Curriculum and Syllabi – R 2021-UG
CHOICE BASED CREDIT SYSTEM AND OBE

Department Vision
To develop Electronics and Communication Engineers by permeating with proficient morals, to be recognized as an adroit engineer worldwide and to strive endlessly for excellence to meet the confronts of our modern society by equipping them with changing technologies, professionalism, creativity research, employability, analytical, practical skills and to excel as a successful

Department Mission
1. To provide excellence through effective and qualitative teaching-learning process that equips the students with adequate knowledge and to transform the students' lives by nurturing the human values to serve as a precious resource for Electronics and Communication Engineering and nation.
2. To enhance the problem solving and lifelong learning skills that will enable by edifying the students to pursue higher studies and career in research.
3. To create students with effective communication skills, the abilities to lead ethical values in order to fulfill the social needs.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1　**Acquiring Quality Education:** To acquire adequate and quality education on all aspects of Engineering and inculcate a spirit of lifelong learning which would spark an interest for Higher studies and Cutting-Edge research.

PEO 2　**Developing Multi-skills & Professionalism:** To develop dynamic Leadership skills, powerful Discerning & Decision making and communication skills with amicable team spirit and ethical responsibility.

PEO 3　**Contemporary learning:** To get equipped with skills in trending technologies in industries, which delivers excellent job prospects and kindles the spirit of entrepreneurship.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO$_1$　Design, Implement and Test Embedded and VLSI systems using state of the art components and software tools

PSO$_2$　Design and develop the signal processing and communication systems for the real time application.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO$_a$　**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO$_b$　**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.

PO$_c$　**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.

PO$_d$　**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.

PO$_e$　**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.

PO$_f$　**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.

PO$_g$　**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.

PO$_h$　**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO$_i$　**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO$_j$　**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.

PO$_k$ **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.

PO$_l$ **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.

**B.E ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION**

SUMMARY OF CREDIT DISTRIBUTION

S. No	Category	Credits Per Semester								Total Credit	Credits in %
		I	II	III	IV	V	VI	VII	VIII		
1	**HSSM**	3	2	1	1	6				**13**	**7.74%**
2	**BS**	12	4	4						**20**	**11.90%**
3	**ES**	9	8	5						**22**	**13.10%**
4	**PC**		5	13	18	12	9	10		**67**	**39.88%**
5	**PE**					3	6	9		**18**	**10.71%**
6	**OE**					3	6	3		**12**	**7.14%**
7	**EEC**			1	1	1	3		10	**16**	**9.52%**
	Total	**24**	**19**	**24**	**20**	**25**	**24**	**22**	**10**	**168**	**100%**

HSSM – Humanities and Social Sciences including Management
BS – Basic Sciences
ES – Engineering Sciences
PC – Professional Core
PE – Professional Elective
OE – Open Elective/ Programme Specific Elective for Expandable Scope
EEC – Employability Enhancement Courses

B.E ELECTRONICS AND COMMUNICATION ENGINEERING
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	2	1	0	3
Theory cum Practical Courses								
1	21HS1101	English for Professional Communication	HSSM	4	2	0	2	3
2	21ME1513	Computer Aided Engineering Graphics	ES	5	2	1	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	30	16	2	12	**24**

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 Application of Fourier Series	BS	4	3	1	0	4
3	21EC2601	Semiconductor Devices and Circuits	PC	3	3	0	0	3
Theory cum Practical Courses								
1	21EC1503	Fundamentals of Electrical, Electronics and Communication	ES	5	3	0	2	4
2	21CS2501	Introduction to Computing using Python	ES	5	3	0	2	4
Practical Courses								
1	21EC2611	Semiconductor Devices and Circuits Laboratory	PC	4	0	0	4	2
			Total	23	14	1	08	**19**

SEMESTER III

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MA3203	Probability and Numerical Techniques	BS	4	3	1	0	4
2	21EC3501	Object Oriented Programming and Data Structures	ES	3	3	0	0	3
3	21EC3601	Analog Electronics	PC	3	3	0	0	3
4	21EC3602	Signals and Systems	PC	4	3	1	0	4
5	21HS1103	Tamil Heritage	HSSM	2	2	0	0	1
Theory cum Practical Courses								
1	21EC3603	Digital Logic Design	PC	5	3	0	2	4
Practical Courses								
1	21EC3511	Object Oriented Programming and Data Structures Laboratory	ES	4	0	0	4	2
2	21EC3611	Analog Electronics Laboratory	PC	4	0	0	4	2
3	21PT3901	Aptitude-I	EEC	2	0	0	2	1
			Total	31	18	2	12	**24**

SEMESTER IV

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC4601	Analog and Digital Communication	PC	3	3	0	0	3
2	21EC4602	Applied Electromagnetics	PC	3	3	0	0	3
3	21EC4604	Principles of Computer Networks	PC	3	3	0	0	3
4	21EC4605	Control Systems	PC	3	3	0	0	3
5	21HS2103	Technology in Tamil Culture	HSSM	2	2	0	0	1
Mandatory Course								
1	21GE2M02	Environmental and Sustainable Engineering	MC	2	2	0	0	0
Theory cum Practical Courses								
1	21EC4603	Linear Integrated Circuits	PC	5	3	0	2	4
Practical Courses								
1	21EC4611	Analog and Digital Communication Laboratory	PC	4	0	0	4	2
2	21PT3902	Verbal Ability	EEC	2	0	0	2	1
			Total	27	19	0	8	**20**

SEMESTER V

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MG5101	Total Quality Management	HSSM	3	3	0	0	3
2	21HS3101	Ethics and Values	HSSM	3	3	0	0	3
5	21EC5601	Microprocessor and Microcontroller	PC	3	3	0	0	3
6	21EC5602	Wireless Communication Systems	PC	3	3	0	0	3
7		Professional Elective – I	PE	3	3	0	0	3
8		Open Elective I	OE	3	3	0	0	3
Theory cum Practical Courses								
1	21EC5603	Discrete Time Signal Processing	PC	5	3	0	2	4
Practical Courses								
1	21EC5611	Microprocessor and Microcontroller Laboratory	PC	4	0	0	4	2
2	21PT3903	Aptitude - II	EEC	2	0	0	2	1
			Total	29	21	0	8	**25**

SEMESTER VI

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC6601	VLSI Design	PC	3	3	0	0	3
2		Professional Elective – II	PE	3	3	0	0	3
3		Professional Elective – III	PE	3	3	0	0	3
4		Open Elective – II	OE	3	3	0	0	3
5		Open Elective – III	OE	3	3	0	0	3
Theory cum Practical Courses								
1	21EC6602	Transmission lines and Radiation Systems	PC	5	3	0	2	4
Practical Courses								
1	21EC6611	VLSI Design Laboratory	PC	4	0	0	4	2
2	21PT3904	Reasoning	EEC	2	0	0	2	1
3	21EC6911	Project Work - I/Internship	EEC	4	0	0	4	2
			Total	30	18	0	12	**24**

SEMESTER VII

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC7601	Microwave and Optical Communication	PC	3	3	0	0	3
2	21EC7602	Embedded and IoT	PC	3	3	0	0	3
3		Professional Elective - IV	PE	3	3	0	0	3
4		Professional Elective - V	PE	3	3	0	0	3
5		Professional Elective - VI	PE	3	3	0	0	3
6		Open Elective IV	OE	3	3	0	0	3
Practical Courses								
1	21EC7611	Advanced Communication Laboratory	PC	4	0	0	4	2
2	21EC7612	Embedded and IoT 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	21EC8911	Project Work – II/Startup	EEC	20	0	0	20	10
			Total	20	0	0	20	**10**

TOTAL NO. OF CREDITS: 168(Regular) / 125(Lateral)

Humanities and Social Sciences Including Management (HSSM)

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	21MG5101	Total Quality Management	HSSM	3	3	0	0	3
4	21HS1103	Tamil Heritage	HSSM	2	2	0	0	1
5	21HS2103	Technology in Tamil Culture	HSSM	2	2	0	0	1
Theory cum Practical Courses								
1	21HS1101	English for Professional Communication	HSSM	4	2	0	2	3

List of Basic Science Courses

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	21MA2201	Partial Differential Equation and Application of Fourier Series	BS	4	3	1	0	4
5	21MA3201	Probability and Numerical Techniques	BS	4	3	1	0	4
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	21CS1501	Problem Solving and Logical Thinking using C	ES	3	2	1	0	3
2	21EC3501	Object Oriented Programming and Data Structures	ES	3	3	0	0	3
Theory cum Practical Courses								
1	21EC1503	Fundamentals of Electrical, Electronics and Communication	ES	5	3	0	2	4
2	21ME1513	Computer Aided Engineering Graphics	ES	5	2	1	2	4
3	21CS2501	Introduction to Computing using Python	ES	5	3	0	2	4
Practical Courses								

| 1 | 21CS1511 | Programming Practice Laboratory using C | ES | 4 | 0 | 0 | 4 | 2 |
| 2 | 21EC3511 | Object Oriented Programming and Data Structures Laboratory | ES | 4 | 0 | 0 | 4 | 2 |

List of Professional Core Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC2601	Semiconductor Devices and Circuits	PC	3	3	0	0	3
2	21EC3601	Analog Electronics	PC	3	3	0	0	3
3	21EC3602	Signals and Systems	PC	3	3	1	0	4
4	21EC4601	Analog and Digital Communication	PC	3	3	0	0	3
5	21EC4602	Applied Electromagnetics	PC	3	3	0	0	3
6	21EC4604	Principles of Computer Networks	PC	3	3	0	0	3
7	21EC4605	Control Systems	PC	3	3	0	0	3
8	21EC5601	Microprocessor and Microcontroller	PC	3	3	0	0	3
9	21EC5602	Wireless Communication Systems	PC	3	3	0	0	3
10	21EC6601	VLSI Design	PC	3	3	0	0	3
11	21EC7601	Microwave and Optical Communication	PC	3	3	0	0	3
12	21EC7602	Embedded and IoT	PC	3	3	0	0	3
Theory cum Practical Courses								
1	21EC3603	Digital Logic Design	PC	5	3	0	2	4
2	21EC4603	Linear Integrated Circuits	PC	5	3	0	2	4
3	21EC5603	Discrete Time Signal Processing	PC	5	3	0	2	4
4	21EC6602	Transmission lines and Radiation Systems	PC	5	3	0	2	4
Practical Courses								
1	21EC2611	Semiconductor Devices and Circuits Laboratory	PC	4	0	0	4	2
2	21EC3611	Analog Electronics Laboratory	PC	4	0	0	4	2
3	21EC4611	Analog and Digital Communication Laboratory	PC	4	0	0	4	2
4	21EC5611	Microprocessor and Microcontroller Laboratory	PC	4	0	0	4	2
5	21EC6611	VLSI Design Laboratory	PC	4	0	0	4	2
6	21EC7611	Advanced Communication Laboratory	PC	4	0	0	4	2
7	21EC7612	Embedded and IoT Laboratory	PC	4	0	0	4	2

