
COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Write down the equation for describing the channellength modulation effect in NMos transistor
2. Why the tunneling current is higher for the nMOS transistor than the pMOS transistor with a silica gate?

COURSE OUTCOME 2:

1. Consider the circuit below



(1) State whether the circuit is a latch or edge-triggered register. Justify your answer.

(2) In the circuit consider C1 and C2 as the intrinsic capacitances of inverters and transmission gates. Assuming an ideal clock, compute the setup time, hold time and propagation delay in terms of the inverter I1, I2 delay and transmission gate T1, T2 delay. Show that the output logic level

of pseudo-NMOS logic is independent of the size of the transistor.

2. What are the sources of power dissipation in CMOS and discuss various design techniques to reduce power dissipation in CMOS?

COURSE OUTCOME 3:

1. a) Explain in detail the ideal I-V characteristics and non-ideal I-V characteristics of NMOS and PMOS devices

   b) Derive the expression for current in nMOS transistors in different regions.

2. Write short notes on

   (i) Noise Margin and Effect of βn / βp ratio in the DC characteristic curve.

   (ii) CMOS inverter layout design

COURSE OUTCOME 4:

1. Design a 16-bit carry bypass and carry select adder and discuss their features.
2. Give the difference between Booth's recoding and modified Booth's recoding?

COURSE OUTCOME 5:

1. i) Discuss in detail FPGA interconnect routing procedures.

   ii) Draw and explain the Xilinx XC4000 FPGA architecture.

   iii) Explain the Altera FPGA architecture.

2. i)Explain ASIC Design Flow

   ii)Explain in detail about FPGA Interconnecting Procedure

PROESSIONAL ELECTIVE V

21EE7710	MODERN POWER CONVERTERS	L	T	P	C
		3	0	0	3

Preamble

It is a professional elective course which emphasizes the advanced concepts and overview of modern power converters in Electrical Engineering. The concepts discussed herein are intended to provide clarification on modern power converters for Electrical Engineering graduates.

Prerequisites for the course

1. SOLID STATE DRIVES
2. POWER ELECTRONICS

Objectives

1. To gain knowledge about the harmonics standards and operation of rectifiers in CCM & DC
2. To analyze and design power factor correction rectifiers for UPS applications.
3. To know the operation of resonant converters for SMPS applications.
4. To carry out dynamic analysis of DC- DC Converters.
5. To introduce the source current shaping methods for rectifiers.

UNIT I	LINE COMMUTATED RECTIFIERS	9

Average power-RMS value of waveform–Effect of Power factor-. current and voltage harmonics – Effect of source and load impedance - AC line current harmonic standards IEC1000-IEEE 519-CCM and DCM operation of single phase full wave rectifier- Behaviour of full wave rectifier for large and small values of capacitance - CCM and DCM operation of three phase full wave rectifier- 12 pulse converters - Harmonic trap filters.

UNIT II	PULSE WIDTH MODULATED RECTIFIERS	9

Properties of Ideal single phase rectifiers-Realization of nearly ideal rectifier-. Single-phase converter systems incorporating ideal rectifiers - Losses and efficiency in CCM high quality rectifiers -single-phase PWM rectifier -PWM concepts - device selection for rectifiers – IGBT based PWM rectifier, comparison with SCR based converters with respect to harmonic content -applications of rectifiers.

UNIT III	RESONANT CONVERTERS	12

Soft Switching - classification of resonant converters - Quasi resonant converters- basics of ZVS and ZCS- half wave and full wave operation (qualitative treatment) - multi resonant converters - operation and analysis of ZVS and ZCS multi resonant converter - zero voltage transition PWM converters -zero current transition PWM converters.

UNIT IV	SWITCHING CONVERTERS	9

Review of linear system analysis-State Space Averaging-Basic State Space Average Model-State Space Average model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter and an ideal Cuk Converter. Pulse Width modulation - Voltage Mode PWM Scheme - Current Mode PWM Scheme - design of PI controller.

UNIT V	EMBEDDED CONTROL OF POWER ELECTRONIC CONVERTER	6
Embedded design of a typical Power Conversion System including: process control, protection, monitoring, real-time feedback control		
Total Periods		

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (50 Marks)
Written Examination	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	Written Examination

Course Outcomes

Upon completion of the course, the students will be able to:

CO 1	Apply the concept of various types of rectifiers.
CO 2	Simulate and design the operation of resonant converter and its importance.
CO 3	Identify the importance of linear system, state space model, PI controller.
CO 4	Design the DC power supplies using advanced techniques.
CO 5	Understand the standards for supply current harmonics and significance.

Text Books

1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press,NewYork, 2004.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski,
4. R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.

Reference Books

1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004
2. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and Zhe Chen Morgan & Claypool Publishers series, United States of America, 2006.

Web Resources

Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004

- https://findsbooks.com/qa/?q=modern+power+electronics+converters+and+inverters+pdf&spid=ac1j89in5o07ei
- https://link.springer.com/chapter/10.1007/978-1-4615-1153-3_5

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	1	2		2									3
2	3	1	2		2									3
3	3	1	2		2									3
4	3	1	2		2									3
5	3	1	2		2									3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. What are the performance parameters of a converter?
2. Discuss operation of Cuk converter. Derive the relation between duty ratio and input voltage.

COURSE OUTCOME 2:

1. Examine the principle of operation for a single-phase full converter with R-L load and no freewheeling diode. Sketch the circuit diagram and draw the waveforms for source voltage, output voltage, load current and source current assuming a large inductor and no ripple in the output current. Derive the expression for RMS output voltage

2. A six pulse thyristor converter connected on the secondary of delta /star connected 6.6 kV /415V ,50 Hz transformer is supplying to 460 V,200 A DC load. Identify the following (i) converter firing angle (ii)dc power delivered by the converter (iii)AC line current (iv)RMS value of the device current. (13)

COURSE OUTCOME 3:

1. Draw and explain the operation of a four level diode clamped multilevel inverter. Write the inverter relationship for R phase. Derive the expression for transistor voltage, freewheeling diode current, capacitor junction current and clamping diode current.
2. Explain the principle of operation of a single phase multilevel cascaded H-bridge inverter with neat diagrams

COURSE OUTCOME 4:

1. A single-phase full wave ac voltage controller has a resistive load of 5Ω and an input voltage 230 V, 50 Hz. The firing angle of thyristors T1 and T2 is 120 degree. Evaluate the (i) the RMS value of load voltage (ii)input power factor, (iii)average value of current of thyristor (iv)RMS current of thyristor (v)load power.
2. Examine the operation of a 3phase AC voltage regulator having six thyristors with neat sketches of voltage waveforms.

COURSE OUTCOME 5:

1. With a help of neat circuit diagram and associated waveforms explain the operation of half wave and full wave mode of ZVS Resonant buck converters.
2. Explain in detail about M type ZCS resonant converter with waveforms and circuit diagram.

Compiled By: Mrs.R.Aandal,AP/EEE Verified By

21EE7711	**POWER QUALITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Preamble					
It is an introductory course which emphasizes the fundamental concepts and overview of Electrical Engineering. The concepts discussed herein are intended to provide clarification on basic electrical engineering for Electrical Engineering graduates.					
Prerequisites for the course					
1. Electric Circuit Analysis 2. Power Systems 3. Power System Analysis **4.** Power Systems Transients					
Objectives					
1. To understand various sources, causes and effects of power quality issues, electrical systems and their					

measures and mitigation		
2. To study about voltage sag and swell concepts		
3. To understand the concepts about Voltage and current distortions, harmonics		
4. To acquire knowledge on compensation techniques		
5. To acquire knowledge on power quality analyzers		
UNIT I	**INTRODUCTION**	**9**
Power quality - Impact of PQ on end users - Need for PQ monitoring - Various PQ problems: Voltage dips - over voltages - short supply interruptions - voltage fluctuations and flicker		
UNIT II	**TRANSIENTS, VOLTAGE AND CURRENT UNBALANCE**	**9**
Transient system model - examples of transient models and their response - power system Transient model - types and causes of transients — Lightning - other switching transients. Symmetrical components of currents and voltages — sources — effects - measurements and mitigation		
UNIT III	**HARMONIC ANALYSIS**	**9**
Definition - odd and even harmonics - harmonic phase sequence - voltage and current Harmonics - individual and total harmonic distortion - harmonic standards – sources - effects on various electrical components - measurements and mitigation – Simulation Studies		
UNIT IV	**POWER FACTOR IMPROVEMENT**	**9**
Active and reactive power flow with nonlinear load - displacement and distortion power factor - power factor penalty - power factor improvement - applications of synchronous condensers and static VAR compensators - automatic power factor controller (Case Studies).		
UNIT V	**CPD FOR POWER FACTOR PROBLEMS**	**9**
Power quality measuring equipment - Smart power quality analyzers - Introduction to Custom Power Devices (CPD) – STATCOM - Dynamic Voltage Restorer (DVR) - Unified Power Quality Controller (UPQC). Active and Passive filters (Case Studies).		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Analyze reactive power requirement and management. Assess and evaluate various compensators. Simulate and design compensators, FACTS application.
2	Understand use of SVC for Voltage Regulation, Gain Supervision, Reactive Power Control and Coordination, Control Signals for System Transient Stability
3	Explain Various Power Quality terms of Electrical Power System
4	Evaluate performance of power systems (in regards to Power Quality Issues) under various power quality polluting devices using appropriate power quality monitoring tools.
5	Analyze the causes of Harmonics, its effect on various equipment and its mitigation techniques.

Text Books

1.Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty,"Electrical Power Systems Quality", Tata McGraw Hill Private Limited, 2012.

2.Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", New York: Wiley, 1999.

Reference Books

1. G.T. Heydt, "Electric Power Quality", 2nd Edition, West Lafayette, IN, Stars in CirclePublications, 2013.
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", New York: IEEE Press, 1999.
3. C. Sankaran, "Power Quality", CRC Press, 2009.
4. Alexander Kusko and Marc. T. Thompson, "Power Quality in Electrical Systems", Tata McGraw Hill Private Limited, 2007.
5. Angelo Baggini, "Handbook of Power Quality", John Wiley & Sons, 2008.

Web Resourses

1.https://archive.nptel.ac.in/courses/108/102/108102179/

2. https://archive.nptel.ac.in/courses/108/102/108102179/

3. https://archive.nptel.ac.in/courses/108/102/108102179/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3										3			3
2	3	1									3			3
3	3	1									3			3
4	3		3								3			3
5	2		1			2	2				3			3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	25	25	10	10	25
APPLY	25	25	10	10	25
ANALYZE	15	15	5	5	15
EVALUATE	10	10	10	10	10
CREATE	15	15	10	10	15
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Criticize “capacitor switching leads to overvoltage”(E)
2. Distinguish sag and swell(E)

COURSE OUTCOME 2:

1. With a waveform sketch, explain the terms (13) (a)Voltage sag (b)Voltage interruption (c)Voltage swells (d)Sag with harmonics(E)
2. Explain the various types of power quality disturbances(E)

COURSE OUTCOME 3:

1. Discuss the Power Quality issues of Grid connected Renewable Energy Sources.(E)
2. Analyze the Capacitor Switching(E)

COURSE OUTCOME 4:

1. Describe the procedure for estimating motor switching voltage sag(E)
2. Discuss the effects of voltage sag and interruption on various electrical equipment(E)

COURSE OUTCOME 5:

1. Infer voltage and current distortion(E)
2. Explain how commercial and industrial loads are responsible for harmonic distortion(E)

Compiled By: Mrs.M.Subashini,AP/EEE Verified By

21EE7712	ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION	L	T	P	C
		3	0	0	3

Preamble

Advancements in power electronics can be traced directly to the development of improved power semiconductor devices. This Course resulted in an experimental merged rectifier structure that exhibits enhanced reverse recovery behaviour with lower forward drop. Moreover, two new power thyristor structures experimentally demonstrated better on-state drop than present technologies.

Prerequisites for the course

1. Electronic Devices

Objectives

To impart knowledge on the following topics

1. Apply the knowledge of power semiconductor device structures for adjustable speed motor control applications.
2. To understand the static and dynamic characteristics of current controlled power semiconductor devices.
3. To analyze the static and dynamic characteristics of voltage controlled power semiconductor devices.
4. To enable the students for the selection of devices for different power electronics applications.
5. To understand the control and firing circuit for different devices.

UNIT I	INTRODUCTION	9

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – rating- Case Study from Data Sheets.

UNIT II	CURRENT CONTROLLED DEVICES	9
BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor- Case Study.		
UNIT III	**VOLTAGE CONTROLLED DEVICES**	**9**
Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs – Basics of GTO, MCT, FCT, RCT and IGCT- Case Study.		
UNIT IV	**FIRING AND PROTECTING CIRCUITS**	**9**
Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. – Over voltage, over current and gate protections; Design of snubbers- Case Study.		
UNIT V	**THERMAL PROTECTION**	**9**
Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types- Case Study.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Design a power semiconductor device structures for adjustable speed motor control applications.
2	Understand the static and dynamic characteristics of current controlled power semiconductor devices
3	Explain the static and dynamic characteristics of voltage controlled power semiconductor devices

4	Enable the students for the selection of devices for different power electronics applications
5	Understand the control and firing circuit for different devices.

Text Books

1. B.W Williams 'Power Electronics Circuit Devices and Applications'. 2004
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.

Reference Books

1. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
2. Mohan, Undcland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc20_ee28/preview
2. https://archive.nptel.ac.in/courses/108/102/108102145/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2											3	
2	3	2	3										3	
3	3	2	3										3	
4	3	2	3										3	
5	3	2	3										3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDETSTAND	30	30	10	10	30

APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Discuss the construction of BJT.Also draw and discuss its I-V characteristics? (Understand)
2. Describe the different breakdown voltages. (Evaluate)

COURSE OUTCOME 2:

1. Draw and explain the construction details of a GTO
2. An IGBT combines the advantages of BJTs and MOSFET's .Justify (Evaluate)

COURSE OUTCOME 3:

1. Discuss some new semiconductor materials? (Understand)
2. Compare JFET and other power devices

COURSE OUTCOME 4:

1. Explain in detail about the need of Electromagnetic compatibility in power electronic circuits. (Understand)
2. How EMI is estimated? How noise can be suppressed? (Evaluate)

COURSE OUTCOME 5:

1. Explain the steps involved in the design of a transformer. (Understand)
2. Write a short note on thermal modeling of any one power switching device. (Understand)

21EE7713	**MICROCONTROLLER BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

It is a professional elective course which emphasizes the advanced concepts and overview of Microcontroller based system design in Electrical Engineering. The concepts discussed herein are intended to provide clarification on Microcontroller based system design in for Electrical Engineering graduates.

Prerequisites for the course		
Microcontrollers and its applications		
Objectives		
1.To introduce the architecture of PIC microcontroller		
2. To educate on use of interrupts and timers.		
3. To educate on the peripheral devices for data communication and transfer.		
4. To introduce the functional blocks of ARM processor.		
5. To educate on the architecture of ARM processors.		
UNIT I	**INTRODUCTION TO PIC MICROCONTROLLER**	**9**
Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx--Pipelining - Program Memory considerations – Register File Structure - Instruction Set -Addressing modes – Simple Operations.		
UNIT II	**INTERRUPTS AND TIMER**	**9**
PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine -Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variable strings.		
UNIT III	**PERIPHERALS AND INTERFACING**	**9**
I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization -LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.		
UNIT IV	**INTRODUCTION TO ARM PROCESSOR**	**9**
ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.		
UNIT V	**APPLICATIONS**	**9**
Light sensing & controlling devices-Temperature sensing and controlling devices-Fire detection & safety devices-Industrial instrumentation devices.		
Total Periods		**45**
Suggestive Assessment Methods		
Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**

WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Understand and apply computing platform and software for engineering problems.
2	Apply the concepts of Architecture of PIC microcontroller.
3	Acquire knowledge on Interrupts and timers.
4	Understand the importance of peripherals devices for data Communication.
5	Acquire knowledge in Architecture of ARM processors.

Text Books

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.

2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2000.

Reference Books

1.Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc22_ee12/preview
2. https://archive.nptel.ac.in/courses/106/105/106105193/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	1	2		2								3	
2	3	1	2		2								3	
3	3	1	2		2								3	
4	3	1	2		2								3	
5	3	1	2		2								3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Give the register file structure of PIC Microcontroller.
2. Explain with neat diagram the architecture of PIC16C6x and PIC16C7x microcontroller.

COURSE OUTCOME 2:

1. Give the block diagram of timer1 with suitable block diagram
2. How timer2 is different from timer 0 and 1.

COURSE OUTCOME 3:

1. How data is transmitted serially using UART?
2. Explain with neat diagram the use of UART to interface two PIC resources.

COURSE OUTCOME 4:

1. Explain with examples different types of addressing used in ARM processor.
2. Write and ARM ALP which dumps a register to the display in hexadecimal notation.

COURSE OUTCOME 5:

1. Compare 3-stage and 5-stage ARM pipeline organization
2. Explain the co-processor interface of ARM in detail.

Compiled By: Mrs.R.Aandal, AP/EEE Verified By

		L	T	P	C
21EE7714	**WIND ENERGY CONVERSION SYSTEMS**	**3**	**0**	**0**	**3**

Preamble

This course introduces about different new and renewable sources of energy. Design of some of the systems are also discussed

Prerequisites for the course

Introduction to Power Engineering/ Energy Systems

Objectives

1. To learn the basic concept of sabinin's theory
2. To learn the design and control principles of Wind turbine
3. To understand the concepts of DFIG- PMSG -Variable speed generators, wind energy conversion systems.
4. To understand the concepts variable speed in wind energy conversion systems
5. To analyze the grid integration issues

UNIT I	**INTRODUCTION**	**9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinins theory-Aerodynamics of Wind turbine.

UNIT II	**WIND TURBINES**	**9**

HAWT- VAWT -Power developed-Thrust-Efficiency- Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control- stall control-Schemes for maximum power extraction.

UNIT III	**FIXED SPEED SYSTEMS**	**9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed-Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis- off shore wind analysis.

UNIT IV	**VARIABLE SPEED SYSTEMS**	**9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling-Variable speed variable frequency schemes- off shore wind analysis.

UNIT V	**GRID CONNECTED SYSTEMS**	**9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Acquire knowledge on the basic concepts of Wind energy conversion system
2	Understand the mathematical modelling and control of the Wind turbine
3	Develop more understanding on the design of fixed speed system
4	Study about the need of Variable speed system and its modelling
5	Analyze Grid integration issues and current practices of wind interconnections with power system

Text Books

1. L.L.Freris “Wind Energy conversion Systems”, Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha,S.Banerjee,”Wind Electrical Systems”,Oxford UniversityPress,2010.
3. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.

Reference Books

1. E.W.Golding “The generation of Electricity by wind power”, Redwood burnLtd.,Trowbridge,1976.
2. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
3. S.Heir “Grid Integration of WECS”, Wiley 1998

Web Resources

1. https://www.ee.iitb.ac.in/~npsc2008/NPSC_CD/Data/Tutorial%202/Wind%20Energy%20Conversion%20Systems%20-%20Prof.%20S.B.%20Kedare.pdf
2. https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
3. https://nptel.ac.in/courses/108/105/108105058/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3												
2	3	3												
3	3				3									
4		3			3									
5		3			3									

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	15	10	20
UNDERSTAND	30	30	15	15	30
APPLY	20	20	10	15	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	0	0	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Summarize the importance of components of wind energy conversion system with a neat diagram.(Understand)
2. Explain clearly about the sabinin’s theory.(Understand)

COURSE OUTCOME 2:

1. Difference between HAWT and VAWT. (Understand)
2. Explain the Yaw and Pitch angle control in WECS (Understand)

COURSE OUTCOME 3:

1. Describe the constant speed and constant frequency systems. Give its advantages and disadvantages. (Understand)
2. Explain the different types of generators used in WECS with suitable diagrams.(Understand)

COURSE OUTCOME 4:

1. Explain with a neat diagram the operation of variable speed constant frequency system and list the advantages and disadvantages.(Understand)
2. Describe the power wind characteristics and explain its types briefly (Understand)

COURSE OUTCOME 5:

1. Explain the briefly about LVRT (Understand)
2. Describe the power dynamic performance and its impacts (Understand)

Compiled By: Dr.R.Rajagopal, AP/EEE Verified By

21EE7715	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

It is an introductory course which emphasizes the fundamental concepts and overview of power electronics for renewable energy systems. The concepts discussed herein are intended to provide clarification on power electronics applications for renewable energy systems.