List of Employability Enhancement Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Practical Courses								
1	21PT3901	Aptitude-I	EEC	2	0	0	2	1
2	21PT3902	Verbal Ability	EEC	2	0	0	2	1
3	21PT3903	Aptitude-II	EEC	2	0	0	2	1
4	21PT3904	Reasoning	EEC	2	0	0	2	1
5	21EC6911	Project Work - I/ Internship	EEC	4	0	0	4	2
6	21EC8911	Project Work – II/ Startup	EEC	20	0	0	20	10

List of Mandatory Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
1	21GE2M02	Environmental and Sustainable Engineering	MC	2	2	0	0	0

List of Professional Electives Courses

S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective I								
1	21EC5701	Medical Electronics	5	3	0	0	3	Electronics
2	21EC5702	Information Theory and Coding Techniques	5	3	0	0	3	Communication
3	21EC5703	Computer Architecture and Organization	5	3	0	0	3	Embedded
4	21EC5704	Wireless Networks	5	3	0	0	3	Networks
5	21EC5705	Robotics and Artificial Intelligence	5	3	0	0	3	Robotics
6	21EC5706	VLSI Signal Processing	5	3	0	0	3	Semiconductor
Professional Elective II								
1	21EC6701	Solid State Devices	6	3	0	0	3	Electronics
2	21EC6702	Satellite Communication and Broadcasting	6	3	0	0	3	Communication
3	21EC6703	Advanced Microprocessors and Microcontrollers	6	3	0	0	3	Embedded
4	21EC6704	Cryptography and Network Security	6	3	0	0	3	Networks
5	21EC6705	Sensors, Actuators and Interface Electronics	6	3	0	0	3	Robotics
6	21EC6706	Mixed Signal IC Design	6	3	0	0	3	Semiconductor
Professional Elective III								
1	21EC6707	Nanoelectronic Devices and	6	3	0	0	3	Electronics

		Circuits						
2	21EC6708	Multimedia Compression and Communication	6	3	0	0	3	Communication
3	21EC6709	ARM based Digital Signal Processing	6	3	0	0	3	Embedded
4	21EC6710	Blockchain Principles	6	3	0	0	3	Networks
5	21EC6711	Automation System Design	6	3	0	0	3	Robotics
6	21EC6712	CMOS Analog IC Design	6	3	0	0	3	Semiconductor
Professional Elective IV								
1	21EC7701	Design and Fabrication of Electronic Product	7	3	0	0	3	Electronics
2	21EC7702	Broadband Access Technologies	7	3	0	0	3	Communication
3	21EC7703	IoT System Design and Applications	7	3	0	0	3	Embedded
4	21EC7704	Ad hoc and Wireless Sensor Networks	7	3	0	0	3	Networks
5	21EC7705	Deep Learning Techniques for computer vision	7	3	0	0	3	Robotics
6	21EC7706	Lowpower SOC	7	3	0	0	3	Semiconductor
Professional Elective V								
1	21EC7707	Micro- and Nano-Fabrication Technologies	7	3	0	0	3	Electronics
2	21EC7708	Mobile Communications	7	3	0	0	3	Communication
3	21EC7709	Embedded C and Linux	7	3	0	0	3	Embedded
4	21EC7710	Cognitive Radio Networks	7	3	0	0	3	Networks
5	21EC7711	Unmanned Aerial Vehicles	7	3	0	0	3	Robotics
6	21EC7712	FPGA for Embedded System Applications	7	3	0	0	3	Semiconductor
Professional Elective VI								
1	21EC7713	Digital Image Processing	7	3	0	0	3	Electronics
2	21EC7714	Millimeter wave Communication	7	3	0	0	3	Communication
3	21EC7715	Design using RaspBerry Pi	7	3	0	0	3	Embedded
4	21EC7716	4G & 5G Networks	7	3	0	0	3	Networks
5	21EC7717	Machine Learning Fundamentals	7	3	0	0	3	Robotics
6	21EC7718	TCAD for VLSI Circuits	7	3	0	0	3	Semiconductor

List of Value Added Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Open Elective I								
1	21EC3V01	Automotive Electronics Applications	VAC	1	1	0	0	1
2	21EC4V02	System design using FPGA	VAC	1	1	0	0	1
3	21EC5V03	Computational Image Analysis	VAC	1	1	0	0	1
4	21EC6V04	Wearable Electronics	VAC	1	1	0	0	1

| 5 | 21EC7V05 | Sensor Technology | VAC | 1 | 1 | 0 | 0 | 1 |

List of Open Elective Courses

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Open Elective I								
1	21EC5801	Digital Electronics Fundamentals	OE	3	3	0	0	3
2	21EC5802	Basics of Biomedical Engineering	OE	3	3	0	0	3
3	21EC5803	Principles of Electronic Communication	OE	3	3	0	0	3
4	21EC5804	Digital Audio Engineering	OE	3	3	0	0	3
Open Elective II								
1	21EC6801	Sensors and Actuators	OE	3	3	0	0	3
2	21EC6802	Principles of Multimedia	OE	3	3	0	0	3
3	21EC6803	Telemedicine	OE	3	3	0	0	3
4	21EC6804	Fundamentals of Nano Electronics	OE	3	3	0	0	3
Open Elective III								
1	21EC6805	Introduction to Mobile Communication	OE	3	3	0	0	3
2	21EC6806	Wireless Communication	OE	3	3	0	0	3
3	21EC6807	Basic VLSI Design	OE	3	3	0	0	3
4	21EC6808	Embedded System Design	OE	3	3	0	0	3
Open Elective IV								
1	21EC7801	Wireless Networks	OE	3	3	0	0	3
2	21EC7802	Image Processing Essentials	OE	3	3	0	0	3
3	21EC7803	Robotic Vision and Automation	OE	3	3	0	0	3
4	21EC7804	Internet of Things	OE	3	3	0	0	3

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	2	1	0	3
Theory cum Practical Courses								
1	21HS1101	English for Professional Communication	HSSM	4	2	0	2	3
2	21ME1513	Computer Aided Engineering Graphics	ES	5	2	1	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	30	16	2	12	**24**

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 a 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)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

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. https://youtu.be/hbk01uhgsos
2. https://archive.nptel.ac.in/content/storage2/111/105/111105122/MP4/mod01lec01.mp4
3. Eigen values and eigen vectors - https://youtu.be/h5urBuE4Xh
   Cayley Hamilton theorem -https://youtu.be/WROFJ15hk00
4. ODE - https://youtu.be/Im242eBqaxw
5. Functions of several variables -https://youtu.be/PA82F91e1vs
6. Integration - https://youtu.be/bVui07yHjzE,
   Multiple integrals -https://youtu.be/3BbrC9JcjOU
   Volume as Triple integral - https://youtu.be/w_KiHgultbM
7. 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	1	1	1			1	1			1		
2	3	2	1	1				1	1			1		
3	3	2	1	1				1	1			1		
4	3	2	1	1				1	1			1		
5	3	2	1	1				1	1			1		

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 $(D^2 - D + 1)y = \square sin\, sin2x + e^{\wedge}(-4x)$
2) Solve $(D^2 + a^2)\, y = \square tan\, tanax$ by using method of variation of parameters.

COURSE OUTCOME 3(CO 3) : (Apply)
1. Find the extreme values of the function $f(x, y)$= x³ + y³ – 12x -3y +20.
2. Calculate the maxima and minima of the function $f(x, y) = x^{\wedge}3y^{\wedge}(2)$(1-x-y).

COURSE OUTCOME 4(CO 4) : (Apply)
1)Find the area of the ellipse $x^{\wedge}2/a^{\wedge}2 + y^{\wedge}2/b^{\wedge}2 = 1.$
2) Find $\int\_0^{\wedge}a \int\_0^{\wedge}b \int\_0^{\wedge}c\, xyz\, dz\, dy\, dx$

COURSE OUTCOME 5(CO 5) : (Apply)

1. Find the directional derivative of $\phi = xy^2 + yz^3$ at the point (2,-1,1) in the direction of $\vec{i} + 2\vec{j} + 2\vec{k}$.

2. Using Green's theorem , find $\int_c [(x)^2 - y^2)dx + 2xy\,dy$ 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 $z = 1$.

Prepared by,	**Verified by,**
Dr. T.Manimozhi,	Mr.A. Santiago Stephen
Prof/Maths	Asso.Prof/Maths

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 and related basic physical concepts.Which are essential in understanding and explaining engineering devices.It encompasses the application of the basic principles of physics to the development of various engineering fields.

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	9

	DEVICES	
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- Spintronic devices and applications.		
	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

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	Explain the basic properties of semiconductors including the band gap, charge carrier concentration and doping. **Understand**
CO 3	Develop the concepts of magnetic properties and their engineering applications. **Apply**
CO 4	Apply the knowledge of optoelectronic devices and circuits to implement engineering applications. **Apply**
CO 5	Learn the concepts of nano materials and compare its properties with those of bulk materials. **Apply**

Text Books

1. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw- Hill Education (Indian Edition), 2019
2. S. Salivahanan,A. Rajalakshmi"Physics for Electronics Engineering and Information Science" - Tata Mc-Graw Hill Education,29 January 2018.

Reference Books

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019
2. S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
3. Laszlo Solymar ,Walsh,Donald,Syms and Richard R.A., Electrical properties of materials ,OXford Univ.press(Indian Edition)2015
4. B.Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.
5. Parag K.Lala, Quantum Computing : A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1			1	1	1				1		
2	3	2	1			1	1	1				1		
3	3	2	1			1	1	1				1		
4	3	2	1			1	1	1				1		
5	3	2	1			1	1	1				1		

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 the electrical conductivity of copper at 300 K. (Lorentz number = $2.45x10^{-8}$)
2. On the basis of classical free electron theory derive an expression for the electrical conductivity.
3. Explain fermi dirac distribution for electrons in a metal and discuss the effect of temperature on fermi function.
COURSE OUTCOME 2: Explain the basic properties of semiconductors including the band gap, charge carrier concentration and doping. . **Understand**
1. Derive an expression for the number of electrons in the conduction band of an intrinsic semiconductor.
2. Show that for a n-type semiconductor the hall Coefficient is given by $RH=+1/pe$ .Describe an experimental setup to measure the Hall voltage.
3. Describe ohmic contact with its energy band diagram.
COURSE OUTCOME 3: Develop the concepts of magnetic properties and their engineering applications. **Apply**
1. How will you differentiate magnetic materials based on their properties
2. Iron has a relative permeability of 5000. Calculate its magnetic susceptibility.
3. How magnetic principle is used in computer data storage.
COURSE OUTCOME 4: Apply the knowledge of optoelectronic devices and circuits to implement engineering applications. **Apply**
1. An LED emits green light of wavelength (λ) = 5511.11 A0. Find out the value of Eg.
2. Compare the working principle of LED with solar cell.
3. 3.Explain the construction and working of solar cells.
COURSE OUTCOME 5:   Learn the concepts of nano materials and compare its properties with those of bulk materials .   **Apply**

1. Using the concept of DOS (Density of State) expounds the different quantum confinements.
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 different dimensions.

Prepared by	**Verified by**
Mrs. Gomathi, AP/Physics	Mrs. S. Sudharthini, AP/Physics

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)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

1	Infer the quality of water parameters from quality parameter data and propose suitable methodologies to treat water. (Understand)
2	Identify and apply the basic principles of electrochemistry, corrosion and corrosion control. (Apply)
3	Apply the knowledge of phase rule and alloys for material analysis. (Apply)
4	Recognise different forms of energy resources and apply them in suitable energy sectors. (Apply)
5	Identify and apply basic concepts of polymer science, composites and nanotechnology in designing the synthesis of materials for engineering and technology applications. (Apply)

Text Books

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2018 (Unit I,II,III,IV,V).

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.
3. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2018.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and

Materials Science, 2018.
5. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
6. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

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
3. Heat treatment of steel   https://www.youtube.com/watch?v=3IQz9LAPuIA
4. Renewable energy resources https://youtu.be/mh51mAUexK4
5. Nanomaterialshttps://youtu.be/qUEbxTkPIWI

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	1					1		
2	3	2	2	1		1	1					1		
3	3	1	1	1		1	1					1		
4	3	2	2	1		1	1					1		
5	3	2	2	1		1	1					1		

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1: Students will be able to infer the quality of water parameters from quality parameter data and propose suitable methodologies to treat water.
(Understand)

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, corrosion and corrosion control.   **(Apply)**

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 apply the knowledge of phase rule and alloys for material analysis**. (Apply)**

1. Illustrate phase, component and degree of freedom with example
2. Will stainless steel rust? Justify.
COURSE OUTCOME 4: Students will be able to recognise 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 identify and apply basic concepts of polymer science, composites and nanotechnology in designing the synthesis of materials for engineering and technology applications. **(Apply)**

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.

Prepared by	**Verified by**
Dr.P.S.Suja Pon Mini, Prof/Chemistry	Dr.P.Jona, AP/Chemistry

		L	**T**	**P**	**C**
21CS1501	**PROBLEM SOLVING AND LOGICAL THINKING USING C**	**2**	**1**	**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 using pre 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 (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

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. ReemaThareja, "Programming in C",Oxford University Press, 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	

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

Prepared By	Mail Id
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21HS1101	ENGLISH FOR PROFESSIONAL COMMUNICATION	L	T	P	C
		2	0	1	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 -Reading Comprehension on technical concepts and answering questions - drafting a self introduction with professional touch; Language development - Framing Yes/No questions, Question tag, Vocabulary development - formation of words– verb – Noun – Adjectives, Standard Abbreviations related to Engineering.

Suggested Activities	Evaluation Method
i) Listening to Conversations/ technical concepts from suggested app/prescribed modules - Submission of 5 Recorded Conversations.	i) Listening & Speaking: Submitted Conversation will 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) Drafting a self introduction	iv) Introduction with a professional touch highlighting the skill sets required for an engineer
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; Reading - extensive reading – short narratives and news items from newspapers related to technology; Writing - sentence structure – paragraphs on describing a gadget – describing an electronic/ mechanical gadget, giving importance to its specifications, descriptions, merits and demerits; Language development - framing 'Wh' Questions, writing a complete sentence using the fragments given; Vocabulary development- prefix and suffix.

Suggested Activities	Evaluation Method

i) Listening to Technical Lectures - Suggested Youtube channels
    a) Learn Engineering
    b) Jared Owen
    c) Interesting Engineering
    d) Practical Engineering
	i) 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 will be 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 Tech News Sites	Activities iii to v will be assessed through Google form tests/ written tests.
iv) Writing reviews of a product	
v) Teaching of Grammar Contents	

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; Language development - Direct Speech and Indirect Speech – Framing Indirect – Questions - Prepositions – Articles; Vocabulary development – Select Single Word Substitutes used in Engineering.

Suggested Activities	

i) Listening to Technical talks on emerging trends - Suggested YouTube channels
    a) Bernard Marr
    b) Concerning Reality
    c) Ideas and Inspiration
	Evaluation Method
	i) Listening skills will be tested through
	a) Cloze Test - 2 Sets

ii) Speaking / Submitting video recording / classroom presentation on giving reviews about a product.	ii)Speaking: Submitted Video Recording/Classroom presentation will be assessed for a) Inquisitiveness
iii) Reading articles -Extracts from reputed journals.	b) Analytical skills c) Presentation Skills

iv) Rearranging Jumbled Sentences. v) Teaching of Grammar Contents	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 Method

i) Listening to talks related to Technology - Suggested YouTube channels
   a) Auto Car India
   b) Lesics
   c) Student Energy
	i) Listening skills will be tested through
	a) Note making - 2 Sets

ii) Speaking / Submitting video recording / Classroom presentation on Technical issues faced in a gadget and expressing suitable solutions.	ii)Speaking: Submitted Video Recording / Classroom Presentation will be assessed for a) Expression of Innovative Ideas and Solution b) Sentence Structure
iii) Reading articles -Extracts from reputed journals and identify problem statements and solution statements.	
iv) Writing - Identifying problems and giving solutions	
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**	**12**

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 Method
i) Watching videos on types of Listening	i) Listening skills will be tested through a) Google form test- 2 Sets
ii) Presentation on Emotional Intelligence	ii)Speaking: Submitted Video Recording / Classroom Presentation will be assessed for a) Emotional awareness

	b) Communication Skills
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	Activities iii to v will be assessed through Google form tests/ written tests/ written exercises.

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 30 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 (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO 1	Enumerate basic information using communication etiquette on par with international communication standards. (Apply)
CO 2	Interpret fundamental technical concepts in English language giving importance to syntax. (Apply)
CO 3	Evaluate advanced varied technical concepts in the current scenario and emerging trends to invent new concepts. (Apply)

CO 4	Write solutions for problems identified using the exact vocabulary and structure without grammatical errors as expected by the corporate world. (Apply)
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. (Apply)

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. Cambridge University Press: New Delhi, 2016.

Reference Books

1. 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	PSO3
1				2				2	1	3	2	2			
2	1	1		1				1	2	3	2	2			
3	1	1		1			2	1		2	2	2			
4	1	1		1				2		2	2	2			
5						1	1	2	2	3		2			

SUGGESTED COURSE LEVEL ASSESSMENT QUESTIONS:

COURSE OUTCOME 1 (CO 1) : Enumerate basic information using communication etiquette on par 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) Read the given technical passage and answer the questions provided.
4) Frame Yes/No Questions for the statements given.
5) Frame Question tags for the statements given.
6) Rearrange the jumbled words into a meaningful sentence.
7) Complete the sentence with the Noun form/ Verb Form/ Adjective form (as Directed) of the word given.

8) Give the expansion of the Abbreviations given.

COURSE OUTCOME 2 (CO 2) : Interpret fundamental technical concepts in English language giving 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 scenario and 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 jumbled 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 vocabulary and 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.

Concept Map

ENGLISH FOR PROFESSIONAL COMMUNICATION

LISTENING

- Listening to Conversations.
- Listening to Basic Concepts in Engineering.
- Listening to talks on emerging trends.
- Listening to talks on merits and demerits of a product.
- Listening to Types of Listening.

SPEAKING

- Formal Introduction.
- Conversation Practice.
- Introducing a device to the audience.
- Stating a problem and expressing solutions.
- Presentation on Emotional Intelligence.

READING

- Reading passages on fundamental Concepts in Engineering.
- Reading articles from newspapers.
- Reading articles from Magazines and Journals.
- Reading articles to identity problem statements and solution statements.
- Reading articles on High-Level Cognition and Social Behaviour.

WRITING

- Rearranging Jumbled words.
- Writing Reviews.
- Writing short Essays.
- Writing Problem Statements, Solution statements and Launch Notes.
- Articulate emotions using the exact words.

LANGUAGE DEVELOPMENT

- Yes/No Questions
- Question tag
- 'Wh' questions
- Direct and Indirect Speech
- Indirect Questions
- Prepositions
- Articles
- Tenses
- Modal verbs

VOCABULARY DEVELOPMENT

- Word Formation
- Abbreviations
- Prefix & Suffix
- Single Word Substitutes
- Synonyms & Antonyms
- Phrasal Verbs
- Fixed and Semi-Fixed Expressions

Prepared by,	**Verified by,**
Mr. David Ayling J, AP/ English	Mrs. Shala F John, AP/English

21ME1513	COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	C
		2	1	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 this 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

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, LINES AND PLANES**	**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 – Projection of planes (Change of position method only)

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- Combinations of 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 practice.	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 views using AutoCAD	C112.3, C112.6
4	Construction of development of surfaces of simple solids	C112.3,C112.6
5.	Isometric projection of simple components-flange, cylinder, chimney, lamp shades, valve, Brackets using AutoCAD	C112.4, C112.6
6.	Creating a Perspective Projection of solids using AutoCAD	C112.5, C112.6
Total Periods		**25 Lecture+20 Tutorial+ 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

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

C109.1: Apply the principles of first angle projection in construction of points, lines and planes

C109.2: Apply the principles of change of position method in projection of simple solids.

C109.3:Develop projections of sectioned solids and their developmental surface.

C109.4:Develop isometric views from orthographic projections

C109.5: Construct the perspective projections of simple solids

C109.6: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)
3. Patil, Rajashekar, "Computer Aided Engineering Graphics", New Age International Ltd,2018

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 Resources

1. http://nptel.ac.in/courses/112103019
2. https://archive.nptel.ac.in/courses/112/105/112105294/

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2									3	2
CO2	3	1	1	1	1								3	2
CO3	3	1	1	1	1								3	2
CO4	2	2	1	1	1								3	1

CO5	2	2	1	1	1								3	2
CO6	2	2	2	2	2								3	3

CO Vs PO Mapping and CO Vs PSO Mapping

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 VP
   D,45 mm below HP and 25 mm behind VP
   E, 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 projections of 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 45^0 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 base 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 cone of diameter 50 mm and axis 70 mm rests on its base on HP. A section plane perpendicular to VP and inclined at 30° to HP cuts the solid and passes through a point on axis which is 40 mm above HP. Draw the isometric view of a truncated cone. (A)
 2. A pentagonal pyramid of base edge 25 mm and height 65 mm rests vertically on its base on the HP such that one of its base edge parallel to VP. It is cut by a plane, parallel to HP and perpendicular to VP and passes through a point 25 mm from the apex. Draw the isometric view of the frustum of pyramid. (A)
**COURSE OUTCOME 5: Construct the perspective projections of simple solids**
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)