Prerequisites for the course

- Power Electronics
- Renewable Energy Systems
- AC machines

Objectives

To impart knowledge on the following topics

1. Introduction to renewable energy systems
2. Solar energy conversion
3. Wind energy conversion
4. Electrical machines for renewable energy conversion.
5. Standalone and grid integrated system.

UNIT I	INTRODUCTION	9

Renewable energy sources and their availability - Recent trends in energy consumption- Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - Review of reference theory fundamentals- Case studies.

UNIT II	SOLAR ENERGY CONVERSION AND ENERGY STORAGE APPLICATIONS	9
Solar PV characteristics, Grid requirement for PV, Power electronic converters used for solar PV, Control techniques, MPPT, Grid connected and Islanding mode, Grid synchronization, PLLs, battery charging in PV systems, Energy storage applications		
UNIT III	**WIND ENERGY CONVERSION**	**9**
Wind Turbine characteristics, Grid requirement for Wind, PMSM and DFIG for wind generators, Power electronic converters for PMSM and DFIG, Control techniques, MPPT, Grid connected and Islanding mode.		
UNIT IV	**HYBRID RENEWABLE ENERGY SYSTEMS**	9
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		
UNIT V	**CONTROL FOR MICROGRIDS AND SMART GRIDS**	**9**
Power electronic converters and control for Microgrids and Smart grids. Modeling and stability analysis- Coordination and control of power electronic converters.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.CASE STUDY ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze the environmental aspects and impacts of renewable energy and describe various types of renewable energy sources
2	Apply suitable power converters for solar power generation and able to describe them in detail.
3	Apply suitable power converters for wind power generation and able to describe them in detail.
4	Know in detail about the various electrical machines used for renewable energy conversion.
5	Know in detail about the standalone and grid integrated system.

Text Books

1. Rashid .M. H, "Power Electronics Hand book", Academic press, Second edition,2006.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995
4. Rai,G.D., "Non- conventional resources of energy", Khanna publishers, Fourth edition, 2010.

Reference Books

1. Rao. S. & Parulekar, "Energy Technology", Khanna publishers, Fourth edition, 2005.
2. Pai, B. R. and Ram Prasad, "Power Generation through Renewable Sources of
3. Energy", Tata McGraw Hill, New Delhi, 1991.
4. Bansal, Kleeman and Meliss, "Renewable Energy Sources and Conversion Techniques", Tata Mc Graw Hill, 1990.
5. Godfrey Boyl, "Renewable Energy: Power sustainable future", Oxford University Press, Third edition, 2012.
6. Khan B.H., "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.
7. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.
8. Freris L.L., "Wind Energy Conversion systems", Prentice Hall, UK, 1990.

WEB RESOURCE(S):

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/108/108/108108034/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO1 2	PSO 1	PSO 2
1	2	1												
2	2	1												
3	3	2	1	1										
4	3	3	2	2										
5	3	2	1	1										

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDERSTAND	40	30	10	10	30
APPLY	40	40	20	20	40
ANALYZE		10	10	10	10
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. List the various types of renewable energy sources.
2. Write the merits of renewable energy sources.

COURSE OUTCOME 2:

1. Discuss the role of power electronics in renewable energy system.
2. Explain the merits and demerits of power electronics.

COURSE OUTCOME 3:

1. Develop the design procedure of soft switching AC-link universal power converter,
2. Compare hard and soft switching converters.

COURSE OUTCOME 4:

1. Consider an induction machine based wind energy conversion system. If induction
2. Machine is replaced by synchronous machine, what are the expected changes in the Performance indices?
3. Consider synchronous machine based wind energy conversion system. If it is replaced by induction machine, analyse change in reactive power scenario.

COURSE OUTCOME 5:

1. Identify the issues related to grid connection of PV system.
2. Compare the issues related to grid connected mode and islanding mode operation of solar power system.

Compiled By: Dr.N.Hemalatha, AP/EEE Verified By

PROFESSIONAL ELECTIVE VI

21EE8701	GENERATION,UTILIZATION AND CONSERVATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Preamble

To study the generation, conservation of electrical power and energy efficient equipments and understand the principle, design of illumination systems and energy efficiency lamps.

Prerequisites for the course

1. Transmission and Distribution
2. Power Systems Transients

Objectives

Upon completion of this course, the students will be able to

1. Evaluate domestic wiring connection and debug any faults occurred.
2. Construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.
3. Realize the appropriate type of electric supply system as well as to evaluate the performance of a traction unit.
4. To understand the main aspects of Traction.
5. Understand the electric traction systems and their performance.

UNIT I	ILLUMINATION	9

Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting LED lighting and energy efficient lamps

UNIT II	REFRIGERATION AND AIR CONDITIONING	9

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor

UNIT III	HEATING AND WELDING	9

Role of electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces. Brief introduction to electric welding – welding generator, welding transformer and the characteristics. Power supply for radiation welding.

UNIT IV	TRACTION	9

Merits of electric traction – Systems of railway electrification- requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking –

Traction motors and its characteristics. Recent trends in electric traction-Traction substations sizing.

UNIT V	DOMESTIC UTILIZATION OF ELECTRICAL ENERGY	9

Domestic utilization of electrical energy – House wiring. Induction based appliances, Online and OFF-line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing – Domestic, Industrial and Substation-Introduction to E-vehicle .

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the main aspects of generation, utilization andconservation.
2	Identify an appropriate method of heating for any particular industrial application
3	Handle domestic wiring connection and debug any faults occurred
4	Construct an electric connection for any domestic appliance likerefrigerator as well as to design a battery charging circuit for a specifichousehold application.
5	Understand the concept of electric tractionsystem.

Text Books

1. Wadhwa, C.L. “Generation, Distribution and Utilization of Electrical Energy”, New Age international Pvt. Ltd, 2003.
2. Dr. Uppal S.L. and Prof. S. Rao, ‘Electrical Power Systems’, Khanna Publishers, New Delhi, 115th Edition, 2014.

Reference Books

1. Partab.H, “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, New Delhi, 2004.
2. Openshaw Taylor.E, “Utilization of Electrical Energy in SI Units”, Orient Longman Pvt. Ltd, 2003.

3. Gupta.J.B,"Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.
4. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

Web Recourses

1. https://youtu.be/RhH7ybjSbPg
2. https://www.youtube.com/watch?v=ARws_bw4uZM&pp=ygUMZWVndWMgdmlkZW9z
3. https://www.youtube.com/watch?v=nMT7MzmG5ZA&list=PLs5_Rtf2P2r7JiPm-TDQ75WYxzMgqm_jk
4. https://www.youtube.com/watch?v=M7Uqc-EnO9M&pp=ygUMZWVndWMgdmlkZW9z

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2		1		1		2	2	1	1	2	1	2
2	1	2												
3	1				1	1	3				1			
4			1			1		3	1	1			1	
5	1													

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	20	20	10	10	20
APPLY	10	10	10	10	10
ANALYZE	20	20	10	10	20
EVALUATE	10	10	5	5	10
CREATE	30	30	10	10	30
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. If the total lumens required are 7200 and coefficient of Is 0.3, calculate lamp lumens required
2. Deduce why sodium vapour lamps are not preferred forindoor lighting.

COURSE OUTCOME 2:

1. How energy-efficient motor different than a standard motor?
2. Evaluate the payback period for selecting energy efficient versus standard efficiency motors

COURSE OUTCOME 3:

1. Evaluate causes of failure of heating element.
2. List the advantages of coreless induction furnace.

COURSE OUTCOME 4:

1. Sketch the speed-time curve for a sub-urban railway system.
2. List the factors affecting scheduled speed of a train.

COURSE OUTCOME 5:

1. Illustrate the advantages of online UPS over offline UPS.
2. Write out the difference between linear and nonlinear loads.

21EE8702	**POWER SYSTEM OPERATION AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Preamble					
The primary intension of power system operation and control is to provide uninterrupted quality power to the required load. Frequency, voltage and uninterrupted power decide the quality of power. The generation of power must be in such way to meet the prevailing demand. The next object is achieved by generating consistent and continuity of service with total output at optimum overall cost.					
Prerequisites for the course					
1. Transmission and Distribution 2. Power System Analysis					
Objectives					
1. To have an overview of power system operation and control and load characteristics.					
2. To study about SCADA and its application for real time operation and control of power systems.					
3. To model power-frequency dynamics and to design power-frequency controller.					
4. To model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load					

5. To study the economic operation of power system optimization techiniques.

UNIT I	**LOAD CHARACTERISTICS**	**9**
System load variation - load characteristics - load curves and load-duration curve - load factor - diversity factor - Simple techniques of forecasting.		
UNIT II	**POWER SYSTEM SECURITY**	**9**
Security functions- State transition diagram - Contingency analysis - Derivation of generalized constants – AC load flow method – State Estimation – LSE and WLSE – SCADA		
UNIT III	**REAL POWER CONTROL**	**9**
Control area concepts -P-f control of single control area- ACE- Two area control- tie line bias control – State variable model - Extension to pool operation or multi control area systems		
UNIT IV	**REACTIVE POWER CONTROL**	**9**
Overview of Reactive Power – Excitation Systems – Reactive power compensation – Facts Devices – Tap Changing Transformers		
UNIT V	**OPTIMIZATION TECHNIQUES**	**9**
Unit Commitment- System constraints- Priority ordering - Dynamic programming - Economic Dispatch- Coordination equation with and without losses – Solution Techniques		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Have adequate understanding to analyze power system operation, stability, control and protection
2	Perform economic operation of power system and generation optimization
3	Design various control techniques for frequency control
4	Compare various devices for voltage control
5	Be familiar with the power system operation, Load forecasting and Load characteristics

Text Books

1. O.I.Elgerd, "Electric Energy System Theory - an Introduction", - Tata McGraw Hill, New Delhi, 2017
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016

Reference Books

1. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
2. A.K.Mahalanabis, D.P.Kothari. and S.I.Ahson., "Computer Aided Power System Analysis and Control", Tata McGraw Hill publishing Ltd, 1984.
3. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

Web Recourses

1. a https://nptel.ac.in/courses/108101040
2. B https://archive.nptel.ac.in/courses/108/104/108104052/
3. C https://freevideolectures.com/course/2354/power-systems-operation-and-control

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3	1	2										3
2	2	2	3	3										3
3	2	3	1	1										3
4	1	3	2	2										3
5	3	2	2	2										3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	60	60	20	30	60
APPLY	10	10			10
ANALYZE	20	20	30	20	20
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Two generators rated at 120MW and 250 MW are operating in parallel. The governor setting on the machines are such that have 4 percent and 3 percent drops. Determine (i) The load taken by each machine for a total load 200MW. (ii) The percentage no load speed and rated output of machine 1 to made by the speeder motor if the machine are to share a load equally (iii) Rated output of machine 1.
2. Draw the P - f and Q - V control channel of a synchronous generator and explain how voltage and frequency are maintained constant

COURSE OUTCOME 2:

1. Explain the power system security and control with neat flow chart
2. Discuss various functions of SCADA with neat diagram. Also list some of the common features

COURSE OUTCOME 3:

1. The area system connected by a tie line describe the following characteristics : Area 1 Area 2 R=0.01 p.u R=0.02 p.u D=0.8p.u D=1.0p.u Base MVA =500 Base MVA =500 A load change of 100MW (0.2p.u) occurs in area 1. What is the new steady state frequency, what is the change in tie line flow? Assume both areas were at nominal frequency (60Hz).
2. Draw the block diagram of uncontrolled two area load frequency control system and describe the salient features under static condition.

COURSE OUTCOME 4:

1. A 415kV line is fed through an 132/415 kV transformer from a constant 132kV supply. At the load end of the line, the voltage is reduced by another transformer of ratio 415/132 KV. The total impedance of line is 40+ j80 ohms both transformers are equipped with tap changing; the product of the two off nominal setting is unity. if the load on the system is 200 MW at 0.8 p.f lagging. Calculate the settings of the tap changers required to maintain the voltage at 132KV.
2. Develop the block diagram of AVR and obtain its transfer function and explain the static and dynamic response.

COURSE OUTCOME 5:

3. Explain with neat block diagram integration of economic dispatch with load frequency control
4. Analyse the coordination equation for economic dispatch including losses and give the steps for economic dispatch calculation, neglecting losses.

21EE8703	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3
Preamble					
This course introduces basic terms and techniques applicable to high voltage ac and dc networks. Generation of different type of High voltage waveforms, their measurement and analysis including the insulation coordination of different equipment's and machinery used in HV applications. It also provides a basic idea of FACTS devices and testing with the help of different testing circuits.					
Prerequisites for the course					
1. Transmission and Distribution					
Objectives					
1. To understand the Various types of over voltages in power system and protection methods					
2. Generation of over voltages in laboratories					
3. Measurement of over voltages.					
4. Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.					
5. Testing of power apparatus and insulation coordination					
UNIT I	**OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**	**9**			
Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Reflection and Refraction of Travelling waves Protection against over voltages.					

UNIT II	DIELECTRIC BREAKDOWN	9
Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics		
UNIT III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**	**9**
Generation of High DC, AC, impulse voltages and currents – Triggering and control of impulse generators.		
UNIT IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**	**9**
High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters – Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps – High current shunts- Digital techniques in high voltage measurement.		
UNIT V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION**	**9**
High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Familiar with the various types of over voltages in power system
2	Understand of the nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
3	Have adequate knowledge about generation of over voltages in laboratories.
4	Familiar with various measurement techniques of high voltages and high currents

5	Familiar with the various testing methods of power apparatus.

Text Books

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.

Reference Books

1. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013
2. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
3. C.L. Wadhwa, 'High Voltage Engineering', New Age International Publishers, Third Edition, 2010.

Web Recourses

1. https://nptel.ac.in/courses/108104048

21EE8704	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	0	0	3

Preamble

Compared with manual systems, automation systems provide superior performance in terms of precision, power and speed of operation. Industrial automation is the use of control devices such as PC/PLCs/PACs etc. to control industrial processes and machinery by replacing as much as possible labour intervention and dangerous assembly operations with automated ones. In industrial control a wide number of process variables such as temperature, flow, pressure, distance, and liquid levels can be sensed simultaneously. All the process variables are acquired, processed and controlled by complex microprocessor systems or PC based data processing controllers.

The control systems along with monitoring adapted to the operating environment in an industry for flexible, efficient and reliable production system. The automated system needs special dedicated hardware and software products for implementing control and monitoring systems.

Prerequisites for the course

- Measurement and Modern Instrumentation
- Control Systems

Objectives

To impart knowledge on the following topics

1. An overview about industrial automation and control
2. About the concepts of process control
3. About the concepts of sequence control
4. The concepts of distributed digital control systems
5. The concepts of production control systems

UNIT I	**Introduction to Industrial Automation and Control**	**9**
Architecture of Industrial Automation Systems. Introduction to Actuators: Flow Control Valves. Hydraulic Actuator Systems: Principles, Components and Symbols - Pumps and Motors, Proportional and Servo Valves Pneumatic Control Systems: System Components - Controllers and Integrated Control Systems. Electric Drives: Introduction, Energy Saving with Adjustable Speed Drives.		
UNIT II	**Introduction to Process Control**	**9**
P-- I -- D Control - Controller Tuning. Implementation of PID Controllers - Special Control Structures : Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response - Cascade Control, Overriding Control, Selective Control, Split Range Control- Case Studies.		
UNIT III	**Introduction to Sequence Control**	**9**
Introduction to Sequence Control, PLCs and Relay Ladder Logic, Scan Cycle, RLL Syntax -Structured Design Approach - Advanced RLL Programming - Functional Block diagram -The Hardware environment.		
UNIT IV	**Distributed Digital Control**	**9**
Distributed Digital Control, Networking of Sensors, Actuators and Controllers: The Fieldbus -The Field bus Communication Protocol – Profibus. Introduction to CNC Machines - Analysis of a control loop.		
UNIT V	**Production Control Systems**	**9**
Introduction to Production Control Systems - Programmable Automation Controller -Supervisory Control and Data Acquisition, Case Studies.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Explain the architecture of Industrial Automation Systems
2	Distinguish between sequence control, Digital and Numeric control
3	Develop Ladder Logic/ Functional Block based PLC program for a given industrial application
4	Explain the components and operation of Hydraulic Actuator Systems & Pneumatic control Systems
5	Calculate the energy savings with Electric motor drives. Explain the working principle of Distributed Control and SCADA

Text Books

1.Frank.D.Petruzella – Programmable Logic Controllers, Tata McGraw Hill Publishing company Ltd.,

2. Lukcas M P, “Distributed Control Systems”, Van Nostrand Reinhold Co., New York, 1986.

3. Krishna Kant, “Computer based Industrial Control”, 2nd Edition, Prentice Hall of India, 2010

Reference Books

1.Bill Hollifield "High Performance HMI Handbook"

2.Seborg, Edgar, Mellichamp, Doyle, Process Dynamics and Control, 3ed, Wiley India Publications, 2015

3. George Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", Prentice Hall of India, 2008

4. B.G. Liptak,"Instrument Engineers Handbook" Vol.1 to Vol.3, Butterworth Hienemann Limited, 2005

5.Bill Hollifield, "The Principles of Alarm Management"

WEB RESOURCE(S):

http://www.nptelvideos.in/2012/11/industrial-automation-and-control.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2													
2	2	1												
3	1	2	1		3									
4	2	1												
5	2	2	1	1										

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	30	20	20	10	20
UNDERSTAND	50	50	30	20	50
APPLY	20	30		20	30
ANALYZE					
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Illustrate the architecture of Industrial Automation Systems.
2. Mention the need of data acquisition system in Industrial automation systems.
3. List a few final control elements in Industries.

COURSE OUTCOME 2:

1. Provide examples for Sequential control in Industries.
2. Distinguish between Sequential control and Digital control.
3. Enlist the differences between Digital control and Numeric control.

COURSE OUTCOME 3:

1. When the lights are turned off in a building (assume 2 lights inside the building), an exit door light is to remain ON for additional 2 minutes. Then parking lot lights should remain on for additional 3 minutes after the door light goes out. Develop a PLC program to implement this process
2. A pump is to be used to fill two storage tanks. The pump is manually started by the Operator from a station. When the first tank is full, the control logic must be able to automatically stop flow to the first tank and direct flow to the second tank through the use of sensors and electric solenoid valves. When the second tank is full, the pump must shut down automatically. Indicator lamps are to be included to signal when each tank is full. Develop a PLC program to implement this process.
3. Two part conveyor lines, A and B, feed a main conveyor line M. A third conveyor line, R, removes rejected parts a short distance away from the main conveyor. Conveyors A, B and R have parts counters connected to them. Construct a PLC program to obtain the total parts

COURSE OUTCOME 4:

1. Explain the components of Pneumatic control systems.
2. Describe the components of Hydraulic control systems.

COURSE OUTCOME 5:

1. List the advantages of distributed control architecture over centralized control architecture
2. Define control complexity ratio
3. Explain about various types of approaches in designing a LCU control architecture
4. Discuss about the input and output devices used for high level operator interface.
5. How is the concept of DCS applicable to Water Treatment Plant? Discuss in detail.

Compiled By: Dr.N.Hemalatha, AP/EEE Verified By

21EE8705	**SPECIAL ELECTRICAL MACHINES AND CONTROLLERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Preamble					
This course aims to impart in students, a good understanding of fundamental principles of different types of special machines. The course includes constructional details, operating principles, motor characteristics, microprocessor based controllers and applications of various types of special machines.					

Prerequisites for the course

DC Machines and Transformer
AC Machines

Objectives

To impart knowledge on the following topics

1. To understand the construction and operating principle and and performance of synchronous reluctance motors.
2. To introduce the concepts of stepper motors and its applications.
3. To develop the control methods and operating principles of switched reluctance motors.
4. To understand the Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
5. To understand the Construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I	**SYNCHRONOUS RELUCTANCE MOTORS**	**9**

Constructional features – Types – Axial and Radial flux motors – Operating principles – Reluctance torque – Phasor diagram – Characteristics.

UNIT II	**STEPPING MOTORS**	**9**

Constructional features – Principle of operation – Variable reluctance motor – Single and multi-stack configurations – Permanent Magnet Stepper motor – Hybrid motor – Theory of torque predictions – Modes of excitations – Characteristics – Drive circuits – Closed loop control.

UNIT III	**SWITCHED RELUCTANCE MOTORS**	**9**

Constructional features – Principle of operation – Inductance profile – Characteristics – Torque equation – Power Converters and their controllers – Methods of Rotor position sensing – Current control schemes – Sensorless operation – Closed loop control of SRM.

UNIT IV	**PERMANENT MAGNET BRUSHLESS DC MOTORS**	**9**

Permanent Magnet materials – Magnetic Characteristics – Principle of operation – Types – Commutators : Mechanical and electronic commutators – Square wave permanent magnet brushless motor drives – Sensors – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control.

UNIT V	**PERMANENT MAGNET SYNCHRONOUS MOTORS**	**9**

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF –Sine wave motor with practical windings – Phasor diagram – Torque / speed characteristics – Power controllers – Converters.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Develop the knowledge in construction, principle of operation and performance of synchronous reluctance motors.
2	Explain the construction, various operating modes, control and performance of stepping motors.
3	Analyze the structure and operation, converters, and controllers of switched reluctance motors.
4	Review the construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
5	Illustrate the construction, principle of operation and control of permanent magnet synchronous motors.

Text Books

1. Miller T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Venkataratnam K., “Special Electric Machines”, Universities Press, 2009.

Reference Books

1. Krishnan R., "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2001.
2. Aearnley P.P., "Stepping Motors – A Guide to Motor Theory and Practice", Peter Perengrinus, London, 2002.
3. Kenjo T. and Nagamori S., „"Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 1988.
4. Gnanavadivel J., Karthikeyan J. and Albert Alexander S., “Special Electrical Machine”, Anuradha publications, 3rd Edition, 2007.
5. Kenjo T., “Stepping Motors and Their Microprocessor Controls”, Clarendon Press London, 2007.

Web Recourses

1. https://nptel.ac.in/courses/108104011/28
2. https://www.scribd.com/document/378009087/Special-Electrical-Machines-Lecture-Notes-Study-Material-and-Important-Questions-Answers

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2											3	
2	3	2											3	
3	3	2											3	
4	3	2											3	
5	3	2											3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDETSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Draw and explain the phasor diagram of synchronous reluctance motor. (Evaluate)

2. Derive the torque equation of synchronous reluctance motor. (Analyze)

COURSE OUTCOME 2:

1. Recommend suitable types of stepper motor for textile mill and explain the reason with the mechanical characteristics. (Evaluate)
2. A variable reluctance stepper motor has 8 poles and they have five teeth in each pole. If the rotor has 50 teeth, calculate the step angle and also resolution. (Evaluate)

COURSE OUTCOME 3:

3. Explain the steady state performance analysis of switched reluctance motor.(Evaluate)
4. A SRM with 6 stator poles and 4 rotor poles has a stator pole arc of 30 degree and rotor pole arc is 32 degree . The aligned inductance is 10.7mH and unaligned inductance is 1.5mH. Saturation can be neglected. Calculate the instantaneous torque when the rotor is 30° before the aligned position and phase current is 6A. What is the maximum energy conversion for one stroke, if the current is limited to 7A? Determine the average torque corresponding to this energy conversion.

COURSE OUTCOME 4:

1. A permanent magnet DC commutator motor has a stalling torque of 2 Nm. The stall current is 5 A.Compute the motor's no-load speed if it is fed with 28 V DC supply.
2. Derive the torque equation and torque ratio of permanent magnet brushless DC motor.

COURSE OUTCOME 5:

1. When does a PMSM operate as synchronous reluctance motor? (Analyze)
2. Discuss PMBLDC and PMSM with respect to torque/ampere and KVA of converter/ kW of power to motor for 4 Pole, 3 Phase motor system. (Evaluate)

Compiled By: Mr.J.Antony Robinson, AP/EEE Verified By

21EE8706	**ELECTRICAL AND HYBRID ELECTRIC VEHICLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

It is an introductory course which emphasize the fundamental concepts and overview of Electrical vehicles. The concepts discussed herein are intended to provide clarification on basic electrical vehicles, motors and drives for Electrical Engineering graduates.

Prerequisites for the course

1. Solid state drives

Objectives

1. To interpret the fundamental concepts of hybrid electric vehicles.
2. To develop the need of batteries in Electric and hybrid vehicles.
3. To impart knowledge on power electronics converters in Electric vehicles.

4. To analyze the use of AC and DC electrical machines used for hybrid electric vehicles.		
5. To design the energy storage components of hybrid electric vehicles.		
UNIT I	**INTRODUCTION TO ELECTRIC VEHICLE (EV) & HYBRID ELECTRIC VEHICLE (HEV)**	**9**
A brief history of Electric and Hybrid vehicles, basic architecture of hybrid drive train and analysis of series drive train., vehicle motion and the dynamic equations for the vehicle, types of HV and EV, advantages over conventional vehicles, vehicle mechanism, limitations of EV and HV, impact on environment of EV and HV technology, disposal of battery, cell and hazardous material and their impact on environment		
UNIT II	**POWER MANAGEMENT AND ENERGY SOURCES OF EV AND HV**	**9**
Power and Energy management strategies and its general architecture of EV and HV, various battery sources, energy storage, battery based energy storage and simplified models of battery, Battery Management Systems (BMS), fuel cells, their characteristics and simplified models, Super capacitor based energy storage, its analysis and simplified models.		
UNIT III	**POWER ELECTRONICS IN EV & HV**	**9**
Introduction, various power electronics converter topologies and its comparisons, Control of convertor operations in EV and HV, battery chargers used in EV & HV, emerging power electronic devices.		
UNIT IV	**DC AND AC MACHINES & DRIVES IN EV & HV**	**9**
Various types of motors, selection and size of motors, Induction motor drives and control characteristics, Permanent magnet motor drives and characteristics, Brushed & Brushless DC motor drive and characteristics, switched reluctance motors and characteristics, IPM motor drives and characteristics, mechanical and electrical connections of motors.		
UNIT V	**COMPONENTS & DESIGN CONSIDERATIONS OF EV & HV**	**9**
Design parameters of batteries, ultra-capacitors and fuel cells, aerodynamic considerations, calculation of the rolling resistance and the grade resistance, calculation of the acceleration force, total tractive effort, torque required on the drive wheel, transmission efficiency, consideration of vehicle mass, electric vehicle chassis & body design, general issues in design, specifications and sizing of components		
	Total Periods	**45**
Suggestive Assessment Methods		

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the architecture and vehicle dynamics of electric and hybrid vehicles
2	Analyze and model the power management systems for electric and hybrid vehicles
3	Devise power electronics based control strategies for electric and hybrid vehicles
4	Analyze and design various components of electric and hybrid vehicles with environment concern.
5	Investigate and model the issues in mathematical domain related to grid interconnections of electric and hybrid vehicle.

Text Books

1. Iqbal Hussain, "Electric and Hybrid Vehicles Design Fundamentals", 1st Edition, CRC Press, 2003.
2. James Larminie, John Lowry "Electric Vehicle Technology Explained", 1st Edition, John Wiley and Sons, 2003.

Reference Books

1. Chris Mi, M. Abul Masrur, David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley publication , 2011.
2. Allen Fuhs, "Hybrid Vehicles and the future of personal transportation", CRC Press, 2009.

Web Resources:

1. https://nptel.ac.in/courses/108/103/108103009/
2. https://nptel.ac.in/courses/108106170

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	2	3	2	2	1	1	3	-	-	-	-	-	-	-
2	3	3	2	2	3	-	3	-	-	-	-	-	-	-
3	2	3	2	2	2	2	3	-	-	-	-	-	-	-
4	3	3	3	3	3	1	3	-	-	-	-	-	-	-
5	2	3	3	3	3	1	3	-	-	-	-	-	-	-

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain the use of Propulsion System Design
2. Describe the Dynamics of vehicle motion.

COURSE OUTCOME 2:

1. Describe the Technical characteristics of Batteries in detail.
2. Elaborate the Battery pack Design.
3. Outline the Properties of Batteries in detail.

COURSE OUTCOME 3:

1. Write a brief note on Induction machines.
2. Describe the use of permanent magnet machines.
3. Explain switched reluctance machines.

COURSE OUTCOME 4:

1. Summarize the implementation issues of energy strategies in EV,
2. Organize the design of a Hybrid Electric Vehicle (HEV)
3. Derive the design of a Battery Electric Vehicle (BEV).

COURSE OUTCOME 5:

1. Summarize Battery based energy storage and its analysis.
2. Describe the fuel cell based and super capacitor based energy storage and its analysis.
3. Explain - Hybridization of different energy storage devices.

OPEN ELECTIVE I

21EE5801	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Preamble

With the advance technology, various biomedical equipment is being used by doctors, hospitals as well as industries. Even people are having the measuring devices to monitor blood pressure, glucose level, Heart beat level etc. With the huge demand of such devices, biomedical industries require more trained and certifies manpower.

Prerequisites for the course

No prior technical background is required

Objectives

- To understand the operations of Sensors, Transducers and Amplifiers
- To learn about the contribution of Sensors and Transducers in biomedical field
- To analyze the human body by Non-Electrical Parameters
- To learn about Bio-Potential measurements equipment to analyze the human organs
- To study about the advanced equipment to analyze the internal organs of human

Syllabus

UNIT - 1	SENSORS, TRANSDUCERS AND AMPLIFIERS IN BIOMEDICAL FIELD	9

Introduction of Nervous system – Cardiovascular system – respiratory system. Basic components of a biomedical system – Piezoelectric Transducers - Ultrasonic Transducers - Temperature measurements - Fibre Optic temperature sensors. Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier

UNIT - 2	BIOCHEMICAL MEASUREMENT USING SENSORS AND TRANSDUCERS	9
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.		
UNIT - 3	**NON-ELECTRICAL PARAMETER MEASUREMENTS**	**9**
Temperature, respiration rate and pulse rate measurements, Plethysmography, Pulse oximetry, Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, Oscillo metric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement-Indicator dilution, dye dilution and thermodilution method.		
UNIT - 4	**BIOPOTENTIAL MEASUREMENT**	**9**
Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven 's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG.		
UNIT - 5	**ADVANCED EQUIPMENT AND PATIENT SAFETY**	**9**
Radio graphic techniques – Computer tomography – MRI – Ultrasonography –Endoscopy – Thermography – Pacemakers – Ventilators Electrical safety analyzer – Testing the Electrical safety of medical equipment, Biomedical Laser Safety. Leakage current analysis-Instruments for checking safety parameters of biomedical equipment		

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
Written Test	Google Form based Online Test	Written Test

Outcomes

Upon completion of the course, the students will:

CO1: Able to analyze the characteristics of Sensors, Transducers and Amplifiers in Biomedical field

CO2: Able to Diagnose the disease and infection using Sensors, Transducers and Amplifiers

CO3: Able to measure and analyze the human body by Non-Electrical Parameters

CO4: Able to investigate the human organs using Bio-Potential Measurements

CO5: Able to identify the human body disease using advanced equipment

Text Books

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 5th Edition, 2018.
2. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 6th Edition, 2019.

Reference Books

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 4th Edition, 2019.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 5th Edition, Reprint 2018.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 3rd Edition, 2017.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 6th Edition, 2018.

Web Recourses

1. https://www.sciencedirect.com/science/article/pii/B9780323854139000050
2. https://www.slideshare.net/PrincyRandhawa/biomedical-instrumentation-60215990
3. https://www.electrical4u.com/introduction-to-biomedical-instrumentation/
4. https://www.robots.ox.ac.uk/~gari/teaching/b18/lecture_slides/B18_LectureA.pdf
5. https://www.eecs.umich.edu/courses/bme458/download/bme458_notes1.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
2	3	2	2	2				2				2		2
2	3			2	2			2				2		2
2	3	3	2	3	3	2		2				2		2
2	3	3	2	3	2			2				2		2
2	3	3	3	3		2		2		2		2		2

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	**10**	**10**			**10**
UNDETSTAND	**30**	**30**	**5**	**5**	**30**
APPLY	**60**	**60**	**10**	**10**	**60**
ANALYZE	**0**	**0**	**10**	**10**	**0**
EVALUATE	**0**	**0**			**0**
CREATE	**0**	**0**			**0**
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

(1) Give Brief notes on,

(i) Piezo electric Transducer

(ii) Ultrasonic Transducer

(2) Explain the human respiratory system with necessary diagram.

COURSE OUTCOME 2 (CO 2) :

(1) Illustrate the working of spirometer with experimental set-up.

(2) Explain about the measurement of PCO2 with neat diagram.

COURSE OUTCOME 3 (CO 3) :

(1) Explain the different analyzing methods of human blood flow

(2) Explain the operation of following,

(i) Plethysmography

(ii) Pulse oximetry

(iii) Pressure amplifiers

COURSE OUTCOME 4 (CO 4) :

(1) Explain the production of X-rays and draw the block diagram of X-Ray Machine.

(2)Draw and Explain the single channel telemetry system suitable for ECG.

COURSE OUTCOME 5 (CO 5) :

(1) Explain the different types of pacemaker with neat diagram

(2) Explain the working of MRI machine.

(3) Elaborate the different safety parameters of biomedical equipments.

21EE5802	**SENSORS AND TRANSDUCERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Preamble					
Transducer is process of converting non-measurable electrical signal into measurable electrical signals. For analyzing physiological signals first, it should be converted into measurable electrical signals. This course will introduce the learners to understand the purpose of measurement, the methods of measurements, errors associated with measurements, the basic principles and design issues of biomedical sensors and Instrumentation.					
Prerequisites for the course					
• Basic electronics • Measurements and Instruments					
Objectives					
1. To impart knowledge on the study of basic Measurement of sensors					
2. To learn the various sensors used to measure various physical parameters.					
3. To make the students to understand the concepts of measuring instruments and the methods ofmeasurement and the use of different transducers.					
4. Ability to understand optical, pressure and temperature sensor-based electronicsapplications.					
5. To learn the fundamentals of signal conditioning, data acquisition and communication systemsused in mechatronics system development.					
UNIT I	**INTRODUCTION**	**9**			
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.					

UNIT II	MOTION, PROXIMITY AND RANGING SENSORS	9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer. GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		
UNIT III	**FORCE, MAGNETIC AND HEADING SENSORS**	**9**
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		
UNIT IV	**OPTICAL, PRESSURE AND TEMPERATURE SENSORS**	**9**
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.		
UNIT V	**SIGNAL CONDITIONING and DAQ SYSTEMS**	**9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	4. ASSIGNMENT 5. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	To understand the concepts of different types of sensors.
2	To understand and compare basic knowledge of motion, proximity and ranging sensors.
3	To Apply the various sensors in the Automotive and Mechatronics applications
4	To Study the basic principles of various smart sensors
5	To Implement the DAQ systems with different sensors for real time applications

Text Books

1. Ernest O Doebelin, Measurement Systems – Applications and Design, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, A Course in Mechanical Measurements and Instrumentation and Control, 12th edition, Dhanpat Rai and Co, New Delhi, 2017.

Reference Books

1. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford Science Publications, 1999.
3. Richard Zurawski, Industrial Communication Technology Handbook 2nd edition, CRC Press, 2015.

Web Recourses

1. https://nptel.ac.in ›courses
2. https://www.egr.msu.edu/classes/ece445/mason/Files/4-Sensors_ch2.pdf
3. http://www.123seminarsonly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf
4. https://www.studocu.com/row/document/jomo-kenyatta-university-of-agriculture-and-technology/measurement-and-instrunmentation/lecture-notes-on-sensors-and-transducers/3804384.

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO 1	PSO 2
1	3	2	3		2		2	2					2	
2	3	2	3		2		2	2					2	
3	3	2	3		2		2	2					2	
4	3	2	3		2		2	2					2	
5	3	2	3		2		2	2					2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	**10**	**10**			**10**
UNDETSTAND	**30**	**30**	**5**	**5**	**30**
APPLY	**60**	**60**	**10**	**10**	**60**
ANALYZE	**0**	**0**	**10**	**10**	**0**
EVALUATE	**0**	**0**			**0**
CREATE	**0**	**0**			**0**
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain the normal Gaussian error (Analyze)
2. Explain the different type of systematic error (Apply)

COURSE OUTCOME 2:

1. List the three application of proximity sensor (Remember)
2. Compare capacitive and inductive transducers (Analyze)

COURSE OUTCOME 3:

1. What are the various characteristics features of strain gauge load cell? (understand)
2. Define Magneto restive effect (Apply)
3. Analyze the advantage of semiconductor strain gauge (Analyze)

COURSE OUTCOME 4:

1. How a thermistor differ from a thermo couple as a temperature sensor (Apply)
2. State the properties of piezoelectric crystals (Understand)
3. Discuss any one fiber optic sensor for displacement measurement (Analyze)

COURSE OUTCOME 5:

1. Explain the function of various sensor in an automated manufacturing process(Understand)

2. Explain how DAQ Assistant is used to acquire and generate signals with procedure for creating, configuring, Test and generate Lab VIEW code using DAQAssistant. (Apply)

21EE5803	**PRINCIPLES OF ROBOTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

To impart high technical knowledge, strong fundamentals, practical skills and creative knowledge for making successful professionals in Robotics and Automation.

Prerequisites for the course

1. **Basic Engineering Knowledge**

Objectives

1.	To introduce the functional elements of Robotics
2.	To impart knowledge on the direct and inverse kinematics
3.	To introduce the manipulator differential motion and control
4.	To educate on various path planning techniques
5.	To introduce the dynamics and control of manipulators

UNITI	**INTRODUCTION**	**9**

Brief history-Types of Robots–Technology-Robot classifications and specifications-Design and control issues-Various manipulators–Sensors -work cell-Programming languages.

UNIT II	**DIRECT AND INVERSE KINEMATICS**	**9**

Mathematical representation of Robots- Position and orientation–Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters-Degrees of freedom-Direct Kinematics-Inverse kinematics-SCARA robots-Solvability –Solution Methods-Closed form solution.

UNITIII	**MANIPULATOR DIFFERENTIAL MOTION AND STATICS**	**9**

Linearandangularvelocities-ManipulatorJacobian-Prismaticandrotaryjoints–Inverse-Wrist and arm singularity-Static Analysis-Force and moment Balance.

UNITIV	**PATH PLANNING**	**9**

Definition-Joint space technique-Use ofp-degree polynomial-Cubic polynomial-Cartesian spacetechnique - Parametric descriptions - Straight line and circular paths - Position and orientation planning

UNIT V	DYNAMICS AND CONTROL	9
Lagrangianmechanics-2DOFManipulator-LagrangeEulerformulation-Dynamicmodel–Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Ability to develop more understanding on functional elements of Robotics
2	Ability to derive the mathematical model and direct and inverse kinematics
3	To Analysis manipulator differential motion and control
	Ability to model different path planning techniques
5	Ability to apply the concepts dynamics and control of manipulators

Text Books

1. R.K.MittalandI.J.Nagrath,‘RoboticsandControl’,TataMcGrawHill,NewDelhi,4th Reprint, 2005
2. JohnJ.Craig,‘IntroductiontoRoboticsMechanicsandControl’,Thirdedition,Pears onEducation, 2009
3. M.P.Groover,M.Weiss,R.N.NagelandN.G.Odrej,‘IndustrialRobotics’,McGraw-HillSingapore, 1996.

Reference Books

1. Ashitava Ghoshal,‘Robotics-Fundamental Concepts and Analysis’, Oxford University Press, Sixth impression, 2010.
2. K.K.AppuKuttan,‘Robotics’, IK International,2007
3. EdwinWise, ‘AppliedRobotics’, Cengage Learning, 2003.
4. R.D.Klafter, T.A.Chimielewski and M.Negin, ‘Robotic Engineering– An Integrated approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh,‘Control in Robotics and Automation: Sensor Based Integration’, Allied Publishers, Chennai, 1998.
6. S.Ghoshal, ‘Embedded Systems & Robotics –Projects using the 8051 Micro controller cengage Learning, 2009.