CONCEPT MAP
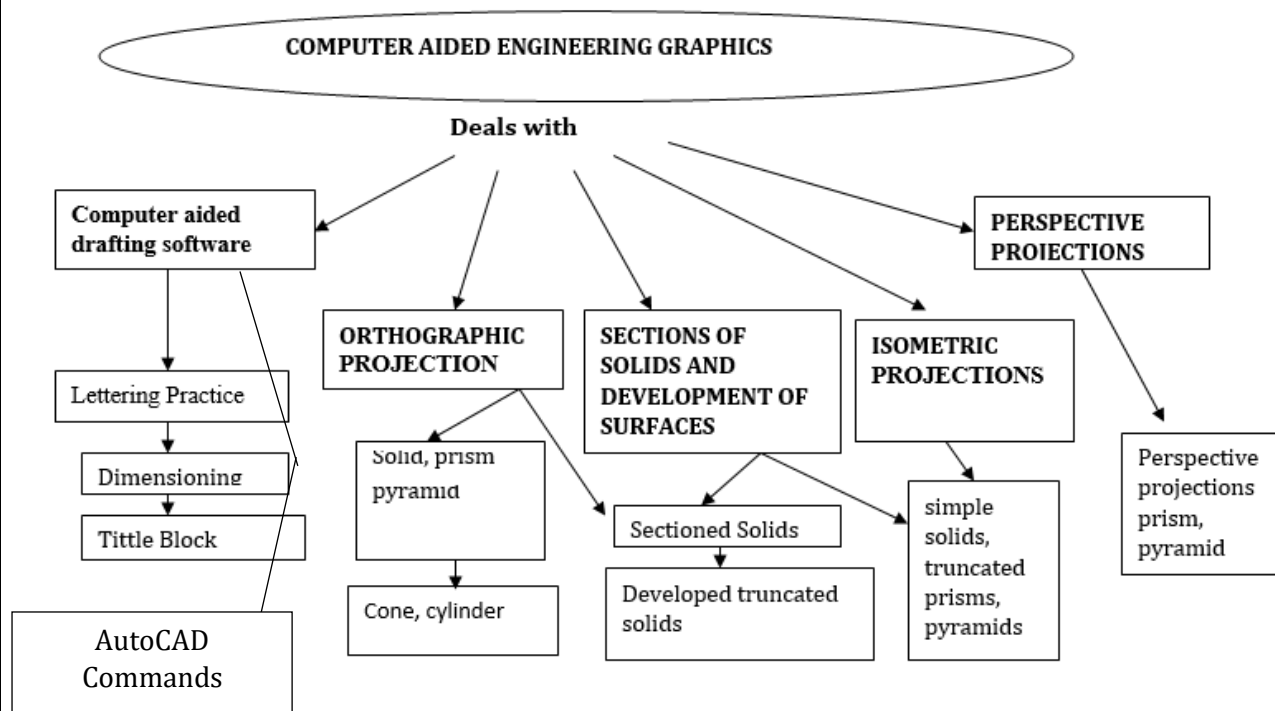
Prepared By	Mail Id
M. Saravanakumar, AP/Mech	saravanakumar@francisxavier.ac.in

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 analyze the instrumental techniques used in measuring data.
● To interrogate the competency and understanding of the basic concepts found in experimental Physics.
● To learn about the electronic mechanisms and their usage in a practical manner.
● To learn the interpretation of experimental data using the equipment in the physics laboratory.
● To investigate the errors in experimental measurements and techniques.

Objectives (Chemistry)
●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.
●To explain the concept of corrosion, its causes, and its environmental consequences.
●To acquaint students with knowledge of molecular weight determination and polymer solubility.
● To interpret chemical and physical phenomena through experimental investigations.

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).	1
3	Determination of planck's constant and work function using the principle of photoelectric effect	5
4	Determination of Young's modulus of the material-Non Uniform bending method.	5
5	Determination of thermal conductivity of a bad conductor – Lee's Disc method.	4
6	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	1
7	Determination of wavelength of spectral lines using grating – Spectrometer.	2

CHEMISTRY

1	Determination of total, temporary & permanent hardness of water by EDTA method.	1,5
2	Corrosion experiments – weight loss method.	3,5
3	Estimation of iron content of the given solution using potentiometer.	2
4	Conductometric titration of strong acid vs strong base.	2
5	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	4
6	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	1,5
7	Determination of strength of given hydrochloric acid using pH meter.	2

List of Projects (PHYSICS)

S. No.	List of Projects	Related Experiment	CO
1	**To study Infrared radiation emitted by different sources using phototransistors.**	3	5

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), used to 'illuminate' the LDR.	2	1
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	1
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.	7	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	6	1
7	Design a water level indicator by connecting a Buzzer, resistor and transistor in series and connect this in parallel to LED.	2	1
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, 6,7	1,5
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.	1,6,7	1,5
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. ii) Give an explanatory report on tracking the deterioration in household plumbing.	2	3,5
4	Air quality monitoring : Study of air pollution in Nellai smart city in the early morning, noon and evening due to CO/CO_2 emissions by Arduino method. i) From the observations give a detailed report about the	4	

	impact of air pollution on human health. ii) Deduce an explanatory report on environmental impact due to CO/CO2 emissions.		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	5

Lab Assessment

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes(Physics)

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

CO1	Analyzation of new instruments and real time application in engineering materials. (Analyse)
CO2	Applying the basic concepts of physics in the experiments by interrogating the data.(Apply)
CO3	Applying basic knowledge to designcircuits using basic components. (Apply)
CO4	Acquire the basic enlightenment of the experimental data for interpretation (Apply)
CO5	Solve problems individually using critical thinking collaboratively. (Analyse)

Outcomes(Chemistry)

CO1	Analyze the water quality related parameters quantitatively. (Analyse)
CO2	Explain the use of equipment for the measurement of conductance, electrode potential, pH of solutions, and viscosity. (Apply)
CO3	Analyze the probable corrosion, corrosion rate, and corrosion mechanism of the metallic material in the given environment (Analyze)
CO4	Analyze polymerization data and predict the conversion and molecular weight, which will lead to critical thinking about how to improve the setup for better polymerization.(Analyze)
CO5	Apply the knowledge of practical to enhance the quality of the environment .(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.

Reference Books (Chemistry)

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

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	1	1		1	1		
2	3	2	1	1	1		1	1	1		1	1		
3	3	2	1	1	1		1	1	1		1	1		
4	3	2	1	1	1		1	1	1		1	1		
5	3	2	1	1	1		1	1	1		1	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		1			2	2					2		
2	3	1	2			1	2					1		
3	3	2	1	1			1					1		
4	2	1	2			2	2					1		
5	2	1	2		1	2	2					1		

COURSE LEVEL ASSESSMENT QUESTIONS - PHYSICS
COURSE OUTCOME 1: The students will be able to analyzation of new instruments and real time application in engineering materials. (Analyse)
1. Determination of band gap of a Semiconductor (Forbidden energy band gap kit).
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.

COURSE OUTCOME 2: The students will be able to apply the basic concepts of physics in the experiments by interrogating the data.(Apply)
  1. Determination of wavelength of spectral lines using grating – Spectrometer.
COURSE OUTCOME 3: The students will be able to apply basic knowledge to design circuits using basic components. (Apply)
  1. Design a circuit for finding unknown resistance and specific resistance of a given coil of wire.
COURSE OUTCOME 4: The students will be able to acquire the basic enlightenment of the experimental data for interpretation (Apply)
  1. Determine the thermal conductivity of a given bad conductor (Glass) using Lee's disc method. (Given: M= 800 X10^{-3} Kg, S = 370 J$Kg^{-1}K^{-1}$).
COURSE OUTCOME 5: The students will be able to solve problems individually using critical thinking collaboratively. (Analyse)
  1. Determination of planck's constant and work function using the principle of photoelectric effect
  2. 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 CONTENT AND LECTURE SCHEDULE - PHYSICS

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 function using the principle of photoelectric effect.	1
4	Determination of Young's modulus of the material-Non Uniform bending method.	1
5	Determination of thermal conductivity of a bad conductor – Lee's Disc method.	1
6	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	1
7	Determination of wavelength of spectral lines using grating – Spectrometer.	1

COURSE LEVEL ASSESSMENT QUESTIONS - CHEMISTRY
COURSE OUTCOME 1:
1. Analyze the water quality related parameters quantitatively. (Analyse)
2. Estimate 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 2:
1. Explain the use of equipment for the measurement of conductance, electrode potential, pH of solutions, and viscosity. (Apply)

2. 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?

COURSE OUTCOME 3:

1. Analyze the probable corrosion, corrosion rate, and corrosion mechanism of the metallic material in the given environment (Analyze)

2. Determine the rate of corrosion of the given material by weight loss method.

COURSE OUTCOME 4:

1. Analyze polymerization data and predict the conversion and molecular weight, which will lead to critical thinking about how to improve the setup for better polymerization.(Analyze)

2. Determine the molecular weight of polyvinyl alcohol by using Ostwald's Viscometer.

COURSE OUTCOME 5:

1. Apply the knowledge of practical to enhance the quality of the environment .(Apply)

2. 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?

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

Prepared by	**Verified**
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21CS1511	PROGRAMMING PRACTICE LAB 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

1. To develop C programs using conditional and looping statements
2. To be able to use arrays and strings in C
3. To build modular programs using functions in C
4. To explicitly manage memory using pointers in C
5. 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 (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

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. Reema Thareja, "Programming in C",Oxford University Press, Second edition, 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	

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	Battleship
B	Cruiser
C	Destroyer
D	

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

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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 Application of Fourier Series	BS	4	3	1	0	4
3	21EC2601	Semiconductor Devices and Circuits	PC	3	3	0	0	3
Theory cum Practical Courses								
1	21EC1503	Fundamentals of Electrical, Electronics and Communication	ES	5	3	0	2	4
2	21CS2501	Introduction to Computing using Python	ES	5	3	0	2	4
Practical Courses								
1	21EC2611	Semiconductor Devices and Circuits Laboratory	PC	4	0	0	4	2
			Total	23	14	1	08	**19**

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
● 21HS1101/ English for Professional Communication

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 1	READING AND STUDY SKILLS	6

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

Suggested Activities	Evaluation Method
Suggested Activities **i) Visit to the Library - Reading articles on emerging trends and taking down notes in the prescribed format - 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) Create a Technical Blog based on their course of study **iv) 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 iii) Create a channel and post the Tech Blog they have created Activity iv will be assessed through Google form tests/ written tests.

MODULE 2	INTRODUCTION TO PROFESSIONAL WRITING	6

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

Suggested Activities	Evaluation Method
Suggested Activities **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 3	INTERVIEW SKILLS	6

Listening - Listening to mock Interviews ; Speaking - answering Interview questions – GD Strategies; Reading- newspaper article - read company profile - practice in speed reading ; Writing - Job Application - Resume- Internship application - letter to the editor - email etiquette - positive, negative and neutral responses - sending professional emails; Writing opinion paragraph - Writing paragraphs with reasons; Vocabulary Development - select Technical Vocabulary Language Development - If – Conditionals

Suggested Activities	Evaluation Method

i) Listening to UPSC Toppers Mock Interviews.	i) Answering questions for Interview questions(Android app based)
	Responses will be assessed for
	    a) Fluency
	    b) Communication etiquette
	    c) Language style

ii) Drafting Job application and Resume building.	ii) Submission: Fast form Document Submitted document will be assessed for a) Language Style b) Design
iii) Teaching of Grammar Contents	Activity iii will be assessed through Google form tests/ written tests.

MODULE 4	REPORT WRITING I	6

Reading - newspaper article & take notes - read company profile - project profile; 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 on Industries -
    a) Profile & Products
    b) Trending technology adopted
    c) Careers
    d) Latest news
        Min - 2 Industries
	i) Content & Structure

ii) Teaching of Grammar Contents	Activity ii will be assessed through Google form tests/ written tests.

MODULE 5	REPORT WRITING II	6

Reading - newspaper article & take notes - read survey & business report; Writing - Writing Feasibility Reports, Survey Reports, Business Report; Vocabulary Development - verbal analogies ; Language Development - Prepositional Phrases.

Suggested Activities	Evaluation Method

i) Drafting feasibility report on-
    a) Launching a new product / Technology
        Min - 2
	i) Content & Structure

ii) Creating a survey form to collect data using different platforms like google forms, survey monkey etc.	ii) Relevance of the question framed, Question structure

iii) Teaching of Grammar Contents	Activity iii will be assessed through Google form tests/ written tests.

	Total Periods	30

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Understand advanced technical texts from varied technical genres to understand engineering concepts and explore more. (Apply)
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. (Apply)
CO3	Articulate appropriately in interviews and Group Discussions effortlessly following the strategies expected by the corporate world. (Apply)
CO4	Write reports utilizing the required format prescribed on par with international standards using the exact vocabulary to make their reports worthy to be read. (Apply)
CO5	Appraise the need for new products and write feasibility and survey reports following the format prescribed in a way to create awareness. (Apply)

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-Hill Publishing Company Limited, 2007

Web Resources

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	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 O 1	PS O 2	PS O 3
1	1		1	2		2	1	1		2	1	1			

2	1			2		1		1		3	2	1			
3						3	2	1	2	3		2			
4		1	1	1		1	1	1	2	3	2	2			
5		1		1		1	1	1	1	3	2	2			

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 Discussions effortlessly 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 par with 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 and survey 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.

Concept Map

TECHNICAL COMMUNICATION

LISTENING
- Listening to mock Interviews.

SPEAKING
- Answering Interview questions.
- Participating in GD

READING
- Reading articles on emerging trends and taking notes.
- Technical topics.
- Longer texts both general and technical and practice speed reading.

WRITING
- Interoperation of charts and Graphs.
- Purpose Statements
- Extended Definitions
- Writing Instructions
- Checklists
- Recommendations
- Minutes of the Meeting
- Job Application & Resume
- Writing opinion paragraph
- Fire accident Report
- Industrial Visit Report
- Project Report
- Writing Feasibility Reports
- Survey Reports

LANGUAGE DEVELOPMENT
- Active Voice and Passive voice
- If – Conditionals
- Clauses
- Advanced use of Articles
- Prepositional Phrases.

VOCABULARY DEVELOPMENT
- Technical Vocabulary
- Subject Verb Agreement
- Compound Words
- Synonyms
- Paraphrasing
- Verbal Analogies

Prepared by,	**Verified by,**
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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
21MA1201 - Matrices and Advanced Calculus

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

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 - transformation w = 1/z .

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)

Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

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", 45rd 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, 22nd 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1				1	1			1			
2	3	2	1	1				1	1			1			
3	3	2	1	1				1	1			1			
4	3	2	1	1				1	1			1			
5	3	2	1	1				1	1			1			

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1 (CO 1) : (Apply)
1. Construct an analytic function whose imaginary part is $v = e\hat{\ }x\ (x\ cosy - ysiny)$
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 $\int e^2z/ [(z+1)]^4 dz$ using Cauchy's Integral formula where C is $|z| = 2$.
2) Compute $\int (2z-1)/(z(z+1)(z-3))dz$ 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 $(d^2 x)/[dt]^2 - 3 dx/dt + 2x = 2$, given $x = 0$ and $dx/dt = 5$ for $t = 0$ using Laplace transform method.
2) Find the Laplace transform for $(cosat - cosbt)/t$.

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Prepared by,   **Verified by,**
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</div>

21EC2601	SEMICONDUCTOR DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Prerequisites for the course
- 21PH1301/Physics for Engineers

Preamble

A network refers to any interconnected set of objects. An "electrical network" is an interconnection of electrical elements (Active and Passive) such as resistors, inductors, capacitors, transformers, diodes, sources, controlled sources and switches. Passive networks have interconnection of elements which cannot generate energy but can dissipate or stored energy. All electrical and electronic devices can be represented by electric circuits. So formulation of equivalent circuit and the study of behaviour of the network is formulated by analyzing the equivalent circuit with network laws and theorem.

It deals with a discussion on how electron energy bands are formed in semiconductors; followed by discussions on equilibrium statistics of electrons and holes, drift, diffusion currents, and generation and recombination processes. It then examines the principles and operations of essential semiconductor devices used in today's electronics: diodes, light detectors and emitters, bipolar junction transistors and MOSFETs. It includes analysis of small signal model and large signal model of the devices which is the prerequisite for next level courses. The goal is to develop a solid understanding of the device concepts that will be needed in a broad range of areas from semiconductor to circuit (analog, digital and VLSI) design and engineering.

UNIT I	CIRCUIT ANALYSIS	9

Introduction– voltage and current division, source transformation -Mesh current and node voltage method of analysis for D.C. circuits, Network theorems -Superposition theorem, Thevenins theorem, Norton's theorem, Reciprocity theorem, and Maximum power transfer theorem

UNIT II	RESONANCE AND TRANSIENT CIRCUITS	9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits. Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT III	BIPOLAR JUNCTION TRANSISTOR	9

Introduction-NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC – Hybrid -π model – h-parameter model, Ebers Moll Model- Gummel Poon-model, Breakdown in Transistors.

UNIT IV	FET AND DISPLAY DEVICES	9

Principle of operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET. Display Devices - SCR, DIAC, TRIAC, LED, LCD, Photo transistor, Opto Coupler, Solar cell.

UNIT V	SPECIAL SEMICONDUCTOR DEVICES	9

Metal-Semiconductor Junction- MESFET, FINFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode-PIN Diode, LASER diode, LDR.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Analyze and interpret the basic laws for AC and DC circuits
CO2	Design and analyze the Resonance and transient circuits.
CO3	Comprehend the structure of the Transistor configurations and Interpret the different models of transistor.
CO4	Analyze and interpret the Field Effect Transistors and Display Devices
CO5	Apply and use the special semiconductor devices.

Text Books

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2017)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2011).

Reference Books

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 6th Edition, 2002.
3. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.

Web Resources
1. https://youtu.be/XEleaNLC1LY (Reciprocity Theorem)
2. https://www.youtube.com/watch?v=Oc9qXwXuW3s (Single Tuned Circuits)
3. https://www.youtube.com/watch?v=LktdcR9IcZo (Gummen-Pool Model)
4. https://www.youtube.com/watch?v=95w7YdIEYQY (Thermal effect on MOSFET)
5. https://www.youtube.com/watch?v=1oRJf54zBRU (LASER Diode)

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	
2	3	3		3									2	
3	3	3		2									2	
4	3	3											2	
5	3	3											2	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Frame nodal equation for the network given and hence identify the potential difference at nodes (Apply)
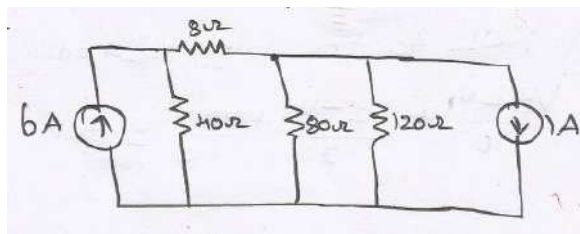
2. Determine Vo using Norton's Theorem (Understand)
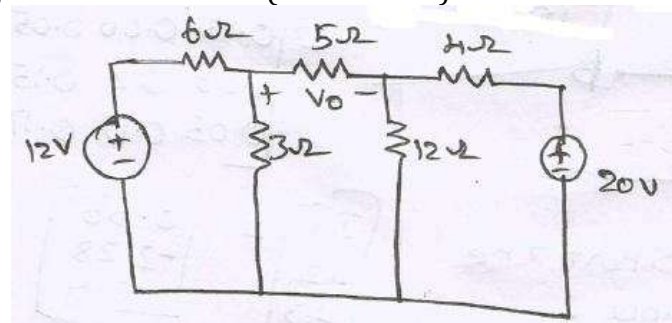
COURSE OUTCOME 2:
1. For a Series RL circuit, Derive the condition of Response for an A.C input. (Understand)
2. For a Series RLC circuit, Derive the condition of Response for an D.C input. (Understand)

COURSE OUTCOME 3:

1. Derive and analyze the expression for current gain, input impedance and voltage gain of a CE Transistor Amplifier. (Analyze)
2. Formulate the expression of Gummel Poon-model with neat circuit diagram (Apply)

COURSE OUTCOME 4:
1. Identify and formulate the differences between BJT and FET. (Understand)
2. Demonstrate in detail the modes of operation of SCR and Solar Cells (Apply)

COURSE OUTCOME 5:
1. Investigate the Tunnel diode with neat principle of operation and its Equivalent circuit (Analyze)
2. Describe the construction details and working principle of LASER diode. (Understand)

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		L	T	P	C
21EC1503	**FUNDAMENTALS OF ELECTRICAL, ELECTRONICS AND COMMUNICATION**	**3**	**0**	**2**	**4**

Prerequisites for the course
*   21PH1301/Physics for Engineers

Preamble
*   This course aims to equip the students with an understanding of the fundamental principles of electrical engineering and provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and digital circuits and basic principles of Electrical Machines .This course also provides an overview of evolution of communication systems, and introduce the basic concepts in digital communication.

UNIT I	ELECTRICAL FUNDAMENTALS	8

Dc Circuits: Terminologies, Ohms law, Kirchhoff's laws, Series- parallel circuits, voltage & current division. *Ac Circuits:* Single Phase RL, RC, RLC Series circuits, Three Phase Systems, Star and Delta Connection- Electrical Safety Fuses and Earthing

UNIT II	PN JUNCTION DIODE	8

PN Junction Diode: Energy bandgap, Pn junction Diode, Drift & Diffusion of carriers, Diode Current equations, forward and reverse characteristics, Switching Characteristics. Zener Diode- Characteristics, Breakdown mechanism in pn junction diode and zener diode.

UNIT III	APPLICATIONS OF DIODE AND DIGITAL SYSTEMS	8

Diode Applications: Rectifier circuits- Halfwave and Fullwave Rectifier, Zener voltage Regulator, Diode Clipper and Clamper circuits.
Digital Systems: Binary, Octal and Hexadecimal number System, Logic gates, Introduction of R-S, J-K, D and T Flip Flops & its truth tables

UNIT IV	ELECTRICAL MACHINES	8

Construction, Working Principle, emf & torque equation and applications of DC Machines, Transformers-single phase and Three Phase, Single phase and Three-phase Induction motors

UNIT V	INTRODUCTION TO COMMUNICATION	8

Introduction: Need and Importance of Communication, Elements of a Communication System, Types of communication systems - Electromagnetic Spectrum used in communication, concept of bandwidth and power, Need for modulation and types.
Analog Modulation: Amplitude modulation, AM-DSBFC-Waveform, Characteristic equation. Angle Modulation, Definition, Types, FM and PM Waveform Digital Modulation. – Review of sampling – Quantization.