Web Recourses

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112105249https:/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3												2	
2	1	2	3										2	
3	1	3	3										2	
4	1	2	3	3									2	
5	1	2	3										2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	40	40	10	10	40
UNDETSTAND	40	40	10	10	40
APPLY	20	20	5	5	20
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Define Industrial Robotics and How this will be useful in Industry application.
2. Explain about the classification of Robot based on i) Configuration ii)Control

COURSE OUTCOME 2:

1. Enumerate the significance of Homogeneous transformation Matrix.
2. Explain the forward and Reverse Manipulator with 2 degree of freedom.

COURSE OUTCOME 3:

1. Derive the Jacobian Matrix for the 2 link planner manipulator.
2. Explain the robot parts and its applications.

COURSE OUTCOME 4:

1. With the suitable example, brief out the position and orientation of centroid of any system.
2. Discuss in details the cubic polynomials.

COURSE OUTCOME 5:

1. List out the characteristics of automated guided vehicle and also explain the different types of robots presently in usage?
2. Design a robot to transfer material from one place to another place with example.

21EE5804	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

An expert system is a computer program that uses artificial intelligence (AI) technologies to simulate the judgment and behavior of a human or an organization that has expertise and experience in a particular field. Expert systems are usually intended to complement, not replace, human experts.

Prerequisites for the course

- Physics For Engineers

Objectives

1. To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
2. To introduce various sensors and actuators
3. To study different materials used for MEMS
4. To learn the rudiments of Micro fabrication techniques.
5. To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I	INTRODUCTION	9
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.		
UNIT II	**SENSORS AND ACTUATORS-I**	**9**
Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.		
UNIT III	**SENSORS AND ACTUATORS-II**	**9**
Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors..		
UNIT IV	**MICROMACHINING**	**9**
Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.		
UNIT V	**APPLICATION OF MEMS**	**9**
MEMS inertial sensors in automobiles, MEMS devices in commercial applications: Inkjet printers, Digital Micro mirror Devices (DMD), Radio frequency MEMS switches, Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.		
	Total Periods	**45**

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3. PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**
Outcomes		

Upon completion of the course, the students will be able to:	
1	Illustrate the concepts of MEMS and its process
2	Analyze the Electrostatic sensors and thermal sensing
3	Apply Piezo resistive and piezo electric sensors and actuators
4	Choose a micromachining technique, such as bulk micromachining and surface Micromachining for a specific MEMS fabrication process.
5	Apply mems technology in Polymer and optical sensing field.

Text Books

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2020.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2014.

Reference Books

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2019.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2018.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2015.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2016.

Web Recourses

1. A https://nptel.ac.in/courses/117105082
2. B https://www.memsnet.org/material/

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	0	0	0	0	0
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	10	10	5	5	10
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable methodfor (Apply)

1. Distinguish between bulk micromachining and surface micromachining.(Understand)
2. Demonstrate the equations for Mass, Acceleration, Transient time and Power Density using Trimmer Force Vector . (Apply)

COURSE OUTCOME 2:

1. Summarize the fabrication steps involved in the design ofbimetallic artificial cilia actuator. (Understand)
2. Design an infrared sensor by giving out the fabricationsteps in detail . (Apply)

COURSE OUTCOME 3:

1. Discuss on the concept of cantilever piezoelectric actuatormodel with neat diagram. (Understand)
2. Discover the need of flow rate sensor. Demonstrate the working and fabrication process of piezoelectric flow ratesensor. (Analyse)

COURSE OUTCOME 4:

1. Discuss in detail about the Assembly of 3D MEMS with any one Applications. (Analyse)
2. Deduce the limitations in micromachining.(Analyse)

COURSE OUTCOME 5:

1. Describe about fabrication process for a parylene channel. (Understand)
2. Deduce the role of MEMS as Secondary Storage in Computer System.(Analyse)

21EE5805	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

This course covers the fundamentals of lighting system, batteries and accessories. It discusses concepts of starting systems, charging systems, sensors and activators and gives exposure to various processes in automotive electronics.

Prerequisites for the course

1. DC Machines and Transformer
2. Modern Electronics Measuring Instruments

Objectives

1. To impart knowledge about the types of lighting system, batteries and accessories.
2. To introduce the basics concepts of starting systems.
3. To understand the aspects of charging systems.

4. To learn the various processes in automotive electronics.		
5. To familiarize the sensors and activators using Arduino.		
UNIT I	**ELECTRICAL SYSTEMS**	**9**
Principle and Construction of Lead Acid and Lithium-Ion Battery - Characteristics of Battery Rating Capacity and Efficiency of Batteries - Various Tests on Batteries - Maintenance and Charging - Lighting System and Photometry: insulated and Earth Return System- Details of Head Light and Side Light- LED Lighting System- Head Light Dazzling and Preventive Methods Horns- Wiper System.		
UNIT II	**STARTING AND IGNITION SYSTEM**	**9**
Condition at Starting- Behavior of Starter During Starting - Series Motor and Its Characteristics - Principle and Construction of Starter Motor - Over Running Clutch Working of Different Starter Drive Units - Care and Maintenances of Starter Motor - Starter Switches - Spark Plugs – Advance Mechanisms - Different Types of Ignition Systems.		
UNIT III	**CHARGING SYSTEM**	**9**
Generation of Direct Current - Shunt Generator Characteristics - Armature Reaction - Third Brush Regulation – Cutout - Voltage and Current Regulators - Compensated Voltage Regulator Alternators Principle and Constructional Aspects and Bridge Rectifiers - New Developments.		
UNIT IV	**ELECTRONICS SYSTEMS**	**9**
Current Trends in Automotive Electronic Engine Management System - Types of EMS Electromagnetic interference Suppression - Electromagnetic Compatibility - Electronic Dashboard Instruments - Onboard Diagnostic System - Security - Warning System infotainmentand Telematics.		
UNIT V	**SENSORS AND ACTUATORS**	**9**
Types of Sensors: Sensor for Speed - Throttle Position - Exhaust Oxygen Level - Manifold Pressure - Crankshaft Position - Coolant Temperature - Exhaust Temperature - Air Mass Flow for Engine Application – Solenoids - Stepper Motors – Relay - Introduction to Arduino about actuators and sensors.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1. ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes	
Upon completion of the course, the students will be able to:	
1	Distinguish the types of lighting system, batteries and accessories.
2	Describe the basics concepts of starting systems.
3	Explain the aspects of charging systems.
4	Explain the various processes in automotive electronics.
5	Develop the sensors and activators using Arduino.

Text Books

1. Tom denton, "Automotive Electrical And Electronics Systems", Allied Publishers, 2016.
2. A. L. Statini, "Automotive Electrical and Electronics", Delmar Publications, 2013.

Reference Books

1. William B.Ribbens "Understanding Automotive Electronics", Butter worth Heinemann Woburn, 2017.
2. Robert Bosch "Automotive Hand Book", SAE, 2018.
3. Ganesan.V. "Internal Combustion Engines", Tata McGraw Hill Private Limited, New Delhi, 2017.
4. Young A.P. & Griffiths. L. "Automotive Electrical Equipment", ELBS & New Press.
5. Bechhold "Understanding Automotive Electronics", SAE, 8th Edition - June 15, 2017.
6. Kohli P L., "Automotive Electrical Equipment", Tata McGraw Hill Publishing Co., Delhi, 2004.

Web Recourses

1. https://nptel.ac.in/courses/107106088
2. https://www.digimat.in/nptel/courses/video/107106088/L01.html

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3						3						3	
2	3						3						3	
3	3						3						3	
4	3						3						3	
5	3						3						3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			10
UNDETSTAND	40	40	10	10	40
APPLY	30	30	10	10	30
ANALYZE	20	20	5	5	20
EVALUATE					
CREATE					
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. List out and explain various tests conducted on a lead acid battery usedin automobiles. (Understand)
2. Write short notes on LED lightning system. (Understand)

COURSE OUTCOME 2:

1. Explain the constructional and working details of solenoid operated pinion driveof a starter motor with a sketch. (Apply)
2. Give the requirements of starter motor. (Apply)

COURSE OUTCOME 3:

1. State the function of cut-out in charging unit. (Apply)
2. Explain in detail the procedure adopted to test the working of a generator regulatorsystem and discuss the common faults occur in generators. (Analyse)

COURSE OUTCOME 4:

1. Write short notes on Electronic Dashboard Instruments. (Apply)
2. Explain in detail About Electronic Fuel Gauge. (Analyse)

COURSE OUTCOME 5:

1. Differentiate sensors and actuators. (Analyse)
2. Discuss the various actuators applied in an Automobile with its typical Applications.(Analyse)

21EE5806	**PCB DESIGN AND ITS FABRICATION**	**L**	**T**	**P**	**C**
		3	0	0	3
Prerequisites for the course					
3.Electron devices and circuits					
Objectives					
• To impart knowledge on the PCB and designing. • To learn about designing rules and its applications • To know about various production techniques. • To analyse the recent trends involved in PCB. • To implement various recycling methods.					
Syllabus					
UNIT I	**INTRODUCTION TO PRINTED CIRCUIT BOARD**	**9**			
Fundamental of electronic components, basic electronic circuits,Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.					

UNIT II	DESIGN RULES FOR PCB	9
Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Powerelectronic applications, Microwave applications.		
UNIT III	**PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES**	**9**
Photo printing, film-master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations.		
UNIT IV	**PCB TECHNOLOGY TRENDS**	**9**
Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.		
UNIT V	**PCB DESIGN FOR EMI/EMC**	**9**
Subsystem/PCB Placement in an enclosure, Filtering circuit placement, Decoupling and bypassing, electronic discharge protection, electronic waste; Printed circuit boardsRecycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards,		
Total Periods		45

Suggestive Assessment Methods		
Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams(60 Marks)**
(i)Google Form based-on- line Test (ii) Written Test	(i) Google Form based – online Testincorporating Listening, Speaking and Reading	(i) WrittenTest

Outcomes

Upon completion of the course, the students will be able to:

1. To understand basics of PCB designing.
2. To apply advance techniques, skills and modern tools for designing and fabrication ofPCBs.
3. To have the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
4. To understand concepts of Packaging.
   To analyze the modern tools for designing and fabrication of PCBs

Text Books

1. Printed circuit board design ,fabrication assembly and testing By R. S.Khandpur, Tata McGraw Hill2006

Reference Books

1. Printed circuit Board Design and technology, Walter C. Bosshart
2. Printed Circuits Handbook, Sixth Edition,by Clyde F. Coombs, Jr, Happy T. Holden,Publisher:

3. McGraw-Hill Education Year: 2016Complete PCB Design Using OrCAD Capture and PCB Editor,Kraig Mitzner Bob
4. Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009.

Web Resources

1. https://youtu.be/x7gr0rctsrE
2. https://nptel.ac.in/courses/108105088

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2	3		3		2	2			2		2	2
2	3	3	3		3		3	2			3		2	2
3	3	3	3		3		3	2			3		2	2
4	3	2	3		3		3	2			3		2	2
5	3	3	3		3		3	2			3		2	2

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	0	0	0	0	0
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	10	10	5	5	10
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

Open Elective II

21EE6801	ENERGY CONSERVATION & AUDITING	L	T	P	C
		3	0	0	3

Preamble

Energy conservation and auditing are critical components of today's sustainability and environmental preservation efforts. With growing concerns about energy consumption and greenhouse gas emissions, individuals and organizations must take steps to promote energy efficiency and reduce their carbon footprint. The Energy Conservation & Auditing course is designed to give participants a thorough understanding of energy conservation and auditing principles and practices. Through a blend of theoretical knowledge and practical skills, participants will gain the ability to assess energy consumption patterns, identify areas of energy wastage, and recommend measures to reduce energy usage.

Prerequisites for course

1. Laws of Thermodynamics and Heat Transfer
2. Knowledge of electrical and mechanical systems
3. HVAC systems
4. Renewable Energy Systems
5. Basic knowledge of environmental regulations and sustainability practices

Objectives

1. To provide a thorough understanding of energy conservation and auditing principles and practices.
2. Develop the skills required to conduct energy audits, identify areas of energy waste, and recommend energy-saving measures.
3. To increase understanding of energy-efficient technologies and best practices in energy conservation.
4. To provide participants with the tools and techniques needed to analyze and interpret energy usage data and develop energy-saving strategies.

5. To raise awareness of environmental sustainability and the environmental impact of energy use, as well as to encourage the adoption of energy-efficient practices in daily life and work.

UNIT I	Introduction to Energy Conservation and Auditing	9
Overview of energy conservation and auditing - The impact of energy consumption on the environment - The principles of energy efficiency and energy management - Overview of energy auditing and energy management programs - Key concepts in energy auditing and energy management.		
UNIT II	**Energy Auditing Fundamentals**	**9**
Types of energy audits - Energy usage patterns and data analysis - Energy data collection and measurement - Energy consumption calculation - Energy modeling and simulation.		
UNIT III	**Energy-Efficient Technologies and Best Practices**	**9**
Energy-efficient lighting systems - HVAC systems and their impact on energy consumption - Renewable energy systems and alternative energy sources - Energy-efficient appliances and building materials - Energy management systems and building automation.		
UNIT IV	**Energy Conservation Strategies and Implementation**	**9**
Energy management plan development - Implementation of energy conservation measures - Monitoring and evaluation of energy consumption - Energy savings analysis and return on investment - Reporting and communication of energy conservation results.		
UNIT V	**Regulatory Environment and Sustainability**	**9**
Energy conservation policies and regulations - Environmental sustainability and energy conservation - Corporate social responsibility and energy conservation - Energy labeling and certifications - Energy conservation case studies and best practices.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:	
1	Conduct thorough energy audits, analyze data on energy usage and identify areas of energy waste.
2	Create and put into action energy-saving strategies and best practices in energy conservation.
3	Evaluating the efficacy of energy-saving technologies and recommending appropriate solutions to reduce energy consumption.
4	Develop data analysis and interpretation skills, as well as the ability to monitor and analyze energy data using computer software and tools.
5	Effective communication with stakeholders is essential, as is raising awareness of environmental sustainability and energy conservation initiatives.

Text Books

1. "Energy Management Handbook" by Wayne C. Turner
2. "The Principles and Practice of Energy Management" by Keith Eaton and David Boaz

Reference Books

1. "Energy Management Handbook" by Wayne C. Turner, published by Fairmont Press, 2009.
2. "Building Energy Management Systems: Applications and Implementation" by Stuart R. Wenham, published by Springer, 2009.
3. "Energy Management Principles: Practices, Calculations, and Applications" by F. Mohammadzadeh, published by Routledge, 2013.
4. "Energy Auditing of Buildings: A Guide to Carbon Footprinting and Energy Conservation" by David M. Beitelman, published by Springer, 2011.
5. "Handbook of Energy Audits" by Albert Thumann, published by Fairmont Press, 2012.
6. "Sustainable Energy Management: A Guide for Energy Managers, Building Owners, and Facility Managers" by Michael D. Starr, published by Fairmont Press, 2010.
7. "Energy Efficiency in Buildings: A Guide to Best Practice in Energy Management" by Peter M. Cusick, published by Routledge, 2014.

Web Resources

1. https://sustainabilityeducationacademy.com/learn/introduction-to-energy- auditing/
2. https://alison.com/careers/stem/energy-conservation-specialist

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2			2			2		1				2
2	3	2			2			2		1				2
3	3	2	1		2			2		1				2
4	3	2	1		2			2		1				2
5	3	2			2			2		1				2

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDERSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

<u>COURSE OUTCOME 1:</u>

1. What are energy auditing and conservation, and what effects do they have on the environment? What are the foundational tenets of energy management

and efficiency?

2. What is energy conservation, why is it vital, and how does energy auditing fit into the scheme of things?

COURSE OUTCOME 2:

1. What types of energy audits are there? How are energy consumption measurements and analyses conducted? What best practices and technology are there for saving energy?
2. What effect do HVAC units have on energy use? How may renewable energy systems and other energy sources be incorporated into energy conservation efforts? What part do energy management systems and building automation play in energy conservation?

COURSE OUTCOME 3:

1. What function can energy management systems and building automation play in energy conservation, and how may energy conservation measures be put in place and tracked?
2. How do going green and sustainable energy interfere? What are energy conservation rules and regulations, and how do they affect energy conservation efforts?

COURSE OUTCOME 4:

1. Exactly what function does corporate social responsibility play in energy conservation? What are the benefits of energy certification and labelling, and how does it affect energy efficiency? Can you give an example of a successful energy conservation initiative?
2. How does green technology affect a building's or a firm's return on investment?

COURSE OUTCOME 5:

1. What function do energy analysis and design play in energy conservation efforts? How else can energy consumption patterns be examined and deciphered? What function do energy management strategies play in attempts to save energy?
2. Can you talk about the future prospects for energy conservation and energy auditing? What part do energy reporting and communication play in supporting energy conservation efforts?

21EE6802	Fundamentals and Modelling of Solar PV Systems	L	T	P	C
		3	0	0	3

Preamble

Prerequisites for the course

1. Power Electronics
2. Electronic Devices

Objectives

3. To acquire the basic principles of solar PV system
4. To Deal with grid connected PV system
5. To inculcate the knowledge on Grid tied PV system
6. To Discuss about different energy storage systems
7. To apply the concept of Solar PV in real life situations

UNIT I	INTRODUCTION	9

Introduction,Sun movement over the day, shadowing effects,Photovoltaic Cell.Advantages & disadvantages of photo-voltaic conversion.Use of solar cell in various instruments. Characteristics of sunlight – semiconductors and P-N junctions –behaviour of solar cells – cell properties – PV cell interconnection

UNIT II	STAND ALONE PV SYSTEM	9

Solar modules – storage systems – power conditioning and regulation - MPPT- protection – stand-alone PV systems design – sizing.

UNIT III	GRID CONNECTED PV SYSTEMS	9

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs, , Hybrid Systems, Photovoltaic in Energy Supply

UNIT IV	ENERGY STORAGE AND CONVERSION SYSTEM	9

Impact of intermittent generation – Battery energy storage – Battery technology, Batteries for Photovoltaic systems, Battery technology, Batteries for Photovoltaic systems, DC – DC converters, Charge Controllers, DC – AC inverters

UNIT V	APPLICATIONS	9

Water pumping –battery chargers – solar car–direct-drive applications –Space – Telecommunications.

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Develop more understanding on solar energy storage systems
2	Calculate the Power regulation for the given PV System.
3	Analyse the performance of Grid tied PV System
4	Model the different energy storage systems and their performances
5	Apply the concept of PV System in real time applications

Text Books

1. Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd.,2015.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, “AppliedPhotovoltaics”, 2007,Earthscan, UK.

Reference Books

1. Eduardo Lorenzo G. Araujo, “Solar electricity engineering of photovoltaic systems”, Progensa,1994.
2. Frank S. Barnes & Jonah G. Levine, “Large Energy storage Systems Handbook”, CRC Press, 2011.
3. McNeils, Frenkel, Desai, “Solar & Wind Energy Technologies”, Wiley Eastern, 1990 S.P. Sukhatme , “Solar Energy”, Tata McGraw Hill,1987

Web Recourses

1.https://nptel.ac.in/courses/115107116
2.https://archive.nptel.ac.in/courses/113/104/113104084/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1			2	2			3				3
2	3	1	1			2	2			3				3
3	3	1	1			2	2			3				3
4	3	1	1			2	2			3				3
5	3	1	1			2	2			3				3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	30	30	20	20	30
UNDETSTAND	40	30	20	20	30
APPLY	30	30	10	10	30
ANALYZE		10			10
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. could you explain theterm effect**of solarlight**, temperature and parasitic resistance on a solar cell?

2. Consider a photovoltaic string consisting of 'm' PV cells in series. 'n' such series photovoltaicstrings are connected in parallel, resulting in series parallel configuration. Assume that all theindividual PV cells are identical. The open circuit voltage and short circuit current of each PV cellare 2.1 V and 1.4 A respectively. If the short circuit current and open circuit voltage of the overallconfiguration are 4.2 A and 8.4 V respectively, what will be the value of (m+n) ?

COURSE OUTCOME 2:

1. List and elaborate protection methods employed for PV system? Explain in detail.
2. Explain about the regulators used in PV system

COURSE OUTCOME 3:

1. Enumerate the design issues for central power stations tied with Solar PVC system.
2. With the suitable example the explain the international solar PVC program.