		Total Periods	40

LABORATORY

S.NO	NAME OF THE EXPERIMENTS	HOURS	CO
1.	Verification Of Ohm's Law And Kirchoff's Laws	2 hours	1
2.	Effect Of Series And Parallel Resistance In A Dc Circuit	2 hours	1
3.	Design A Circuit To Measure The Cut-In And Reverse Breakdown Voltages Of A PN junction Diode.	2 hours	2
4.	Design A Circuit To Measure The Cut-In And Regulation Region Voltages Of A Zener Diode	2 hours	2
5.	Measurement Of AC Signal Parameter (Amp, Time, Freq, Peak-To-Peak, Rms, Avg)	2 hours	3
6.	Study of Logic Gates and verify its truth table.	2 hours	3
7.	Construct and validate the Step-Up /Step-Down behavior of the transformer	2 hours	4
8.	Study the construction of single phase transformer.	2 hours	4
9.	Generate amplitude modulated wave and determine the percentage modulation.	2 hours	5
10.	Generate frequency modulated wave and determine the percentage modulation	2 hours	5
	Total Periods	20	

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO1	Concern fundamental concepts and circuit laws to solve simple DC electric circuits
CO2	illustrate the basic principles of PN Junction Diode
CO3	Analyze the application of Diode and Digital systems
CO4	Outline the principle of an Electrical Machines
CO5	Enlighten the principle of Analog and digital communication

Text Books

1. S. Salivahanan, R. Rengaraj,G. R. Venkatakrishnan,"Basic Electrical, Electronics and Measurement Engineering ,McGraw Hill Education (India) Private Limited 1st Edition 2018
2. Abhijit Chakrabarti ,Sudipta Debnath, "Basic Electrical and Electronics Engineering-I" McGraw Hill Education (India) Private Limited Fifth Edition 2015
3. Shuqin Lou, Chunling Yang," Digital Electronic Circuits: Principles and Practices" De Gruyter, 2019 Edition.
4. John G.Proakis Masoud Salehi,"Fundamentals of communication systems "Prentice Hall, 2nd Edition 2015.

Reference Books

1. R Muthusubramanian, S Salivahanan, ' Basic Electrical and Electronics Engineering', McGraw Hill Publisher
2. S Salivahanan, 'Electronic Devices'. McGraw Hill -2018 edition
3. Wayne Tomasi,' Electronic Communication Systems: Fundamentals through Advanced,

5th dition, Pearson Publisher.

Web Resources
- https://onlinecourses.nptel.ac.in/noc19_ee35/preview
- https://nptel.ac.in/courses/108106177
- https://nptel.ac.in/courses/117102059

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	1.8	2			0.5						0.5		
2	5.5		2.5											
3	3.5	2		2.5										
4	4	3										1		
5	4	2										2		

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. With the help of RL circuits estimate the resonance frequency for the circuit (Apply)
2. Enumerate the precautionary steps in regard with Electrical Safety? (Apply)

COURSE OUTCOME 2:
1. Estimate the characteristics curve of a diode with relevant diagrams. (Understand)
2. Draw and explain the characteristics curve of a diode with relevant diagrams (Understand).

COURSE OUTCOME 3:
1. Derive and analyse half wave rectifier parameter along with the performance equations. (analyse).
2. Convert the $(2345)_{10}$ in to equivalent decimal, octal and hexa decimal values. (analyse).

COURSE OUTCOME 4:
1. Construct the single phase induction motor and its working principle with relevant sketches. (Analyse)
2. Develop the torque equation of DC motor and its working principle with relevant sketches. (Analyse)

COURSE OUTCOME 5:
1. Draw the block diagram of essential Elements of a Communication System and its role. (Understand)
2. Interpret the importance of carrier signal in amplitude modulation and significance of modulation index with various values. (Understand)

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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 and Identifiers – 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 with python IDLE or equivalent.

Suggestive Assessment

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (30 Marks)**	**End Semester Exams (50 Marks)**
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

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

3	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 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

5	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'). 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.	CO3

| 6 | Python Programs using String, Tuples, Numpy array and Pandas.
a)Accepts a string and calculate the number of upper case letters 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:

      What is the type of each variable of the mtcars data 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. | CO3 |

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:

	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	no
j	Jonas	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 a valid <u>regex</u> 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 False **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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

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 absolute value 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 test cases.