COURSE OUTCOME 4:

1. Discuss in detail with a neat diagram the charge and discharge cycles of typical Li- ion battery.
2. Explain briefly thermal runway, capacity fading and loss of high-rate discharge capacity in Li-ion battery

COURSE OUTCOME 5:

1. Explain in details with necessary diagram, the principle of operation of SPVC based direct drive application and Battery charger.
2. Design of a PVC system for pumping 25000 litres of water every day from a depth of about 10 m is considered. The following data is to be assumed for: total vertical lift 12 m. water density =1000 kg/m^2. G= 9.8 m/s^2. SPVC module = 75 Wp. Operating factor =0.75, Pump efficiency =30% and mismatch factor =0.85.

21EE6803	GENERATION OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

Preamble

Providing an overview of generation of electrical Energy and importance electrical energy conservation.

To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels and to expose the students to the principles of safety and environmental issues

Prerequisites for the course

NIL

Objectives

1. Understand the layout, construction and working of the components inside a thermal power plant.
2. Understand the layout, construction and working of the components inside hydroelectric power plants.
3. Understand the layout, construction and working of the components inside nuclear power plants
4. Understand the construction and working of the components of solar energy sources
5. Understand the construction and working of the components of Wind energy sources

UNIT I	THERMAL POWER PLANT	9

Layout of modern thermal power plant, Subsystems of thermal power plants – Fuel and ash handling, Draught system. Binary Cycles and Cogeneration systems -Feed water treatment-Mechanical method, Advantages and disadvantages-limitations of Thermal power plant.

UNIT II	HYDRO ELECTRIC POWER PLANT	9

Hydrology, Hydrographs, Flow duration curve, Hydroelectric power plants - classification, Layout, auxiliaries and working of a hydro station

UNIT III	NUCLEAR POWER PLANTS	9

Nuclear power plant-introduction-nuclear fuels, nuclear fission and fusion, working of a nuclear power plant, types of reactors- pressurized water reactor- boiling water reactor, effects of nuclear radiation, different methods for nuclear waste disposal-low, medium and high level waste disposal, Advantages -disadvantages- limitations.

UNIT IV	SOLAR RADIATION AND SOLAR ENERGY COLLECTORS	9
Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - concentrating collector - advantages and disadvantages of concentrating collectors		
UNIT V	**WIND ENERGY**	**9**
Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze economics of power plants and list factors affecting the power plants and interpret the performance of power plants based on load variations.
2	Identify elements and their functions of, hydro power plants.
3	Identify elements and their functions and operations of nuclear power plant.
4	Identify elements and their functions and operations of Solar power plants.
5	Identify elements and their functions and operations of wind and power plants.

Text Books

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990

Reference Books

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

Web Recourses .

1. **https://archive.nptel.ac.in/content/storage2/112/107/112107291/MP4/mod03lec15.mp4**
2. **https://archive.nptel.ac.in/content/storage2/112/107/112107291/MP4/mod05lec21.mp4**

CO Vs PO Mapping and CO Vs PSO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
1	3		2		1									3
2	3		2		1									3
3	3		2		1									3
4	3		2		2									3
5	3		2		1									3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	25	25	20	20	30
UNDETSTAND	30	30	10	10	25
APPLY	20	20	10	10	25
ANALYZE	25	25	10	10	20
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. Define power plant
2. Explain briefly the working of thermal power plant

COURSE OUTCOME 2:

1. List the essential components of hydro electric power plant.
2. List the different factors to be considered while selecting the site for hydroelectric power plant

COURSE OUTCOME 3:

1. Define nuclear fusion and nuclear fission
2. Name the different nuclear fuels used for nuclear power plant

COURSE OUTCOME 4:

1. Define solar period
2. Explain briefly about solar cells.

COURSE OUTCOME 5:

1. List the advantages of wind power plant
2. Explain in brief about WECS

21EE6804	PLC and SCADA	L	T	P	C
		3	0	0	3

Preamble

It is an introductory course which emphasize the fundamental concepts and overview of PLC and SCADA. The concepts discussed herein are intended to provide clarification on basic electrical engineering for automation purpose.

Prerequisites for the course

1. Power system operation and control

Objectives

1. To impart knowledge on automations and their types for the control of AC and DC drives in industry process.
2. To acquire the basic concept of PLC and their Interfaces.
3. To develop an Industrial Automation applications using PLC
4. To analyse the concept involved in SCADA.
5. To provide an overview of Industrial Automation applications using SCADA and DCS.

UNIT I	INTRODUCTION	9

Definition of Automation, Types & Application of Automation to Industry processors, Architecture of Industrial Automation system, Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives for motion control

UNIT II	PLC HARDWARE COMPONENTS	9

The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).

UNIT III	BASICS OF PLC PROGRAMMING	9

Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation.

UNIT IV	SUPERVISORY CONTROL AND DATA ACQUISITION	9
Introduction to SCADA – SCADA Functional requirements and Components – General features, Functions and Applications, Benefits – Configurations of SCADA, RTU (Remote Terminal Units) Connections – SCADA Communication requirements – Structure of a SCADA Communications Protocol.		
UNIT V	**APPLICATIONS OF SCADA & DCS IN INDUSTRIES**	**9**
Applications of SCADA & DCS in Thermal power plant, Cement manufacturing Industries, Sugar Industries, paper manufacturing Industries and Water Treatment plant		
	Total Periods	**4 5**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Design automation and control methods of AC and DC drives
2	Understand the basic concept of PLC and their Interfaces
3	Discuss history of PLC and describe the hardware components of PLC
4	Describe field devices Relays, Contactors, Motor Starters, Switches, Sensors, Output Control Devices, Seal-In Circuits, and Latching Relays commonly used with I/O module.
5	Develop Industrial Automation applications using SCADA and DCS

Text Books

1. Garry Dunning, "Introduction to Programmable Logic Controllers", CENGAGE Learning, 3rd edition, 2006.
2. Frank D.Petruzella, "Programmable logic controllers", McGraw-Hill Inc.,US; 4th edition 2010.

Reference Books

1. Krishna Kant, "Computer Based Industrial control", PHI Publishers, 2nd Edition, 2006.

Web Resources

1. Industrial Automation and Control - Course (nptel.ac.in)

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	2	1	2									3
2	3	2	3	2	2							2		3
3	3	3	3	3	3	3					2			3
4	3	3	2	2	2	2			2		2			3
5	3	2	3	3	3	3	3				3	2		3

1-Low 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. Describe the Sensors used for measuring temperature(Understand)
2. Draw and explain the general rules in automation.(Analyse)

COURSE OUTCOME 2:

1. Analyze the analog I/O modules (Analyse)
2. Describe the Human Machine Interfaces in automation (Understand)

COURSE OUTCOME 3:

1. What is meant by Processor Memory Organization.(Remember)
2. Summarize the Safety measures in the use of automation(Understand)

COURSE OUTCOME 4:

1. Explain the Need for SCADA. (Understand)
2. Analyze how the Classification of equipments was made (Analyse)

COURSE OUTCOME 5:

1. Explain briefly the applications of SCADA? (Understand)
2. Describe the operation of Cement manufacturing Industries. (Understand)

21EE6805	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

Renewable energy systems are becoming more popular for electricity generation since they are clean and can fulfill the power requirement at the local level. They reduce the congestions in the power grid and also reduce the burden in hydro and thermal based power plants. The concepts discussed herein are intended to provide clarification on power electronics for renewable energy systems for Electrical Engineering graduates.

Prerequisites for the course

1. Power Electronics
2. Power Generation Systems

Objectives

1. To know the importance of energy conversion in the present energy scenario

2. To discuss the environmental and the availability of renewable energy sources for Solar energy conversion.		
3. To Outline the concepts related to conventional and non-conventional energy.		
4. To Understand the hybrid renewable energy resources for grid integration and facilitate developing renewable systems for domestic and industrial applications		
5. To use of Biomass energy and to perform desired generation strategy.		
UNIT I	**INTRODUCTION**	**9**
Recent trends in energy consumption - World energy scenario - Energy sources and their availability - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies.		
UNIT II	**SOLAR ENERGY CONVERSION**	**9**
Photovoltaic Energy Conversion: Working principle – Energy conversion – Maximum power tracker – Photovoltaic system components – Factor influencing output – System design –Power electronics for photovoltaic power systems - DC Power conditioning converters - AC power conditioners - Line commutated inverters - synchronized operation with grid supply		
UNIT III	**WIND ENERGY CONVERSION**	**9**
Wind Energy Conversion Systems: Basic principle of wind energy conversion – nature of wind - Wind survey in India - Power in the wind - Components of a wind energy conversion system - Performance of Induction Generators for WECS –IG-SCIGPMSG - Classification of WECS – Power electronics converter for variable speed wind turbines –Matrix - Multilevel converters for very high power wind turbines – Future trends		
UNIT IV	**FUEL CELL POWER ELECTRONICS FOR DISTRIBUTED GENERATION (DG)**	**9**
Fuel Cell - Working Principle – Distributed generation – Fuel cell based energy system for DG – Power electronic topologies for residential stationary fuel cell energy systems –Issues in fuel cell power conditioning system –Energy management system issues –Auxiliary storage		
UNIT V	**BIOMASS ENERGY**	**9**
Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.		
	Total Periods	**45**
Suggestive Assessment Methods		

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. ASSIGNMENT 2. ONLINE QUIZZES 3. PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Analyze the environmental aspects and impacts of renewable energy and describe various types of renewable energy sources
2	Apply suitable power converters for solar power generation and able to describe them in detail.
3	Apply suitable power converters for wind power generation and able to describe them in detail.
4	Apply suitable technique for Fuel cell design and selection
5	Analyze the need of biomass energy and case studies of different hydropower schemes.

Text Books

1. Rashid .M. H, "Power Electronics Hand book", Academic press, Second edition, 2006.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
4. Rai,G.D., "Non- conventional resources of energy", Khanna publishers, Fourth edition, 2010.

Reference Books

1. Rao. S. & Parulekar, “Energy Technology”, Khanna publishers, Fourth edition, 2005.
2. Pai, B. R. and Ram Prasad, “Power Generation through Renewable Sources of Energy”, Tata McGraw Hill, New Delhi, 1991.
3. Bansal, Kleeman and Meliss, “Renewable Energy Sources and Conversion Techniques”, Tata Mc Graw Hill, 1990.
4. Godfrey Boyl, “Renewable Energy: Power sustainable future”, Oxford University Press, Third edition, 2012.
5. Khan B.H., “Non-Conventional Energy Resources”, The McGraw Hills, Second edition, 2009.
6. John W Twidell and Anthony D Weir, “Renewable Energy Resources”, Taylor and Francis, 2006.
7. Freris L.L., “Wind Energy Conversion systems”, Prentice Hall, UK, 1990.

Web Recourses

1. https://nptel.ac.in/courses/108/108/108108078/
2. https://nptel.ac.in/courses/108/108/108108034/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2						3					2	
2	3	3	3		3						3		2	
3	2	3	3		3						3		2	
4	2	3	2										2	
5	2	3	3										2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	5	5	20
UNDETSTAND	40	40	10	10	40
APPLY	40	40	10	10	40
ANALYZE					
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to Predict the suitable method for….(Apply)

1. What are the contributions of GHG Emissions in renewable energy generation?
2. List out the salient features of renewable energy resources.

COURSE OUTCOME 2:

1. What are the factors to be considered for the selection of batteries for solar energy conversion system?
2. What will happen if no load is connected to a solar PV system?

COURSE OUTCOME 3:

1. Why are induction generators preferred over DC generators in WECS?
2. What are the constructional differences between SCIG and DFIG?

COURSE OUTCOME 4:

1. Mention the use of a fuel cell.
2. Justify how fuel cell becomes renewable energy source.

COURSE OUTCOME 5

1. What is the meaning of biomass? Further, discuss its multipurpose utilization:
2. Explain with a neat sketch explain the operation flashed steam geothermal power plant.

21EE6806	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

Preamble

The course is designed to give students the required knowledge for the Fiber optics and LASER have been used in the industry for years. The physical characteristics of fiber make it as a natural choice for many different applications. Traditional fiber optic applications include light therapy, x-ray imaging,. In this course students will learn optical properties of the tissues and the applications of laser in diagnosis and therapy. They get knowledge about instrumentation in photonics and understand the safety usage of laser.

Prerequisites for the course

1. Physics For Engineers

Objectives

1. To expose the students to the basic concepts of optical fibres and their properties.
2. To provide adequate knowledge about the Industrial applications of optical fibres.
3. To expose the students to the Laser fundamentals.
4. To provide adequate knowledge about Industrial application of lasers.
5. To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT I	OPTICAL FIBRES AND THEIR PROPERTIES	9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, – Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fiber characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers

UNIT II	INDUSTRIAL APPLICATION OF OPTICAL FIBRES	9
Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflect meters, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length		
UNIT III	**LASER FUNDAMENTALS**	**9**
Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Mon chromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.		
UNIT IV	**INDUSTRIAL APPLICATION OF LASERS**	**9**
Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material		
UNIT V	**HOLOGRAM AND MEDICAL APPLICATIONS**	**9**
Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non- destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1. **ASSIGNMENT** 2. **ONLINE QUIZZES** 3. **PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

1	Ability to Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers.
2	Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3	Ability to Understand laser theory and laser generation system.
4	Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.
5	To provide adequate knowledge about holography and Medical applications of Lasers

Text Books

1. J.M. Senior, ‘Optical Fibre Communication – Principles and Practice’, Prentice Hall of India,1985.
2. J. Wilson and J.F.B. Hawkes, ‘Introduction to Opto Electronics’, Prentice Hall of India, 2001.

Reference Books

1. Eric Udd, William B., and Spillman, Jr., “Fiber Optic Sensors: An Introduction for Engineers and Scientists John Wiley & Sons, 2011
2. G. Keiser, ‘Optical Fibre Communication’, McGraw Hill, 1995.
3. John F. Ready, “Industrial Applications of Lasers”, Academic Press, Digitized in 2008.
4. Monte Ross, ‘Laser Applications’, McGraw Hill, 1968.
5. John and Harry, “Industrial lasers and their application”, McGraw-Hill, 2002.
6. Keiser, G., “Optical Fiber Communication”, McGraw-Hill, 3rd Edition, 2000

Web Recourses

1. **https://nptel.ac.in/courses/115107095**
2. **http://nptel.ac.in/courses/117101002/**

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
1	3	3										2	3	
2	3	3										2	3	
3	3	3										2	3	
4	3	3										2	3	
5	3	3										2	3	

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDETSTAND	30	30	10	10	30
APPLY	30	30	10	10	30
ANALYZE	20	20	10	10	15
EVALUATE	10	10	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low , 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Students will be able to predict the suitable method for Apply and Analyse

COURSE OUTCOME 1

1. Elaborate about the various attenuation losses possible in optical fibres. Also discuss how intra modal and inter modal dispersion can be minimized. (Apply)
2. What are the general requirements considered while selecting a light source for fibre optic link? Explain about the construction and working of photomultiplier Tubes used as optical source in fibre communication. (Analyze)

COURSE OUTCOME 2:

1. Point out the working principle of Electro optic modulator with a neat sketch. (Analyze)
2. Explain the significance of fibre optic sensor with other commercial sensor and describe in detail. (Analyze)

COURSE OUTCOME 3:

1. With the help of an energy diagram, analyze how four level laser system is advantageous to three level laser system .Also explain the construction and working of a four level laser. (Analyze)
2. Compare a homo junction laser with hetero junction laser based on the electron beam principle. (Apply)

COURSE OUTCOME 4:

1. Analyze the role of laser for industrial measurements and explain anyone in detail. (Analyze)
2. Explain the principle of laser for the measurement of cold atom interferometry.(Analyze)

COURSE OUTCOME 5:

1. Analyze the principles of holographic inferometry and its application in Non-destructive Testing of materials (Analyze)
2. Explain how laser is used for Brain surgery and Plastic surgery. (Analyze)

OPEN ELECTIVE III

21EE7801	ELECTRICAL EQUIPMENT SAFETY	L	T	P	C
		3	0	0	3

Preamble

It is an professional elective course which emphasizes the advanced concepts and overview of Operation And Maintenance Of Electrical Equipment in Electrical Engineering. The concepts discussed herein are intended to provide clarification on Operation And Maintenance Of Electrical Equipment in for Electrical Engineering graduates.

Prerequisites for the course

Nil

Objectives

1. To introduce the various causes for accident and also explain the role of safety engineer
2. To educate on use of Earthing techniques
3. To educate on the Maintenance of Electrical equipments
4. To introduce the Maintenance Generator and Substation
5. To educate on the Maintenance of Switchgears

UNIT I	ELECTRICAL ACCIDENTS AND SAFETY	9

Causes of electrical accidents – Factors affecting severity of electrical shock - Actions to be taken when a person gets attached to live part - Safety regulations and safety measures- Indian electricity supply act 1948-1956; Factory Act -1948; Fire extinguishers- Building Electrical Installations – Annual Inspection, Safe working of Electrical Equipments.

UNIT II	EARTHING	9

Necessity of earthing - System earthing: advantage of neutral earthing of generator in power station; Equipment earthing: Objective - Types of earth electrodes – Methods of earthing :plate earthing, pipe earthing and coil earthing - Earthing in extra high voltage and underground cable, Earthing resistance- factors affecting, Determination of maximum permissible resistance of the earthing system - Comparison between equipment earthing and system grounding

UNIT III	TRANSFORMER, MOTORS (DC AND AC) AND STARTERS	9

Maintenance schedule of transformer (Below and above 1000kVA): -Insulation co-ordination and Impulse voltage testing, Lightning arrestor. Maintenance and Trouble shooting – Oil Purification and Testing. Maintenance of DC, AC Motors and their Starters: – Operation, Routine and Breakdown Maintenance, Causes of failure, Precautions and Trouble shooting.

UNIT IV	GENERATOR AND SUBSTATION	9

Maintenance of Generator: Operation, Routine and breakdown Maintenance, Causes of Failure and Precautions. Maintenance of Substation: Operation, Routine & breakdown Maintenance, Causes of Failure and Precautions. Sub-station shut down procedure -certificate of requisition for shut down; certificate of Permit to work and certificate of Line clear - Instruction for the safety of persons working on a job with a permit to work.

UNIT V	SWITCHGEARS, TRANSMISSION AND DISTRIBUTION SYSTEM	9
Maintenance of Switchgear: – Operation, Routine and breakdown Maintenance, Causes of Failure and Precautions. Maintenance of Transmission and Distribution system: – Rules for Low, Medium and High voltages, Factor of safety, precautions - Minimum Clearance,Conductors, System protection.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Describe the causes of electrical accidents, safety measures and regulations.
2	Describe earthing concept, different methods of earthing, earth resistance and its measurement
3	Discuss the fundamentals of different types of maintenance and its procedures and records.
4	Explain the operation and maintenance practices for various electrical equipment and systems.
5	Apply suitable troubleshooting practices for various electrical equipment and systems.

Text Books

1. B.V.S.Rao, “Operation and Maintenance of Electrical Equipment”, Volume I & II, 2008 Edition, Media Promoters & Publishers Pvt. Ltd., Mumbai..

Reference Books

1.S. Rao, “Testing Commissioning Operation and Maintenance of Electrical Equipments”, Sixth Edition, Khanna Publishers, New Delhi, 2010.
2. Tarlok Singh, “Installation Commissioning and Maintenance of Electrical Equipments”, First Edition, S. K. Kataria & Sons, 2013. L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
3. Paul Gill, “Electrical Power Equipment Maintenance and Testing”, Second Edition, CRC Press, 2013.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc22_ee35/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	1	2		2									3
2	3	1	2		2									3
3	3	1	2		2									3
4	3	1	2		2									3
5	3	1	2		2									3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. If a blackout occurs, what are your methods for troubleshooting?
2. Differentiate between a generator and an alternator

COURSE OUTCOME 2:

1. Are you familiar with the different varieties of wires used in transmission?
2. Name some self-protection equipment you use at work.

COURSE OUTCOME 3:

1. Tell us about proximity sensors and various principles of using them
2. How is a servo motor different from a stepper motor?

COURSE OUTCOME 4:

1. Causes of electrical accident? Factor on which severity of shock depends
2. Parallel operation of transformer & preventive maintenance of transformer.