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

$1 \le T \le 1000$

$1 \le X,Y \le 1000$

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() + r
   print(r)
   ```
2. Is string is mutable. Justify your answer.   (Understand)

3. Write a Python Program to count the number of lowercase letters and uppercase letters 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)

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21EC2611	SEMICONDUCTOR DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course
- Nil

Preamble
- This laboratory is to enhance your knowledge of the basic semiconductor devices with hands-on experience, by measuring their basic characteristics.

S.No	List of Experiments	CO
1	Verifications Of Thevenin & Norton theorem	CO 1
2	Verifications Of Super Position Theorem	CO 1
3	Verifications of Maximum power transfer & reciprocity	CO 1
4	Transient response of RL and RC circuits	CO 2
5	Frequency response of series and parallel resonance circuits	CO 2
6	Characteristics of CE and CB configuration	CO 3
7	Characteristics of JFET and MOSFET	CO 3
8	Characteristics of UJT and SCR	CO 4
9	Characteristics of DIAC and TRIAC	CO 4
10	Simulation of CE,CB and CS Amplifier using PSPICE	CO 5

S.No.	List of Projects	Related Experiment	CO
1.	Analysis of electric circuit.	1,2,3	CO1
2.	Design of radio receiver	5	CO2
3.	Voltage regulator using transistor	6	CO 3
4.	LED Blinker	6	CO 3
5.	Electronic eye ball	6	CO 3

6.	Flip-flop	**6**	**CO 3**
7.	Buffer Amplifier	**7**	**CO 3**
8.	Analog switch	**7**	**CO 3**
9.	Burglar Alarm	**9**	**CO4**
10.	Automatic Battery charger	**9**	**CO4**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

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

CO1	Verify Thevinin & Norton theorem and Super Position Theorems.
CO2	Analyze the Response of Resonance circuits.
CO3	Understand the Characteristics of BJT and FET.
CO4	Analyze the UJT and SCR Characteristics.
CO5	Simulate the Transistor and JFET configurations.

Laboratory Requirements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS
BC 107, BC 148,2N2646,BFW10 - 25 each
1N4007, Zener diodes - 25 each
Resistors, Capacitors, Inductors - sufficient quantities Bread Boards - 15 Nos
CRO (30MHz) – 10 Nos.
Function Generators (3MHz) – 10 Nos.
Dual Regulated Power Supplies (0 – 30V) – 10 Nos.
PC with ORCAD PSPICE Software-5 Nos

Reference Books

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill, 6th Edition, 2002.

Web Resources

1. **https://www.youtube.com/watch?v=7JfoDFk61o8**
2. **https://www.youtube.com/watch?v=_MHzpX44Rbs**
3. **https://www.youtube.com/watch?v=xgYdLvWcvms**

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									3	
2	2	2	3	3									3	
3	3	3		3									3	
4	3	3		3									3	
5	2	2	3	3									3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. State Thevenin & Norton theorem

COURSE OUTCOME 2:

   1. A series RLC circuit whose R = 1 kΩ, L = 1 mH and C = 1000 pF is connected across a sinusoidal source of 10 V and Draw the Frequency Response

 COURSE OUTCOME 3:

 1. Determine the input and output characteristics of CB Configuration.

 COURSE OUTCOME 4:

 1. Determine the VI characteristics of SCR

 COURSE OUTCOME 5:

 1. Simulate the CB configuration using PSPICE

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SEMESTER III

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MA3203	Probability and Numerical Techniques	BS	4	3	1	0	4
2	21EC3501	Object Oriented Programming and Data Structures	ES	3	3	0	0	3
3	21EC3601	Analog Electronics	PC	3	3	0	0	3
4	21EC3602	Signals and Systems	PC	4	3	1	0	4
5	21HS1103	Tamil Heritage	HSSM	2	2	0	0	1
Theory cum Practical Courses								
1	21EC3603	Digital Logic Design	PC	5	3	0	2	4
Practical Courses								
1	21EC3511	Object Oriented Programming and Data Structures Laboratory	ES	4	0	0	4	2
2	21EC3611	Analog Electronics Laboratory	PC	4	0	0	4	2
3	21PT3901	Aptitude-I	EEC	2	0	0	2	1
			Total	31	18	2	12	**24**

21MA3203	PROBABILITY AND NUMERICAL TECHNIQUES	L	T	P	C
		3	1	0	4

Preamble:
The course consists of topics in Random variables, Random Processes and Numerical solution of system of equations and differential equations with applications to various engineering problems. This course will cover the following main topics: Probability distributions, Correlation and Linear regression, Classification of random processes, Classification of Markov Process, Newton Raphson method, Gauss Jacobi and Gauss Seidel methods, Fourth order Runge-Kutta method and Milne's method.

Prerequisites for the course
- Basic knowledge about solving systems of equations and Probability.
- 21MA1201 - Matrices and Advanced Calculus

Objectives
The Course will enable learners:
1 To apply the concept of random variable and various distribution
2 To equip themselves familiar with basic concept of two dimensional random variable
3 To familiarize the knowledge concept of random processes.
4 To develop the proficiency in Numerical techniques and solving linear , non linear equations and algebraic equations arising in engineering applications.
5 Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.

UNIT I	RANDOM VARIABLES	9+3

Probabilities and its properties - Random variables - Discrete and Continuous random variables – Moments – Moment generating functions – Binomial distributions, Poisson distributions, Uniform distributions and Normal distributions

SUGGESTED EVALUATION METHODS:
- Tutorial Problems on Random variables , Moment generating functions, distributions.

UNIT II	TWO-DIMENSIONAL RANDOM VARIABLES	9+3

Joint distributions – Marginal distributions and Conditional distributions – Covariance – Correlation and Linear regression for two dimensional random variables for Statistical data- Method of Least Squares - Curve Fitting.

SUGGESTED EVALUATION METHODS:
- Tutorial Problems on distributions ,Correlation, regression

UNIT III	RANDOM PROCESSES	9+3

Random processes - Classification of random processes – Stationary process –Wide Sense Stationary process – Ergodic process – Markov process - Poisson process – Random Telegram signal

SUGGESTED EVALUATION METHODS:
- Tutorial Problems on WSS, Markov process, Poisson process

UNIT IV	SOLUTION OF ALGEBRAIC AND SYSTEM OF EQUATIONS	9+3

Solution of algebraic and transcendental equations Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

SUGGESTED EVALUATION METHODS:
- Tutorial Problems on Newton Raphson method, Gauss elimination and Gauss Jordan methods.

UNIT V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9+3

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)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1: Apply the fundamental knowledge of moments and distributions (Apply)
CO2: Apply the concept of two dimensional random variables in real life phenomenon (Apply)
CO3: Solve the problems using Random process (Apply)
CO4: Solve linear and non linear system of equations using numerical techniques (Apply)
. CO5: Solve the ordinary differential equations using numerical techniques (Apply)

Text Books

1. Fundamentals of Applied Probability and Random Processes & quot;, Elsevier, Indian Reprint, 2015. (CO1, CO2, CO3)
2. B. S. Grewal, " Higher Engineering Mathematics", 45rd edition, 2017. (CO4, CO5)

Reference Books

1. Hwei Hsu, & quot; Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes & quot;, Tata McGraw Hill Edition, New Delhi, 2016.
2. Taha, H.A., & quot; Operations Research & quot;, 9th Edition, Pearson India Education Services, Delhi, 2016.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2016.
4. A Textbook of Engineering Mathematics(Dr. A.P.J. Abdul Kalam Technical University, Lucknow) (For . Gautam Bhudh technical Universities ,Lucknow) January 2020
5. Advanced Engineering Mathematics , H. K. DASS, S. CHAND and Company Limited, New Delhi, 22nd revised edition, 2018.

Web Resources

1. Random variables - https://youtu.be/zujeSyREcQ4
2. Two dimensional random variables - https://youtu.be/_WM8vzYSQhs
3. Random Processes - https://youtu.be/vVEmNUOGKlQ
4. Solving System of equations - https://youtu.be/oD8-Bb5YYmo
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	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	3	2	1	1				1	1			1		
2	3	2	1	1				1	1			1		
3	3	2	1	1				1	1			1		
4	3	2	1	1				1	1			1		
5	3	2	1	1				1	1			1		

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1 (CO 1) : (Apply)
1) A random variable 'X' has the following probability function

(x)	a	a	a	a	1a	3a	5a	7a

(i) Determine the value of 'a'
(ii) Find $P(X < 3), \ P(X \geq 3), \ P(0 < X < 5)$
(iii) Find the distribution function of X.
    2) The weekly wages of 1000 workmen are normally distributed around a mean of Rs. 70 with Standard Deviation of Rs. 5. Estimate the number of workers whose weekly wages will be (i) Between Rs. 69 and 72 (ii) less that Rs. 69 (iii) more than Rs 72.
COURSE OUTCOME 2 (CO 2) : (Apply)
    1) If the joint p.d.f of (x,y) is given by p(x,y)=k(2x+3y), x= 0,1,2 &y =1,2,3. Find k and all the marginal and the conditional probability distribution of (x,y) &   p(x+y>3)

2) If the joint PDF of X and Y is given by $f(x,y) = \{1/8\,(6-x-y); 0 < x < 2, 2 < y < 4, 0$ *else* find (a) $P[X < 1 \cap Y < 3]$ and (b) $P[X < 1/Y < 3]$.

COURSE OUTCOME 3 (CO 3) : (Apply)

1) The process {X(t)} whose probability distribution under certain conditions is given by

$$P(X(t) = n) = \frac{(at)^{n-1}}{(1+at)^{n+1}} , n = 1, 2, 3.....$$

$$\frac{at}{1+at} , n = 0$$

Show that it is not stationary.

2) In a village road, buses cross a particular place at a Poisson rate of 4 per hour. If a boy start counting at 9 am. (i) What is the probability that his count is 1 by 9.30 am? ii) What is the probability that his count is 3 by 11 am?(iii) What is the probability that his count is more than 5 by noon? .

COURSE OUTCOME 4 (CO 4) : (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 $3x^2 - tanx - 1 = 0$ to three decimal places

COURSE OUTCOME 5 (CO 5) : (Apply)

1. Find y (0.8) given that $\frac{dy}{dx} = y - x^2$, y (0.6) = 1.7393 by using Runge-Kutta method of fourth order. Take h=0.1

Using Euler's method, solve $\frac{dy}{dx} = xy + y^2$, $y(0)=1$ at $x=0.1$, 0.2 and 0.3 continue the solution at $x=0.4$ by Milne's predictor corrector method.

Prepared by,　　　　　　　　　　　　　　**Verified by,**
Dr. T. Manimozhi , Prof/Maths　　　　　　　A. Santiago Stephen ,Asso.Prof/Maths

21EC3501	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

Prerequisites for the course

- 21CS1501/ Problem Solving and Logical Thinking using C

Objectives

- To comprehend the fundamentals of object oriented programming, particularly in Java.
- To use object oriented programming to implement data structures.
- To introduce linear, non-linear data structures and their applications.

UNIT I	INTRODUCTION TO JAVA	9

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- Characteristics of Java – The Java Environment. Fundamental Programming Structures in Java – constructors, methods -access specifiers -Data Types, Variables, Operators, Control Flow, Looping, Arrays, ArrayList, Strings, Packages.

UNIT II	INHERITANCE, EXCEPTION HANDLING AND MULTI	9

	THREADING	

Inheritance- super and sub classes, member access rules, method overriding, multiple inheritance - interfaces. Exception handling and Multi Threading: Exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions. Multi threading- thread life cycle, creating multiple threads using Thread class.

UNIT III	**I/O AND GRAPHICS PROGRAMMING**	**9**

I/O Streams – file streams – byte stream – character stream: creating, processing, opening, and closing a data file – applet – frames. Working with window AWT classes – AWT control – Layout manager – menus.

UNIT IV	**LINEAR DATA STRUCTURES**	**9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists –Polynomial Manipulation – Stack ADT – Queue ADT – Evaluating arithmetic expressions.

UNIT V	**NON-LINEAR DATA STRUCTURES**	**9**

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search – Connected components.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive Answers-CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Course Outcomes

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

- Understand the basic concepts of Object Oriented Programming. (Understand)
- Develop Java programs with the concepts such as inheritance, exception handling and mulit-threading. (Apply)
- Develop interactive Java programs using applet and frame. (Apply)
- Implement abstract data types for linear data structures using java (Apply)
- Implement non-linear data structures using java (Apply)
- Understand the applications of data structures (Apply)

Text Books

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. E. Balagurusamy, 2004, Programming with JAVA, 2nd Edition,Tata McGraw-Hill Publishing Co.Ltd.
3. Data Structures and Algorithms in Java, 2nd edition, Robert Lefore, SAMS publishing, 2003
4. Data Structures and Algorithms in Java, 2nd edition, M.T.Goodrich and R.Tamassia, John Wiley and Sons, Inc.

Reference Books

1. Data Structures and Java Collections Frame Work, W.J.Collins, McGraw Hill.
2. Data Structures Using Java, Yedidyah Langsam, Moshe Augenstein, Aaron M. Tenenbaum, Pearson Education.
3. Data Structures and Software Development in an Object Oriented Domain, Java Edition, Tremblay, Pearson Education.
4. Data Structures with Java, J.R.Hubbard and A.Huray, Pearson Education/PHI.

Web Resources

1. https://www.mygreatlearning.com/blog/data-structures-using-java/

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								1	2	2
2	3	2	2	1								1	2	2
3	3	2	2	1								1	2	2
4	3	2	2	1								1	2	
5	3	2	2	1								1	2	

COURSE LEVEL ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Understand the basic concepts of Object Oriented Programming
1. List the features of OOP. (Remember)
2. Illustrate classes and objects with an example program. (Understand)
3. Explain how methods can be defined. (Understand)

Course Outcome 2 (CO2): Develop Java programs with the concepts such as inheritance, exception handling and mulit-threading.
1. Define inheritance. (Remember)