COURSE OUTCOME 5:

1. State and explain the factors affecting the life of insulating material.
2. Differentiate between installation earthing and system earthing.

Compiled By : Mrs.R.Aandal, AP/EEE Verified By

21EE7802	Measurement and Instrumentation System	L	T	P	C
		3	0	0	3

Preamble

This course is designed to impart fundamental knowledge of analog measuring instruments characteristics. This course exposes the knowledge about the construction, principle and applications of analog and digital measuring instruments. Students will get the fundamental knowledge of DC and AC null measurement methods along with its behaviors on its various applications.

Prerequisites for the course

1. Physics for Engineers
2. Electric Circuits and Network Analysis
3. Analog and Integrated Circuits

Objectives

To impart knowledge on the following Topics

1. To impart knowledge on Basic functional elements of instrumentation
2. To learn about the Fundamentals of electrical and electronic instruments
3. To study the Measurement of Capacitance, Inductance and resistance
4. To discuss about storage and display devices
5. To introduce Various transducers and the data acquisition systems

UNIT I	CHARACTERISTICS, ERRORS & STANDARDS OF INSTRUMENTS	9

Functional elements of generalized instrumentation systems- Static and dynamic characteristics of measuring instruments- Absolute- Statistical estimation of measurements data (Arithmetic mean, Average deviation, Standard deviation, Variance and Probable error of mean) Errors in measurement – Standards and calibration.

UNIT II	ELECTRICAL MEASURING INSTRUMENTS	9

Classification of measuring instruments, working principle and Torque equation of Permanent Magnet Moving Coil instruments - Attraction type and Repulsion type Moving iron instruments- Electro-dynamometer type Wattmeter, Extension of voltmeter and ammeter range - Construction, working principle of Instrument transformers -1φ and 3φ Induction type Energy meter.

UNIT III	MEASUREMENT OF RESISTANCE, INDUCTANCE & CAPACITANCE	9
D.C Bridges: Wheatstone Bridge, Kelvin's bridge, Kelvin's double bridge - A.C bridges: Maxwell bridge, Anderson bridge, Hays bridge, Schering bridge, Wein's bridge.		
UNIT IV	**STORAGE AND DISPLAY DEVICES**	**9**
Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.		
UNIT V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**	**9**
Classification of transducers – Selection of transducers –Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors- Thermal Imagers.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Apply the basic laws governing the operation of the instruments
2	Compare the operation of various types of measuring instruments.
3	Determine the unknown values of R, L, C using bridges
4	Analyze the operations of storage and display devices
5	Apply the suitable transducers and the data acquisition systems

Text Books

1. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, 18th Edition, 2012.
2. Gupta J.B., "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, Delhi, 2009.

Reference Books

1. Prithwiraj Purkait, Budhaditya Biswas, Chiranjib Koley "Electrical and Electronics Measurements and Instrumentation", McGraw Hill Education India, First Edition, 2013.
2. Golding E W, and Widdis F C, "Electrical Measurements and Measuring Instruments", A H Wheeler & Company, Calcutta, Fifth Edition, 2011.
3. Doeblin E., "Measurement Systems: Application and Design", Mc-Graw Hill Book Co., Fifth Edition, New Delhi, 2004.
4. Moorthy D.V.S, "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd, 2007.
5. Patranabi.D, "Sensors and Transducers", PHI Learning Pvt. Ltd., 2003. 6. Kalsi H.S, "Electronic Instrumentation", McGraw Hill Education India, 3rd Edition, 2010.

Web Recourses

1. https://archive.nptel.ac.in/courses/108/105/108105153/
2. https://archive.nptel.ac.in/courses/108/105/108105153/
3. https://archive.nptel.ac.in/courses/108/105/108105153/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	1		1				1				1			3
2	1		2				1				1			3
3	2		2				2				2			3
4	2	2	2				2				2			3
5	3	3	2				3							3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	10	10	10
UNDETSTAND	30	30	10	10	30
APPLY	30	30	10	10	30
ANALYZE	20	20	10	10	15
EVALUATE	10	10	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

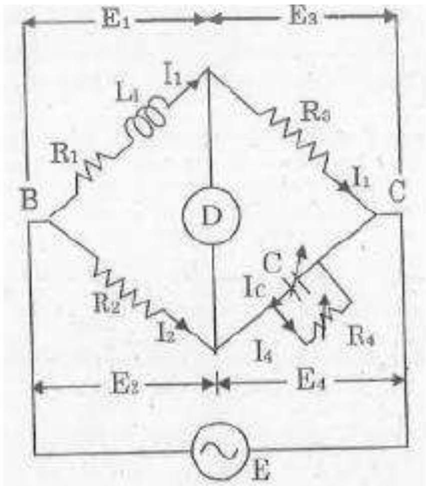
3. What are the different inputs for studying the Dynamic response of a system? Compose and Sketch them.
4. Classify and explain the different types of error and also mention its compensation methods (Understand)

COURSE OUTCOME 2:

1. Discuss with Circuit and Phase diagram, describe the working of Three phase AC Energy Meter.(Analyze)
1. Describe the Construction and Working of Permanent Magnet Moving coil Instrument. Also Derive the expression for deflection.(Understand)

COURSE OUTCOME 3:

3. A Maxwell's Capacitance Bridge Shown below figure, is used to measure an unknown inductance in comparison with capacitance. The various values at balance: R2= 400ohm; R3= 600ohm; R4=1000ohm; C4=0.5µF.Calculate the value of R1 and L1.Calculate also the value of storage Q Factor of the coil if frequency is 1000Hz. (Analyze)



1. Draw a neat diagram of Kelvin double bridge and explain how to measure low resistance. (Analyze)

COURSE OUTCOME 4:

1. Develop a neat block diagram of X-Y recorder and describe it's working.
2. Explain the Dot matrix printer working and sketch the construction layout.

COURSE OUTCOME 5:

3. Describe the measurement of resistance using strain gauge.(Analyze)
4. Explain in detail about Hall Effect transducer and mention some applications of Hall Effect transducer.

Compiled By : S.Selvakumar,AP/EEE　　　　Verified By

21EE7803	Control Engineering	L	T	P	C
		3	0	0	3
Preamble					
Control Systems plays vital role in the advance of engineering and science. Automatic control has become an important and integral part of modern manufacturing and industrial processes. In recent years there has a rapid increase in the use of digital controller in control systems. Digital controls are used for achieving optimal performance in the form of maximum productivity, maximum profit and minimum cost. Decision making capability and flexibility in the control programs are major advantages of digital control systems. The study of analog and discrete time control system prepares the student for early productivity upon entering industrial practice.					
Prerequisites for the course					
1. Engineering Mathematics					
Objectives					
1. To introduce the use of transfer function models for analysis physical systems and the					

control system components.		
2. To provide adequate knowledge in the time domain analysis of the systems.		
3. To discuss the frequency domain analysis of the systems		
4. To study the stability analysis.		
5. To learn the design of compensators and state variable representation of physical systems		
UNIT I	**Basics of Control Systems**	**9**
Open loop LTI systems, Closed loop LTI systems, Modelling in Laplace Domain, Laplace transform review, transfer function, electrical network transfer function, Electric circuits analogs, Modelling in time domain.		
UNIT II	**Time response**	**9**
Poles, zeros and system response, First order systems, second order Systems, General second order systems, underdamped second order systems, Higher order systems, System response with additional poles, system response with zeros, Effects of non linearities upon time response		
UNIT III	**Reduction of multiple subsystems and Stability**	**9**
Reduction of multiple subsystems: Block diagrams, Analysis and design of feedback systems, signal flow graphs, Mason‟s rule, signal flow graph of state equation. Stability: Routh Hurwitz criterion, Root locus techniques, Nyquist stability		
UNIT IV	**Frequency response techniques**	**9**
Bode plot, Nyquist diagram, Gain margin, phase margin, transient response via gain adjustment, Lag compensation, Lead compensation, Lag-Lead compensation.		
UNIT V	**Digital Control systems**	**9**
Modeling the digital computer, z-transforms, transfer functions, block diagram reduction, stability, transient response on the z-plane, gain design on the z-plane, Implementing the digital compensator.		
	Total Periods	**45**
Suggestive Assessment Methods		
Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**
Outcomes		

Upon completion of the course, the students will be able to:	
1	Develop a mathematical model for a given system in Laplace domain and time domain
2	Compute and describe the output response and steady state error of first, second and higher order control systems for standard input signals
3	Compute transfer function of multiple subsystems modelled as block diagram/ signal flow graph/ state space representation
4	Find the closed loop frequency response and time response parameter given the open the loop frequency response.
5	Design stable analog/digital system to meet given steady state/transient response specifications

Text Books

1. Norman Nise, " Control System Engineering" John Wiley & Sons, 6th Edition,2011
2. Katsuhiko Ogata, "Modern Control Engineering", 4th Edition, Prentice Hall,2002

Reference Books

1. Katsuhiko Ogata, "Discrete time control systems", 2nd Edition, Prentice Hall, 1995
2. M Gopal, "Control Systems Principles and Design", Tata McGraw Hill,2002,
3. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
4. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition, 2007

Web Recourses

1. https://archive.nptel.ac.in/courses/107/106/107106081/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	3	2										3	
2	2	3	2										3	
3	2	3	2										3	
4	2	3	2										3	
5	2	3	2										3	

1-Low , 2- Medium, 3- High

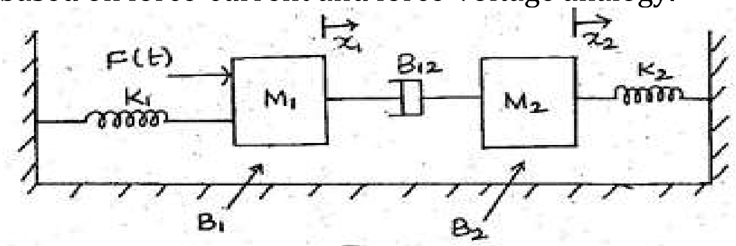
BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10			0
UNDETSTAND	50	50	25	25	50
APPLY	10	10			20
ANALYZE	30	30	25	25	30
EVALUATE					
CREATE					
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Write the differential equations for the system shown below. Obtain the electric circuit based on force-current and force-voltage analogy.



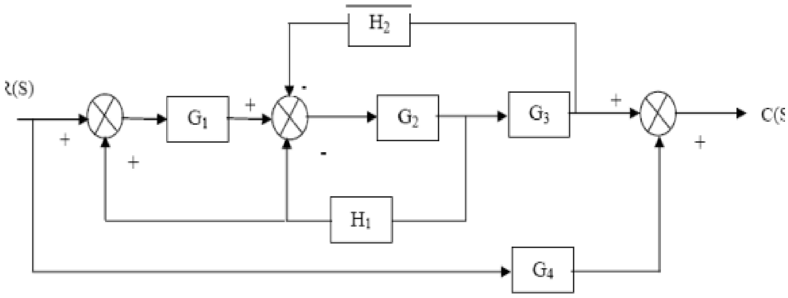
2. The open loop transfer function of servo system with unity feedback is $G(S) = \frac{10}{S(0.1S+1)}$. Evaluate the static error constants (K_p, K_v, K_a) for the system. Obtain the steady state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + \frac{a_2 t^2}{2}$.

COURSE OUTCOME 2:

1. A unity feedback control system has an open loop transfer function $G(S) = \frac{10}{S(S+2)}$. Find the rise time, peak time, percentage overshoot and settling time for step input of 12 units.
2. Derive the expression for Peak time and Settling time for the underdamped second order system with unit step input.

COURSE OUTCOME 3:

1. Using Block diagram reduction technique finds the transfer function for the system shown in fig.



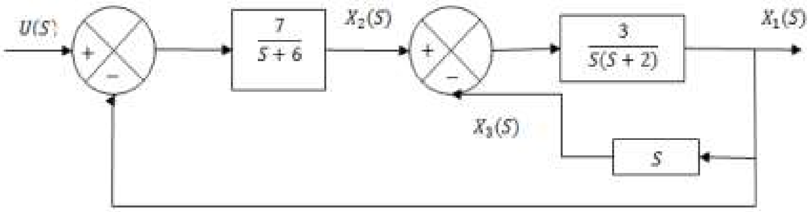
2. Evaluate the location of roots on S- Plane and stability for the polynomial **$S^7+9S^6+24S^5+24S^4+24S^3+24S^2+23S+15=0$**

COURSE OUTCOME 4:

1. Plot the Bode diagram for the following transfer function and obtain the gain and phase cross over frequencies G(S) =KS^2 / (1+0.2S) (1+0.02S).Determine the value of K for a gain cross over frequency of 5 rad/sec.
2. Write down the procedure for designing lag compensator using bode plot.

COURSE OUTCOME 5:

1. Elaborate whether the system is completely (i) Controllable (ii) Observable.



2. The State model of the system is given by,

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u\,;\,y=\begin{bmatrix}1 & 0 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

Determine whether the system is completely controllable or not.

Compiled By : Dr.J.Kohila,AP/EEE Verified By

21EE7804	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Preamble

The course aims in imparting fundamental knowledge of construction, types, Operation of Transformers, DC machines and AC Machines required for electrical engineers. DC machine is a highly versatile energy converting device. They can be designed to give a wide variety of voltage-current or speed- torque characteristics for both dynamic and steady state operation. AC machines are becoming more and more attractive in many applications such as those requiring variable speed and flexible control. Alternating Current (AC) machines are the most preferred for generation of electric power.

Prerequisites for the course

1. Engineering Physics

Objectives

To impart knowledge on the following topics

1. To explain the basic principles and construction of single phase and three phase transformer
2. To introduce the construction, principle of operation and various types of DC machines.
3. To develop the Construction and performance of three phase induction motors
4. To understand the operation, characteristics and speed control of synchronous motor.
5. To understand the Steady state operation and transient dynamics of a motor load system

UNIT I	TRANSFORMERS	9

Operating principle, classification, construction, emf equation, phasor diagrams, equivalent circuit model, losses & efficiency, voltage regulation, frequency response, polarity test, autotransformers, three-phase transformer connections, impedance matching, isolation & instrument transformers.

UNIT II	D.C. MACHINES	9

Operating principle, generator & motor action, construction, types of excitation, emf & torque equations, power stages & efficiency. Commutation & Armature Reaction, characteristics & application of d.c generators, starting & speed control of d.c motors, characteristics & applications of d.c motors, electric braking

UNIT III	INDUCTION AC MACHINES	9

Three-phase induction motors. Principle of operation, construction, types. Rotating magnetic field, emf equation of an AC Machine, torque developed in an induction motor, equivalent circuit model, torque-speed characteristics, starting & speed control. Single phase induction motors, starting, application.

UNIT IV	SYNCHRONOUS MACHINES	9
Construction, types & operating principle of synchronous generator, A.C armature windings, equivalent circuit, phasor diagrams, voltage regulation, parallel operation, synchronization, Power Angle characteristics, effect of field excitation change. Synchronous Motor, principle, starting, hunting, damper windings. Special Purpose Motors: Stepper Motor, Universal Motor, shaded-pole Motor.		
UNIT V	**Introduction of Electrical Drives**	**9**
Electric drive — Equations governing motor load dynamics — steady state stabilty — multi quadrant Dynamics: aceleration, deceleration, starting & stoping — typical load torque characteristics — Selection of motor.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. ONLINE QUIZZES 3.PROBLEM-SOLVING ACTIVITIES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Explain the basic principles and construction of single phase and three phase transformer
2	Explain the construction, principle of operation and various types of DC machines.
3	Discuss the starting and speed control methods for three phase induction motor.
4	Discuss the operation, characteristics and speed control of synchronous motor.
5	Study about the steady state operation and transient dynamics of a motor load system.

Text Books

1. Kothari. D.P and Nagrath. I.J, “Electric Machines”, Tata McGraw Hill Private Limited, Reprint 2010.
2. Mehta. V.K and Rohit Mehta, “Principle of Electrical Machines”, S. Chand Publishers, 2009.

Reference Books

1. Fitzgerald. A.E, Charles Kingsley, Stephen D. Umans, “Electric Machinery”, Tata McGraw Hill Private Limited, 2013.
2. Theraja. B.L, Theraja. A.K, “A text book on Electrical Technology”, Volume–II, S. Chand

Company and Ltd, 2009.

3. Gupta. J.B, "Theory and Performance of Electrical Machines", S. K. Kataria and Sons, 2009.
4. Murugesh Kumar. K, "Electric Machines", Vikas Publishing House Private Ltd, 2010.
5. Rajput. R.K, "A Text Book of Electrical Machines", Firewall Media, 2008.

Web Recourses

1. https://www.youtube.com/watch?v=qmcriUdYBW0
2. https://www.youtube.com/watch?v=AECBgmkWvo0

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2											3	
2	3	2											3	
3	3	2											3	
4	3	2											3	
5	3	2											3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	10	10	20
UNDETSTAND	30	30	10	10	30
APPLY	20	20	10	10	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	10	10	15
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Derive the EMF equation of single phase transformer.

2. Define the term transformation ratio in Transformer. (Evaluate)

COURSE OUTCOME 2:

1. Derive the EMF equation of a DC generator.

2. A DC series motor drives a load, the torque of which varies as the square of the speed. The motor takes a current of 20 A when the speed is 800 rpm. Calculate the speed and current when the motor field winding is shunted by a diverter of the same resistance as that of the field winding. (Evaluate)

COURSE OUTCOME 3:

1. What does skewing means in squirrel cage Induction motor? (Understand)

2. Specify the purpose of connecting a capacitor in the auxiliary winding of a single- phase induction motor? (Evaluate)

COURSE OUTCOME 4:

1. Explain phasor diagram of one phase of a synchronous generator and describe the features of synchronous impedance. (Evaluate)

2. Calculate the leakage reactance of the machine assuming the resistance to be negligible. (Evaluate)

COURSE OUTCOME 5:

1. Explain in detail the multi quadrant dynamics in the speed-torque plane. (Understand)

2. List the Various types of load torque. (Understand)

Compiled By : Mr.J.Antony Robinson,AP/EEE Verified By

21EE7806	ELECTRIC VEHICLES AND CONTROL	L	T	P	C
		3	0	0	3

Preamble

Vehicle is an unavoidable machine for the industry, individual and government. The fuel consumptions have led the nations to be dependent on electric vehicles and needs a major change in the operation in context to energy saving. The electric vehicle has drawn attention of the designers, researchers and manufacturers for the skilled persons needed in this era. The energy saving concept has led to hybrid electric vehicle in all the concepts for the transportation.

Prerequisites for the course

1. Basic Electrical and Electronics Engineering

Objectives

1. To interpret the fundamental concepts of hybrid electric vehicles.
2. To develop the need of batteries in Electric and hybrid vehicles.
3. To impart knowledge on power electronics converters.
4. To analyze the use of AC and DC electrical machines used for hybrid electric vehicles.
5. To design the energy storage components of hybrid electric vehicles.

UNIT I	INTRODUCTION TO HYBRID ELECTRIC VEHICLE	9

Review of Conventional Vehicle: Introduction to Hybrid Electric Vehicles: Types of EVs, Hybrid Electric Drive-train, Tractive effort in normal driving

UNIT II	ELECTRIC DRIVES	9

Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor

UNIT III	ENERGY STORAGE	9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles:- Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle

UNIT IV	ENERGY MANAGEMENT SYSTEM	9

Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business-E-mobility business, electrification challenges.

UNIT V	**MOBILITY AND CONNECTORS**	**9**
Connected Mobility and Autonomous Mobility- case study E mobility Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs. Connectors- Types of EV charging connector, DC Fast Charge EV Plug Stan, CCS (Combined Charging System),		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the architecture and vehicle dynamics of electric and hybrid vehicles
2	Analyze and model the power management systems for electric and hybrid vehicles
3	Devise power electronics based control strategies for electric and hybrid vehicles
4	Analyze and design various components of electric and hybrid vehicles with environment concern.
5	Investigate and model the issues in mathematical domain related to grid interconnections of electric and hybrid vehicle.

Text Books

1. Emadi, A. , Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003
2. Husain, I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2010.

Reference Books

1. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012
2. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.

Web Resources:

1. https://nptel.ac.in/courses/108/103/108103009/
2. Video Course on “Electric Vehicles” by Prof. Amitkumar Ja.

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	2	3	2	2	1	1	3	-	-	-	-	-	-	-
2	3	3	2	2	3	-	3	-	-	-	-	-	-	-
3	2	3	2	2	2	2	3	-	-	-	-	-	-	-
4	3	3	3	3	3	1	3	-	-	-	-	-	-	-
5	2	3	3	3	3	1	3	-	-	-	-	-	-	-

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain the use of Propulsion System Design

2. Describe the Dynamics of vehicle motion.

COURSE OUTCOME 2:

1. Describe the Technical characteristics of Batteries in detail.
2. Elaborate the Battery pack Design.
3. Outline the Properties of Batteries in detail.

COURSE OUTCOME 3:

1. Write a brief note on Induction machines.
2. Describe the use of permanent magnet machines.
3. Explain switched reluctance machines.

COURSE OUTCOME 4:

1. Summarize the implementation issues of energy strategies in EV,
2. Organize the design of a Hybrid Electric Vehicle (HEV)
3. Derive the design of a Battery Electric Vehicle (BEV).

COURSE OUTCOME 5:

1. Summarize Battery based energy storage and its analysis.
2. Describe the fuel cell based and super capacitor based energy storage and its analysis.
3. Explain - Hybridization of different energy storage devices.

Compiled By : Mr.N.Subramanian,AP/EEE Verified By

OPEN ELECTIVE –IV

21EE8801	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

This course introduces about different new and renewable sources of energy. Design of some of the systems are also discussed

Prerequisites for the course

Introduction to Power Engineering/ Energy Systems

Objectives

1. To learn the basic concept of sabinin's theory
2. To learn the design and control principles of Wind turbine
3. To understand the concepts of DFIG- PMSG -Variable speed generators, wind energy conversion systems.
4. To understand the concepts of fixed speed and variable speed, wind energy conversion systems
5. To analyze the grid integration issues

UNIT I	INTRODUCTION	9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinin‟s theory-Aerodynamics of Wind turbine.

UNIT II	WIND TURBINES	9

HAWT- VAWT -Power developed-Thrust-Efficiency- Rotor selection-Rotor design considerations- Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control- stall control-Schemes for maximum power extraction.

UNIT III	FIXED SPEED SYSTEMS	9

Generating Systems- Constant speed constant frequency systems -Choice of Generators Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV	VARIABLE SPEED SYSTEMS	9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling- Variable speed variable frequency schemes.

UNIT V	GRID CONNECTED SYSTEMS	9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Acquire knowledge on the basic concepts of Wind energy conversion system
2	Understand the mathematical modelling and control of the Wind turbine
3	Develop more understanding on the design of fixed speed system
4	Study about the need of Variable speed system and its modelling
5	Able to learn about Grid integration issues and current practices of wind interconnections with power system

Text Books

1. L.L.Freris “Wind Energy conversion Systems”, Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha,S.Banerjee,”Wind Electrical Systems”,Oxford UniversityPress,2010.
3. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.

Reference Books

1. E.W.Golding “The generation of Electricity by wind power”, Redwood urnLtd.,Trowbridge,1976.
2. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
3. S.Heir “Grid Integration of WECS”, Wiley 1998

Web Resources

1. https://www.ee.iitb.ac.in/~npsc2008/NPSC_CD/Data/Tutorial%202/Wind%20Energy%20Conversion%20Systems%20-%20Prof.%20S.B.%20Kedare.pdf
2. https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
3. https://nptel.ac.in/courses/108/105/108105058/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	3												
2	3	3												
3	3				3									
4		3			3									
5		3			3									

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	20	20	15	10	20
UNDERSTAND	30	30	15	15	30
APPLY	20	20	10	15	20
ANALYZE	15	15	10	10	15
EVALUATE	15	15	0	0	15
CREATE	0	0	0	0	0
	100	100	50	50	100

1-Low, 2- Medium, 3- High

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Summarize the importance of components of wind energy conversion system with a neat diagram.(Understand)
2. Explain clearly about the sabinin's theory.(Understand)

COURSE OUTCOME 2:

1. Difference between HAWT and VAWT. (Understand)

2. Explain the Yaw and Pitch angle control in WECS (Understand)

COURSE OUTCOME 3:

1. Describe the constant speed and constant frequency systems. Give its advantages and disadvantages. (Understand)

2. Explain the different types of generators used in WECS with suitable diagrams.(Understand)

COURSE OUTCOME 4:

1. Explain with a neat diagram the operation of variable speed constant frequency system and list the advantages and disadvantages.(Understand)
2. Describe the power wind characteristics and explain its types briefly (Understand)

COURSE OUTCOME 5:

1. Explain the briefly about LVRT (Understand)
2. Describe the power dynamic performance and its impacts (Understand)

Compiled By : Dr.R.Rajagopal,AP/EEE Verified By

21EE8802	**ELECTRICAL SAFETY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Preamble					
Electrical safety is a system of organizational measures and technical means to prevent harmful and dangerous effects on workers from electric current, electric arc, electromagnetic field and static electricity. Safety hazards encompass any type of substance, condition or object that can injure workers. It is mandatory for a product to conform to safety standards promulgated by safety and standard agencies. To conform to such standards, the product must pass safety tests such as the, Insulation Resistance Test, Ground Bond & Ground Continuity Test and Leakage Current Test. Analyzing the electrical standards we will apply the electrical safety concept in health care.					
Prerequisites for the course					
NIL					
Objectives					
1. To Understand the basic concepts of Electrical hazards					
2. To Creating knowledge how to handle proper guidelines while using EST					
3. To Analyzing various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.					
4. To Evaluating quality control and assurance activities as well as safety measures to be followed in hospitals.					
5. To Applying the electrical safety concept in health care.					
UNIT I	**ELECTRICAL HAZARDS**	**9**			
Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards –Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity					

UNIT II	STANDARDS AND REQUIREMENTS	9
National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards)		
UNIT III	**ELECTRICAL PROTECTION AND MAINTENANCE**	**9**
Selection of Environment, Protection and Interlock – Discharge rods and earthing device –Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation(CPR), Electrical Safety Analyser (ESA).		
UNIT IV	**STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS**	**9**
Define Quality- Need for Standardization& Quality Management, QM in Health CareOrganization-Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipment.		
UNIT V	**REGULATORY REQUIREMENT FOR HEALTH CARE**	**9**
FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Regulatory Codes		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.ASSIGNMENT 2. QUIZZES	WRITTEN TEST

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the basic concepts of Electrical hazards
2	Creating knowledge how to handle proper guidelines while using EST
3	Analyzing various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
4	Evaluating quality control and assurance activities as well as safety measures to be followed in hospitals.
5	Applying the electrical safety concept in health care.

Text Books

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 24
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere& Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.

Reference Books

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.
2. Karen Parsley, Karen Parsley Philomena Corrigan" Quality improvement in Healthcare, 2nd edition, Nelson Thrones Pub, 2002.
3. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012
4. Joseph F Dyro "Clinical Engineering Handbook" Elsevier Publishers, 2004.

Web Recourses

1. https://ehs.princeton.edu/book/export/html/75
2. https://en.wikipedia.org/wiki/Electrical_safety_standards

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	1	2								3	3		1
2	2		2								3	3		1
3	2		2								3	3		1
4	2	1	2								3	3		1
5	2		2								3	3		1

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Explain the effects of electric and electromagnetic fields on men working at substations.
2. What are all the safety measures to be followed while the electromagnetic fields on men working at energized HV lines and substations

COURSE OUTCOME 2:

1. Write briefly about sources, hazardous conditions, controland electrical causes of fire
2. Explain the use of Unsafe conditions like Civil, Mechanical and electrical hazards likely to occur during installation of electric plant

COURSE OUTCOME 3:

1. Summarize the safety aspects in operation and maintenance of electrical plant and equipment.
2. Differentiate between system grounding and equipment grounding.

COURSE OUTCOME 4:

1. Bring out the interface protocols betweenGeneral safety, Industrial safety and TQM
2. Enumerate Standardization in patient safety. Explain the WHO High 5s project.

COURSE OUTCOME 5:

1. Explain the safety codes and IS codes for national electrical Energy
2. What would be the best way to introduce QI approaches in rural setting with low cadre providers?
3. Explain the Electrical safety codes of practice

Compiled By :Mrs.A.Amala Manulea Verified By

21EE8803	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

Electrical safety is a system of organizational measures and technical means to prevent harmful and dangerous effects on workers from electric current, electric arc, electromagnetic field and static electricity. Safety hazards encompass any type of substance, condition or object that can injure workers. It is mandatory for a product to conform to safety standards promulgated by safety and standard agencies. To conform to such standards, the product must pass safety tests such as the, Insulation Resistance Test, Ground Bond & Ground Continuity Test and Leakage Current Test. Analyzing the electrical standards we will apply the electrical safety concept in health care.

Prerequisites for the course

1. Power Generation Systems
2. Solar photovoltaic system

Objectives

1. To understand the various types of energy storage Technologies.

2. To analyze thermal storage system.
3. To analyze different battery storage technologies
4. To analyze the thermodynamics of Fuel Cell
5. To study the various applications of energy storage systems.

UNIT I	**INTRODUCTION**	**9**
Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.		
UNIT II	**THERMAL STORAGE SYSTEM**	**9**
Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.		
UNIT III	**ENERGY STORAGE DEVICES**	**9**
Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.		
UNIT IV	**FUEL CELL**	**9**
Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.		
UNIT V	**ALTERNATE ENERGY STORAGE TECHNOLOGIES**	**9**
Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand different types storage technologies CO2: Design a thermal storage system
2	Model battery storage system
3	Analyze the thermodynamics of fuel cell

4	Analyze the appropriate storage technologies for different applications
5	Explore the alternate energy storage technologies.

Text Books

1. 1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', John Wiley & Sons, 3rd Edition, 2021.
2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2nd Volume set, 2012.
3. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rd Edition, 2018.

Reference Books

1. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons 1981, 1st Edition.
2. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1st Edition.

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc21_mm34/preview
2. http://www.nitttrc.edu.in/nptel/courses/video/112107283/L17.html
3. https://www.sciencedirect.com/topics/engineering/energy-storage-system

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	1	2								3	3	3	
2	2		2								3	3	3	
3	2		2								3	3	3	
4	2	1	2								3	3	3	
5	2		2								3	3	3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. List the steps required to achieve effective management for load and generation.
2. Describe the benefits of Energy storage.

COURSE OUTCOME 2:

1. Describe the need, types and constructional detail of thermal energy system.
2. Demonstrate impact of intermittent generation.

COURSE OUTCOME 3:

1. Explain the roles of electrical energy storage technologies in viewpoint of consumers.
2. Express in detail about the battery energy storage
3. Explain with a neat sketch the operation of Sodium Sulfur (NaS) Batteries

COURSE OUTCOME 4:

1. Compare the different EES technologies in technical sense and highlight the superior technologies.
2. Explain the new trends in applications of EES in view of following:
   a) Smart grid
   b) Smart house
   c) Electrical vehicles

COURSE OUTCOME 5:

1. Explain in detail about latent heat storage.
2. Explain the following mechanical storage systems
   a) Compressed air energy storage
   b) Pumped hydro storage.

Compiled By :Mrs.A.Amala Manulea Verified By

21EE8804	Industrial Drives and control	L	T	P	C
		3	0	0	3

Preamble

The electrical engineering applications in many industries use small and large AC and DC motors in some crucial application systems. Further electrical speed control in almost all industrial applications is incomplete without the use of the specific electric drive. This course will empower the students with the necessary skills to identify operate and maintain the AC and DC drives.The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

Prerequisites for the course

1. Power Electronics and Drives
2. Microcontrollers and its Applications

Objectives

1. To identify the relevant electric drive for the required speed torque characteristics.
2. To maintain the functioning of DC Drives using converters.
3. To maintain the functioning of DC Drives using choppers.
4. To maintain the functioning of AC Drives.
5. To Use microcontroller-based systems for motor control.

UNIT I	BASICS OF ELECTRIC DRIVES	9

Electric drive, types and choice of electric drives, Parts of electrical drive. Motor duty classification. Motor power rating for continuous, short time and intermittent duty, equivalent torque current, and power methods for fluctuating and intermittent loads. Speed-torque characteristics of DC motors. Speed-torque characteristics of three phase induction motor.

UNIT II	DC DRIVES USING CONVERTERS	9

Single phase SCR Drives- Half wave converter - Full wave converter - Semi converter- Dual converter. Three Phase SCR Drives -Half wave converter - Full wave converter - Semi converter - Dual converter. Three Phase SCR Drives- Half wave converters - Full wave converter - Semi converter - Dual converter. Power factor in SCR motor drives. Reversible SCR Drives.

UNIT III	DC DRIVES USING CHOPPERS	9

Basic chopper circuit using SCR. Classification based on output voltage and quadrant of operation. Chopper Controlled DC Drives. Application of chopper control drive in Solar and battery powered vehicles.

UNIT IV	**AC DRIVES**	**9**

Stator voltage control method using thyristor circuit. Variable frequency control method using square wave inverter. Constant V/F control method. Rotor resistance control using Chopper. Slip power recovery system. Solar powered pump drives. Drives required at each stage for following applications: Textile mills, Seel rolling mills. Paper mills Sugar mills.

UNIT V	**ADVANCED DRIVES FOR MOTOR CONTROL**	**9**

Microcontroller/ Microprocessor based control for drives. Phase locked loop control of DC motor. AC/DC drive using microprocessor control. AC/DC drive using microcontroller control. Synchronous motor drives. Ratings and specifications of stepper motor. Stepper motor drives employing microcontroller (No programming)

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Identify the relevant electric drive for the required speed torque characteristics.
2	Maintain the functioning of DC Drives using converters.
3	Maintain the functioning of DC Drives using choppers.
4	Maintain the functioning of AC Drives.
5	Use microcontroller-based systems for motor control

Text Books

1. Dubey, Gopal K, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi, 2016.
2. Subrahmanyam, Vedam, Electrical Drives Concepts and Applications, Mcgraw-Hill Publishing New Delhi, 2016

Reference Books

1. Agrawal, Jai P, Power Electronic Systems Theory and Design, Pearson Education Inc. New Delhi, 2016
2. Pillai,S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, 2016.

Web Recourses

1. www.cesim.com/simulations
2. www.scilab.org/scilab
3. www.ni.com/multisim

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3		2	3								3	3	
2	3	3	2	3								3	3	
3	3	3	2	3								3	3	
4	3	3	2	3								3	3	
5	3	3	2	3								3	3	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1

1. Describe the block diagram of the given type of electric drive

2. State the selection criteria for the given type of electric drive
3. Determine the power rating for the given load curve by equivalent current, torque and power methods.
4. Select the relevant motor on the basis of given duty cycles with justification.

COURSE OUTCOME 2:

1. Explain with sketches the operation of the given type of single phase SCR converter.
2. Explain with sketches the operation of the given type of three phase SCR converter.
3. Give the effect of power factor variation in the given type of SCR motor drive.
4. Describe the procedure to maintain the given type of DC drive using converter

COURSE OUTCOME 3:

1. Explain with sketches the operation of the given type of two quadrant chopper drive with quadrant diagram
2. Explain with sketches the operation of chopper controlled DC Drive in Solar and battery's powered vehicles
3. Describe the procedure to maintain the given type of DC drive using chopper

COURSE OUTCOME 4:

1. Explain with sketches the operation of three phase induction motor using the given type of control method
2. Explain with sketches the operation if three phase induction motor using the given type of slip power recovery system
3. Describe with sketches the working of the given type of solar powered pump drives.
4. Describe the procedure to maintain the given type of AC

COURSE OUTCOME 5:

1. Explain with sketches the working of PLL control for the given type of DC motor
2. Explain with sketches the working of microcontroller control of the given type of electric drive.

Compiled By :Mrs.A.Amala Manulea   Verified By

21EE8806	**ELECTRICAL WIRING ESTIMATION AND COSTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

This advanced course embraces the concepts of electrical wiring, cost estimation, modern tools usage in electrical wiring, testing and commissioning. This course is significant for the electrical energy auditors.

Prerequisites for the course

- Engineering Practices

Objectives

1. To impart knowledge on general principle of electrical estimation
2. To analyze the interaction of residential building interaction and installation
3. To emphasis the need for planning of electrical installation.
4. To impart knowledge on service connection, inspection and testing of installation
5. To perform electrical installation for power circuits

Syllabus

UNIT - 1	**GENERAL PRINCIPLES OF ESTIMATION**	**9**
Introduction to estimation & costing - Electrical schedule & estimation: commercial & residential - Market Survey and source selection - Recording of estimates – Required Material for electrical survey - Labour conditions - Determination of cost material and labour contingencies – Overhead Charges - General idea about IE rule - Indian Electricity Act and major applicable IE rules		
UNIT - 2	**RESIDENTIAL BUILDING ELECTRIFICATION**	**9**
General rules guidelines for wiring of residential installation - Principles of circuit design in lighting and power circuits - Method of drawing single line diagram - Wiring and load calculations - Selection of size of conductor - Selection of rating of main switch Distribution board - Protective switchgear: ELCB and MCB - Earthing of residential Installation		
UNIT - 3	**ELECTRIFICATION OF COMMERCIAL INSTALLATION**	**9**
Concept of commercial installation - Differentiate between electrification of residential and commercial installation - Fundamental considerations for planning of an electrical installation system for commercial building - Design considerations of electrical installation - system for commercial building – Load calculation and selection of size of service connection and nature of supply - Deciding the size of the cables, and bus bar - Mounting arrangements and positioning of switchboards, distribution boards main switch etc. - Earthing of the electrical installation - Selection of type wire - Wiring system and layout.		
UNIT - 4	**SERVICE CONNECTION, INSPECTION AND TESTING OF INSTALLATION**	**9**
Concept of service connection - Types of service connection and their features - Method of installation of service connection - Estimates of underground and overhead service - connections, Inspection of internal wiring installations, Inspection of new installations, testing of installations, testing of wiring installations, Reason for excess recording of energy consumption by energy meter		
UNIT - 5	**ELECTRICAL INSTALLATION FOR POWER CIRCUITS**	**9**
Introduction of power sector - Important considerations regarding motor installation wiring - Determination of input power to motor, rating of cables, rating of fuse, type of conduit - Distribution Board main switch and starter installation		

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Written Examination	1.Assignment 2. Online Quizzes 3.Problem-Solving Activities	Written Examination

Outcomes

Upon completion of the course, the students will be:

CO1: Able to understand basic principle of electrical estimation and their applications

CO2: Able to analyze the building installation. and selection of wire

CO3: Able to know the commercial installation calculations and importance of planning

CO4: Able to understand types of service connection, inspection and testing of installation

CO5: Able to apply electrical installation for major power circuits.

Text Books

1. J.B.Gupta, "Electrical Installation Estimating & Costing", VIII Edition S.K. Katria &Sons New Delhi, 2020.

Reference Books

1. K.R Gangadhara Rao "Electrical Estimating And Energy Management" Sapna Publications, Banglore, Vth Edition, 2020.

2. S.K.Bhattacharya Electrical Design Estimating and Costing ", New Age International (P) Ltd., Publishers, New Delhi, 2019.

Web Recourses

- https://esticom.com/wp-content/uploads/Real%20World%20Electrical%20Estimating.pdf
- https://www.electricaltechnology.org/2013/09/electrical-wiring.html

CO (vs) PO Mapping and CO (vs) PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2		3										2
2	3	2		3										2
3	3	3	2	3	3				3		2			2
4	3	3	3	3	3				3		2			2
5	3	3	3	3	3				3		2			2

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT-1	CAT-2	FAT-1	FAT-2	END SEMESTER EXAMINATION
REMEMBER	0	0	0	0	0
UNDERSTAND	20	20	20	20	20
APPLY	40	40	40	40	40
ANALYZE	40	40	40	40	40
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO1) :

(1) Prepare energy auditing chart for commercial & residential connection.

(2) Discuss about new Indian Electricity Act and major applicable IE rules

COURSE OUTCOME 2 (CO2) :

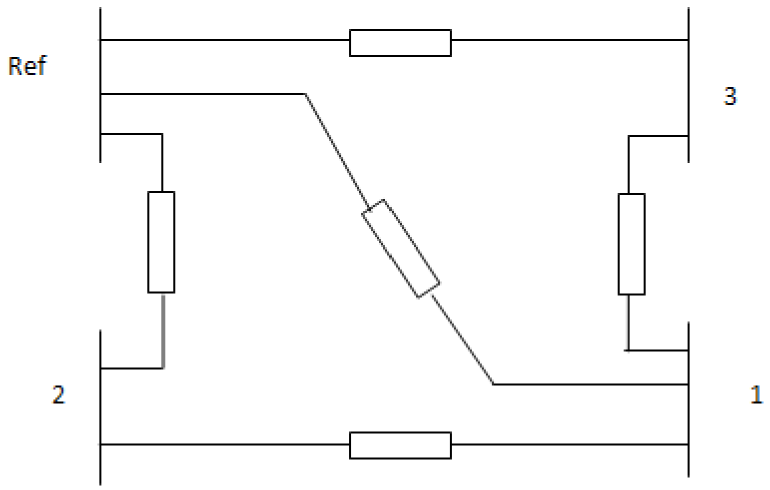
(1) Prepare the 1 year model audit for home which consist of

- 8 - Ceiling fans
- 2 - LCD TV
- 2 - LED TV

- 3 - Washing Machine
- 2 - Double door Refrigerator
- 2 - Washing Machine
- 1 - 3HP Submersible pump
- 1 - Vacuum Cleaner
- 1 - Electric Dishwasher
- 3 - Water Heater
- 3 - Inverting AC
- 10 - Tube lights
- 8 - LED bulbs
- 3 - Table Fans

COURSE OUTCOME 3 (CO3) :

(1) Obtain the Zbus matrix using bus building algorithm for the figure given below. Consider each impedance (z) value is j1.0



COURSE OUTCOME 4 (CO 4) :

(1) **<u>Scenario-1:</u>** If you are having the one month project to establish the transmission line of 100km.

Which one of the below option you will choose for transmission purpose, and Why?

1) ACSR Transmission Line
2) PVC underground cabling
3) XPLE underground cabling

Provide a comparative statement of above three options and validate your choice.

<u>Consider</u>

- Cost of 33KVA transformer
- Cost of Erection of transformer
- Cost of Pin type insulator and Post type insulator
- Man power estimation

- Cost of Cable
- Cost of Cable cladding etc.

COURSE OUTCOME 5 (CO 5) :

(1) It is necessary to obtain a tower footing resistance of 20 ohms in a soil of resistivity = 100 ohm-m using the three different types of electrodes. Take a=1.25cm for rods and counterpoise and a depth y=0.5m for the counterpoise wires. Calculate the required dimensions.

(2) An underground cable of inductance 0.150 mH/km and of capacitance 0.2 μF/km is connected to an overhead line having an inductance of 1.2 mH/km and capacitance of 0.006μF/km. Calculate the transmitted and reflected voltage and current waves at the junction, if a surge of 200 kV travels to the junction, (1) along the cable and (2) along the overhead line.

Compiled By : Mr.A.SHEIK SIDTHIK, AP/EEE Verified By

Minor/Specialization Honour degree courses

21EE4S01	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

Preamble

The course Industry 4.0 is all about revolutionizing of industries in the way of manufacturing, Product development, Improvement in product distribution. Manufacturers are integrating new technologies, including Internet of Things (IoT), cloud computing and analytics, and AI and machine learning into their production facilities and throughout their operations

Prerequisites for the course

- No prior technical background is required

Objectives

- To understand the functional knowledge of industry
- To analyze the new technologies in industries
- To measure and analyze outcome of smart factories
- To understand and apply the norms of industrial safety
- To analyze the Real-Time applications of Internet of Things

Syllabus

UNIT - 1	Introduction to Industry 4.0	9

Definition of Industry 4.0 - Automotive Industry (VW, Audi, Mercedes) Production process - Developments in USA, Europe, China and other countries - Comparison of Industry 4.0 Factory and today's Factory - Most important things that will change with Industry 4.0 - Difference between conventional automation and Industry 4.0 - Challenges and chances of a new industrial paradigm - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT - 2	Basic principles and technologies of Smart Factory	9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) - Internet of Services - Smart Factories - Smart Manufacturing- Customization & LEAN Production Systems - Smart Logistics - Smart and Connected Business Perspective - Predictive Analytics - Security issues within Industry 4.0 networks

UNIT - 3	Concept of Cyber-Physical Systems (CPS)	9

Introduction of cyber-physical systems - Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems - Next Generation Sensors - Robotic Automation and Collaborative Robots - Augmented Reality and Virtual Reality- Artificial Intelligence - Big Data - Self-organization principles ("Self-X", autonomy, negotiations)

UNIT - 4	**Safety and Security in Industry 4.0**	**9**
Safety with Industry 4.0 - Safety for connected Machines and Systems - Safety in Human Robot cooperation - Safety optimization in Industry 4.0 - Security & Security Risks with Industry 4.0 - Security and privacy risks in Artificial Intelligence - Approach to Cyber-Physical Security in Industry 4.0 - Practical Security Aspects with Industry 4.0		
UNIT - 5	**Real-Time Applications of Industrial IoT**	**9**
Case study - 1 : Milk Processing and Packaging Industries Case study - 2: Auto-mobile Industries Case study - 3 : Manufacturing Industries Case study - 4 : Oil Refinery Industry Case study - 5 : Virtual Reality Lab Case study - 6 : Health Care Industry		

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	**Formative Assessment Test (10 Marks)**	**End Semester Exams (60 Marks)**
Written Test	Google Form based Online Test	Written Test

Outcomes

Upon completion of the course, the students will:

CO1: Able to understand the industrial operations, developments, challenges and future analysis

CO2: Able to analyze the emerging technologies that makes the industries as smart industries

CO3: Able to measure and analyze the outcomes of smart factories using next generation sensors

CO4: Able to understand and apply the industrial safety norms and standards to avoid the risk factors in the industries

CO5: Able to analyze the Real-Time applications of Internet of Things in Industries to increase the efficiency and quality

Text Books

1. Klaus Schwab, “The Fourth Industrial Revolution”, Crown Business, 2017.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.
3. Cevikcan, Emre, Ustundag, Alp, “Industry 4.0: Managing the digital transformation”, Springer series in advanced manufacturing, 2018.

Reference Books

1. Mark Skilton, Felix Hovsepian (auth.), “The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on business, Palgrave Macmillan, 2018.
2. Srikanta Patnaik, “New Paradigm of Industry 4.0: Internet of Things, Big Data & Cyber Physical Systems”, Springer-Studies In Big Data Vol. 64, 2020.
3. Krzysztof Iniewski, “ Smart sensors for Industrial Applications”, CRC Press Taylor & Francis, 2021

Web Recourses

1. https://onlinecourses.nptel.ac.in/noc20_cs69/preview
2. https://1lib.in/book/3420536/8b3291
3. https://1lib.in/book/5298482/e88aa6
4. https://1lib.in/book/2197010/35d9e5
5. https://1lib.in/book/2950947/b284cd
6. https://1lib.in/book/2741192/da810f
7. https://1lib.in/book/3375898/dc1758

CO (vs) PO Mapping and CO (vs) PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2												3
2	3	2			3	2					2			3
3	3	2	2	2	3	2	2							3
4	3	2		2	3		2	2	2		2	3		3
5	3	3	3	3	3	3	3	3	2		2	2		3

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT-1	CAT-2	FAT-1	FAT-2	END SEMESTER EXAMINATION
REMEMBER	10	10	5	5	10
UNDERSTAND	30	30	5	5	30
APPLY	40	40	5	5	40
ANALYZE	20	20	10	10	20
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

(1) Comparison between Industry 4.0 Factory and today's Factory

(2) Explain the Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

COURSE OUTCOME 2 (CO 2) :

(1) Explain the concept of Internet of Things (IoT) & Industrial Internet of Things (IIoT)

(2) Explain the following

(i) Smart Factories

(ii) Smart Manufacturing

(iii) Customization & LEAN Production Systems

(iv) Smart Logistics

(v) Smart and Connected Business

COURSE OUTCOME 3 (CO 3) : (1) Elaborate the concept of Cyber-Physical Production Systems (2) Explain in details about Self-organization principles
COURSE OUTCOME 4 (CO 4) : **(1)** Mention the details about Safety in Human Robot cooperation **(2)** Explain in details about Practical Security Aspects with Industry 4.0
COURSE OUTCOME 5 (CO 5) : (1) Case study about Milk Processing and Packaging Industries 4.0 (2) Case study about Auto-mobile Industry 4.0

21EE5S01	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

Preamble
To study the various instruments displays and panels in the aircraft and to discuss the cock pit layout. The objective of the study of aircraft instrumentation is to know the functions of all the flight, gyroscopic and power plant instruments in the aircraft and enable the learners to rectify the problems occurring in the aircraft.
Prerequisites for the course
1. Basic electronics **2.** Measurements and Instruments
Objectives
1. To impart knowledge on sensors.
2. To understand the basic concepts of inductive transducers.
3. Understand the concepts of actuators.
4. Realize the appropriate types of micro sensors.
5. To impart knowledge on bulk silicon micro machining

UNIT I	SENSORS	9
Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.		
UNIT II	**INDUCTIVE & CAPACITIVE TRANSDUCER**	**9**
Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor, proximity sensor.		
UNIT III	**ACTUATORS**	**9**
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.		
UNIT IV	**MICRO SENSORS AND MICRO ACTUATORS**	**9**
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.		
UNIT V	**SENSOR PROCESSING TECHNIQUES**	**9**
Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.		

	Total Periods	**45**
Suggestive Assessment Methods		
Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES** **3.PROBLEM-SOLVING ACTIVITIES**	**WRITTEN TEST**

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the main aspects of sensors
2	Identify the appropriate theory of inductive and capacitive sensors
3	Handle mechanical actuating system
4	Construct bio sensors,chemical sensors
5	Understand the concept of sensor processing techniques

Text Books

1. Patranabis.D, “Sensors and Transducers”, Wheeler publisher, 1994.

2. Sergej Fatikow and Ulrich Rembold, “ Microsystem Technology and Microbotics”, First edition, Springer –Verlag NEwyork, Inc, 1997

Reference Books

1.Robert H Bishop, “The Mechatronics Hand Book”, CRC Press, 2002.

2. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.,

3. Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, First edition, Kluwer academic publishers, Springer, 1997.

4. Manfred Kohl, “Shape Memory Actuators”, first edition, Springer.

Web Recourses

1. https://youtu.be/nE1C4ghfvac
2. https://www.youtube.com/watch?v=r_Pqc9boyIU&list=PLgMDNELGJ1CbufZjqWa8uoSlQWKqVwPN7&index=2&pp=iAQB
3. https://www.youtube.com/watch?v=BOUwimpns4U&list=PLgMDNELGJ1CbufZjqWa8uoSlQWKqVwPN7&index=4&pp=iAQB

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3	2	1			1			1	2				1
2	3	2	1											2
3	3		1											1
4	3		1			1								1
5	3	2	1											3

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	20	20	10	10	20
APPLY	10	10	10	10	10
ANALYZE	20	20	10	10	20
EVALUATE	10	10	5	5	10
CREATE	30	30	10	10	30
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Give the factors responsible in selection of a sensor or actuator.(E)
2. Give the advantages and disadvantages of LVDT(E)

COURSE OUTCOME 2:

1. State the need of sensors in robotics(E)
2. Explain the principle of inductive transducers(E)

COURSE OUTCOME 3:

1. Explain the principle of Induction motor(E)
2. How a transistor can be operated as a solid state switch.(E)

COURSE OUTCOME 4:

1. Define Microrobots(E)
2. Define Shape memory effect.(E)

COURSE OUTCOME 5:

1. Define sputtering.(E)
2. Give the application of vacuum deposition.(E)

Compiled By: Mrs.S.Subashini,AP/EEE Verified By

21EE6S01	**ARTIFICIAL INTELLIGENCE FOR ROBOTICS (Practical cum Theory)**	**L**	**T**	**P**	**C**
		2	**0**	**4**	**4**
Preamble					
This course will serve as an introductory robotics course for the design of control of complex robotic systems .The new study program initiated by the Center for Intelligent Cyber-Physical Systems (CICPS) is designed to address these future topics and help to meet the growing need for engineers. Graduates will be able to use scientific methods and analyses for solving complex problems in both practice and research. The program offers several optional modules in the field of Robotics and Artificial Intelligence					
Prerequisites for the course					
Basic C,C++,					
Objectives					
1. To learn fundamental image processing and algorithms in vision					
2. To learn vison based image Classification, object recognition and object detection					
3. To be familiar about the applications regarding vision					
4. To analyze the use of image classification Algorithms					
5. To design the object recognition.					
UNIT I	**FUNDAMENTALS OF ROBOTICS**	**6**			
Historical Perspective, Specifications of Robots, Classifications of robots, Work envelope, Flexible automation versus Robotic technology, Applications of robotics in active perception, medical robotics, autonomous vehicles, and other areas.					
UNIT II	**ROBOT SENSING & VISION**	**6**			
Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis, segmentation- Thresholding- edge detection- binary morphology – grey morphology and Application of Machine Vision System, Robotic Assembly					

Sensors and Intelligent Sensors, visual servo-control.		
UNIT III	**VISION ALGORITHMS**	**6**
Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation – Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.		
UNIT IV	**IMAGE CLASSIFICATION ALGORITHMS**	**6**
Regression, logistic regression, decision tree, support vector machine, random forest, naive Bayes, and knearest neighbor. Overview of SLAM, Different Approaches to SLAM: Kalman Filters ParticleFilters / Monte Carlo methods.		
UNIT V	**OBJECT RECOGNITION**	**6**
Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of depth values. Histogram of oriented gradients (HOG)		
	Total Periods	**30**
S.No.	List of Experiments	CO
1	Image Enhancement, Noise removal, Simple morphological operations.	1
2	Contouring of objects in an image	1
3	Edge Detection – Roberts and Sobel	2
4	Basic Transformations	2
5	Color Image Segmentation algorithm development	3
6	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.	4
7	Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set	5

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
WRITTEN TEST	**1.ASSIGNMENT** **2. ONLINE QUIZZES**	**WRITTEN TEST**

	3.PROBLEM-SOLVING ACTIVITIES	

Outcomes

Upon completion of the course, the students will be able to:

1	Understand the fundamentals of robotics and its applications.
2	Give an understanding of image processing for computer vision
3	Focus on early processing of images and the determination of structure: edges, lines, shapes
4	Apply computer vision to recognize objects , its trajectory and the basics of visual learning for the purpose of classification
5	Learn the applications of vision system in modern manufacturing environment

Text Books

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2018.
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms, Springer Tracts in Advanced Robotics,Volume 118, Second Edition, 2016

Reference Books

1. Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", PHI Learning, 2009.
2. Deb S R and Deb S, "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.

Web Resources:

Lecture 34: Robot Vision **https://youtu.be/rYaTu3Y2DMY**

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	2	3	2	2	1	1	3	-	-	-	-	-	-	-
2	3	3	2	2	3	-	3	-	-	-	-	-	-	-
3	2	3	2	2	2	2	3	-	-	-	-	-	-	-
4	3	3	3	3	3	1	3	-	-	-	-	-	-	-
5	2	3	3	3	3	1	3	-	-	-	-	-	-	-

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	5	5	10
UNDETSTAND	30	30	10	10	30
APPLY	60	60	10	10	60
ANALYZE	0	0	0	0	0
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	50	50	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Describe any four work envelop of a robot with suitable diagram and mention its applications.
2. Illustrate with neat sketch about the basic robot motions.

COURSE OUTCOME 2:

1. Explain mono and stereo vision in the context of robot vision digital convolution
2. Outline how image segmentation helps to improve quality of images in vision system.

COURSE OUTCOME 3:

1. Write a brief note on fundamental Data Structures
2. Describe the use of Geometric Transformation

COURSE OUTCOME 4:

1. Derive the forward and reverse kinematics with two degree of freedom.
2. Organize the teach pendant for Robot system

COURSE OUTCOME 5:

1. Summarize the economic analysis of the robot using EUAC method
2. Explain with an example procedure of applying payback method in the economic analysis of robots.

Compiled By : Mr.N.Subramanian,AP/EEE Verified By

21EE7S01	DIGITAL IMAGE PROCESSING AND MACHINE VISION (Practical cum Theory)	L	T	P	C
		2	0	4	4

Preamble

This advanced course embraces two different contents that are digital image processing and machine vision. The first content imbeds the knowledge on digital image sampling, sharpening, filtering, smoothening and cutting edge technology. The second content of this subject imbeds the knowledge on machine vision, robotic vision control and real time applications.

Prerequisites for the course

- 21EE3604 - Signals and System
- 21EE5703 - Digital Signal Processing and its applications

Objectives

1. To provide knowledge on the basics of digital image processing system
2. To apply the filters and enhancing the quality of the image
3. To enrich the knowledge on image compression and image recognition
4. To imbed the technical knowledge on machine vision in image processing
5. To analyze the real time machine vision applications

Syllabus

UNIT - 1	DIGITAL IMAGE FUNDAMENTALS	9

Steps in Digital Image Processing – Components used for DIP – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms.

UNIT - 2	IMAGE ENHANCEMENT	9
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing - Sharpening – Edge Detection - Binary Morphology – Butterworth filter usage in image enhancement - Color image enhancement.		
UNIT - 3	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression - Run Length Encoding - Shift codes - Arithmetic coding - Vector Quantization - Transform coding - JPEG standard – MPEG - Boundary representation - Topological feature, Texture - Patterns and Pattern classes		
UNIT - 4	**MACHINE VISION IN IMAGE PROCESSING**	**9**
Machine vision and Computer Vision – Benefits of Machine Vision – Block Diagram and Function of Machine Vision System - Industrial Machine Vision System - Machine Vision Software.		
UNIT - 5	**MACHINE VISION APPLICATIONS**	**9**
Machine Vision Applications in: Manufacturing Industry; Electronics Industry; Printing Technology; Pharmaceutical and Textile Industry - Applications of Non-Visible Spectrum - Vision Guided Robots - Surveillance Robot Vision – Field and Service Applications – Augmented Reality.		

S.No.	List of Experiment	CO
1	Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)	CO1
2	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization	CO1
3	Averaging filter in spatial domain	CO2
4	Canny Algorithm: edge detection, line detection and corner detection	CO2
5	Implementation of image restoring techniques	CO3
6	Robotic Camera Calibration	CO4
7	Project based on Computer Vision Applications	CO5

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Lab Components Assessments (20 Marks)	End Semester Exams (50 Marks)
Written Examination	1. Lab Experiments 2. Model Examination	Written Examination

Outcomes

Upon completion of the course, the students will:

CO1: Able to know the basics of digital image processing system

CO2: Able to apply the filters to enhance the quality of digital image

CO3: Able to understand the concept of image compression and image recognition

CO4: Able to know the technical operation of machine vision in image processing

CO5: Able to analyze the real time machine vision applications

Text Books

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. NewDelhi, 2020.

Reference Books

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of a. India, New Delhi, 2015.
2. Davies E.R., "Machine Vision Theory, Algorithms and Practicalities", Elsevier, 2016.

Web Recourses

1. https://nptel.ac.in/courses/108103174
2. https://onlinecourses.nptel.ac.in/noc19_ee55/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	3	2	3	2	3								2	
3	3	2	3	2	3								2	
4	3				2								2	
5	3		3	3	3				2				2	

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	Theory		Lab		END SEMESTER EXAMINATION
	CAT-1	CAT-2	Lab Experiments	Model Practical	
REMEMBER	10	0	0	0	0
UNDERSTAND	40	40	0	0	40
APPLY	40	40	100	100	40
ANALYZE	10	20	0	0	20
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :

(1) Differentiate sampling and quantization process in image improving technique.

COURSE OUTCOME 2 (CO 2) :

(1) How can we improve the 1st image like 2nd image? Explain about the different techniques.

COURSE OUTCOME 3 (CO 3) :

(1) Explain in details about the canny algorithm in image processing technique.

COURSE OUTCOME 4 (CO 4) :

(1) Differentiate Machine vision and Computer vision.

(2) Draw and explain the block diagram of real time machine vision.

COURSE OUTCOME 5 (CO 5) :

(1) Case Study: Analyze any one of the real time usage of machine vision technology.

Compiled By : Mr.A.Sheik Sidthick,AP/EEE   Verified By