2. Explain how exceptions can be handled? (Understand)
3. Write a java program for Banking Transactions using Multithreading. (Apply)

Course Outcome 3 (CO3): Develop interactive Java programs using applet and frame
1. Write an Applet code to draw a Smiley. (Apply)
2. Implement a scientific calculator using Swing in java.(Apply)
3. Implement Library Management System using Swing in java. (Apply)

Course Outcome 4 (CO4): Implement abstract data types for linear data structures using java.
1. Define ADT. (Remember)
2. List the Linear Data Structures. (Remember)
3. Implement Stack using java. (Create)

Course Outcome 5 (CO5): Implement non-linear data structures using java
1. Write a java program to implement the Tree traversals. (Apply)
2. Implement BFS and DFS in java. (Apply)

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21EC3601	**ANALOG ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisites for the course
*   21EC1503/Fundamentals of Electrical, Electronics and Communication

Preamble

The course "21EC3601: Analog Electronics" is offered in the third semester. The purpose of this course is to understand the small signal analysis and frequency response of BJT & FET circuits and apply the knowledge to give solutions. Moreover, the concepts of power amplifiers, the methods of feedback in amplifiers and the multivibrator circuits are covered in this course.

UNIT I	**BJT AMPLIFIERS**	9

DC load line - Operating point - Various biasing methods for BJT amplifier - AC load line – Stability – Compensation methods – Small signal analysis of CE amplifier - AC Coupling - Frequency response - Multistage amplifier - Darlington Amplifier - Differential Amplifier

UNIT II	FET AMPLIFIERS	9

Various biasing methods for FET amplifiers – small signal analysis of CS, CD, CG amplifier circuits - Frequency Response of CS amplifier – Miller Effect – Current Mirrors – Cascaded amplifier – Cascoded amplifier

UNIT III	POWER AMPLIFIERS	9

Class A, Class B, Class AB, Class C, Class D Amplifiers - Amplifiers using Complementary Symmetry configuration - Non Linear Distortion - Power Transistor and Heat sink - Tuned Amplifiers - Switched Mode Power Supply (SMPS)

UNIT IV	FEEDBACK AMPLIFIERS AND OSCILLATORS	9

Feedback Concept- Analysis of Negative feedback amplifiers: Voltage Series, Current Series, Current Shunt, Voltage Shunt - Conditions for Oscillation - RC & LC Oscillator –phase shift Oscillator - Wien Bridge Oscillator - Hartley Oscillator- Colpitts Oscillator -Tuned Collector Oscillator - Crystal Oscillators

UNIT V	PULSE CIRCUITS	9

Attenuators – RC integrator and differentiator circuits – diode clampers and clippers – multivibrators - Schmitt Trigger

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Understand the working of different types of amplifier, oscillator and multivibrator circuits.
CO 2	Design BJT and FET amplifier and oscillator circuits
CO 3	Design and analyze the power amplifier.
CO 4	Analyze transistorized amplifier and oscillator circuits
CO 5	Review the applications of different types of amplifier, oscillator, attenuators and multivibrator circuits

Text Books

1. Donald .A. Neamen, Electronic Circuit Analysis and Design –3rd Edition, Tata Mc Graw Hill, 2010.
2. Adel S. Sedra, Kenneth C.Smith, Tony Chan Carusone and Vincent Gaudet "Microelectronic Circuits", Oxford University Press, 8th Edition, 2020.

Reference Books

1. Behzad Razavi, "Fundamentals of Microelectronics", 1st edition, Wiley publication, 2008.
2. Millman & Halkias, "Integrated Electronics", 48th reprint, Tata McGraw Hill, 2008.
3. David A., "Bell Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010.

Web Resources

1. http://ncert.nic.in/textbook/pdf/leph206.pdf
2. https://www.elprocus.com/semiconductor-devices-types-and-applications/
3. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee32/
4. https://www.youtube.com/watch?v=J6QS_aCT2No
5. https://www.youtube.com/watch?v=88lo7MgCpNo

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	2									3	1
2	3	3	3	3									3	1
3	3	3	3	3									3	1
4	3	3	3	3									3	1
5	3	2	2	3									3	1

QUESTIONS

COURSE OUTCOME 1:
1. Give the condition of thermal stability
2. In a self bias circuit calculate V_{CE} and I_C and stability factor where $\alpha = 0.985$ for the silicon transistor, Given V_{CC}=16V, R_1=56KΩ, R_2=20KΩ, R_c = 3KΩ, R_e =2KΩ

COURSE OUTCOME 2:
1. State Miller's theorem
2. Elucidate the high frequency operation of common source amplifier with its equivalent circuit

COURSE OUTCOME 3:
1. A tuned amplifier is designed to receive AM broadcast of speech signal at 650 kHz. What is the needed Q for amplifier?
2. Compare the different classes of large signal amplifiers with neat sketch and table

COURSE OUTCOME 4:
1. State the Barkhausen criteria for sustained oscillation. What will happen to the oscillation if the magnitude of the loop gain is greater than unity?
2. Design LC circuit for Hartley and Colpitts oscillators to oscillate at 600KHz

COURSE OUTCOME 5:
1. Distinguish the multivibrators and oscillators
2. Review on RC integrator and differentiator circuits

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21EC3602	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

Prerequisites for the course
- 21MA2201/ Partial Differential Equation and Application of Fourier Series

Preamble
- Signals and Systems arise in a wide variety of fields, and the ideas and techniques associated with these concepts play an important role in areas of science and technology as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. The signal can be either analog or converted digital signal. Processing of both the signal type requires some mathematics. This course provides the basic knowledge on the required mathematics for further processing of signals.

UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9+3

Continuous time signals (CT signals) – discrete time signals (DT signals) – Step, Ramp, Pulse, Impulse, Exponential –Transformation of the independent variable – Representation of signals – Classification of CT and DT signals – CT systems and DT systems – Linear Time invariant (LTI)

Systems and properties – MATLAB exercises for generation of basic elementary signals

UNIT II	**FREQUENCY DOMAIN REPRESENTATION OF CONTINUOUS TIME SIGNALS**	**9+3**

Fourier Series representation of CT periodic signals – Convergence of Fourier Series – Properties – Differential equation – Fourier Transform Representation of signal – Convergence of Fourier Transforms – Properties – Analysis of LTI Systems using Fourier Transform – Frequency response – MATLAB exercises for Fourier Transforms

UNIT III	**LAPLACE DOMAIN REPRESENTATION OF CONTINUOUS TIME SIGNALS**	**9+3**

Laplace Transform – Region of Convergence for Laplace Transform – Inverse Laplace Transform – Properties – Convolution integral – Properties – Impulse response – Impulse response of interconnected systems   – Analysis and characterization of LTI system using Laplace transform

UNIT IV	**FREQUENCY DOMAIN REPRESENTATION IN DISCRETE TIME SIGNALS**	**9+3**

Sampling- Representation of sequences - Discrete Time Fourier Transform (DTFT) - Properties of DTFT - Impulse response of a system with DTFT - Frequency response of a system with DTFT - Solution of linear constant coefficient difference equations – MATLAB exercises for sampling process

UNIT V	**ANALYSIS AND CHARACTERISATION OF DISCRETE TIME LTI SYSTEM**	**9+3**

Z transform – Region of convergence of finite duration sequences - Properties of Z transform– Relation between DTFT and Z transform - Inverse Z transform - Analysis and characterization of DT system using Z-transform - Evaluation of Impulse response & Step response -Convolution Sum

	Total Periods	**45+15**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Clarify signal properties like periodicity, even or odd, energy or power and system properties such as causality, linearity and time-invariance
CO 2	Determine the frequency response of periodic and aperiodic continuous time signals using Fourier transform
CO 3	Interpret the response of an LTI interconnected System of a given continuous time input signal interms of Laplace
CO 4	Convert a continuous time signal into discrete time signal and reconstruct the continuous time signal.
CO 5	Analyze and characterize LTI system using z-Transforms

Text Books

1. Alan V Oppenheim, Ronald W. Schafer Signals & Systems, 2nd ed., Pearson Education, 2015
2. P.Ramakrishna Rao, Shankar Prakriya, Signals & Systems, 2nd ed., McGraw Hill Education, 2015

Reference Books

1. Simon Haykin, Barry Van Veen, Signals and Systems, 2nd ed., John Wiley & Sons Inc., 2007
2. Lathi B.P, Linear Systems & Signals, 2nd ed., Oxford Press, 2009

3. John G. Proakis, Manolakis, Digital Signal Processing, Principles, Algorithms and Applications, 4th ed., Pearson Education, 2007.

Web Resources
1. https://www.youtube.com/watch?v=2D66kbRiVko
2. https://www.youtube.com/watch?v=spUNpyF58BY
3. https://www.youtube.com/watch?v=n2y7n6jw5d0
4. https://www.youtube.com/watch?v=Ww_8hPQcCHs
5. https://www.youtube.com/watch?v=hewTwm5P0Gg

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	1									3
2	3	3		2	1									3
3	2	3		3										3
4	3	3		3	1									3
5	3	3		3										3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Show that $\delta(n) = u(n) - u(n-1)$ **(Understand)**
2. For the each of the following systems, determine whether or not the system is Linear and Time invariant.   **(Apply)**
   (i) $y(n) = x(n) \cos(0.2\pi n)$
   (ii) $y(n) = A x(n) + B$, where A and B are constants.

COURSE OUTCOME 2:
1. A periodic signal $x(t)$ is given by $x(t) = 1 + 2\cos(300\pi t + \pi/4) + \sin(500\pi t)$ **(Understand)**
   a. What is the period of x (t)?
   b. Predict the Fourier series coefficient of $x(t)$ for $-6 \le k \le 6$
2. Calculate the FT of the following and sketch the magnitude and phase spectrum **(Apply)**
   a. $x(t) = \delta(t)$
   b. $x(t) = u(t)$
   c. $x(t) = e^{-3t} u(t)$

COURSE OUTCOME 3:
1. Resolve the Laplace transform X(s) and sketch the pole-zero plot with the ROC for the following signals x(t): **(Apply)**
   a. $x(t) = e^{-3t} u(t) + e^{2t} u(-t)$
   b. $x(t) = e^{2t} u(t) + e^{-4t} u(-t)$
2. Let $x(t) = u(t-1) - u(t-5)$ and $h(t) = e^{-3t} u(t)$ **(Analyze)**
   a. Compute $y(t) = x(t) * h(t)$
   b. Compute $g(t) = (dx(t)/dt) * h(t)$
   c. How g(t) related to y(t).

COURSE OUTCOME 4: (Apply)
1. Consider the analog signal $x_a(t) = 3\cos(2000\pi t) + 5\sin(6000\pi t) + 10\cos(12000\pi t)$
   a. What is the Nyquist rate for this signal?
   b. Assume now that we sample this sample using a sampling rate Fs= 5000 samples/sec. What is the discrete time signal obtained after sampling? **(Apply)**

2. Consider the interconnection of LTI systems as shown in figure **(Apply)**
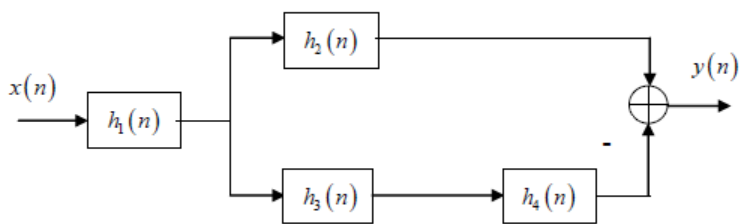
Express the overall impulse response in terms of $h_1(n)$, $h_2(n)$, $h_3(n)$ and $h_4(n)$.

COURSE OUTCOME 5: (Analyze)

1. Infer the system function for the given equation. Also calculate the step response. y(n)-0.7y(n-1)+0.1y(n-2)=2x(n)-x(n-2) **(Analyze)**
2. Convolve the following two sequences x(n) and h(n) to get y(n). x(n)={1,1,1} and h(n)={2,2}. Also give the illustration **(Analyze)**

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21HS1103	**TAMIL HERITAGE**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**1**

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 fine arts.

Prerequisites for the course:

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

UNIT I	**LANGUAGE AND LITERATURE**	**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.

UNIT II	**HERITAGE-ROCK ART PAINTINGS TO MODERN ART–SCULPTURE**	**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, Making of musical instruments - Mridangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III	**FOLK AND MARTIAL ARTS**	**6**

Therukoothu, Karakattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance-Sports and Games of Tamils.

UNIT IV	THINAI CONCEPT OF TAMILS	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.

UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	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.

Total Periods	30

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 of India.

CO PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
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 banks 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: The Author)
7. Porunai Civilization(Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Industo Vaigai (R.Balakrishnan) (Published by:RMRL)–Reference Book.

21HS1103	தமிழர் மரபு	L	T	P	C
		2	0	0	1

முன்னுரை (Preamble)

இப்பாடத்திட்டம் பொறியியல் பயிலும் முதலாம் ஆண்டு மாணவர்களின் முதலாம் பருவத்திற்கு உரியது. தமிழ் மொழி மற்றும் இலக்கியத்தின் தன்மைகளை எடுத்துரைத்து மரபுக் கலைகளான நிகழ்த்து கலைகள் மற்றும் நுண்கலைகள் வழியாகத் தமிழ்ப் பண்பாட்டை புலப்படுத்தி இந்திய பண்பாட்டிற்கு தமிழர்கள் ஆற்றிய பங்கினை மாணவர்கள் அறியச் செய்தல்.

பாடநெறிக்கான முன்னிபந்தனைகள் (Prerequisites for the course)

தமிழ் மொழியில் எழுத படிக்க தெரிந்திருத்தல் அவசியம்.

அலகு I	மொழி மற்றும் இலக்கியம்	6

இந்திய மொழிக் குடும்பங்கள்- திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள் தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி- தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு– பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை– சிற்பக்கலை	6

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள்- தேர் செய்யும் கலை- சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள்- குமரி முனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள்- மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு..

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	6

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	6

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்க கால நகரங்களும் துறைமுகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	6

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ் புத்தகங்களின் அச்சு வரலாறு

Total Periods		**30**

எதிர்பார்க்கும் படிப்பின் முடிவுகள்

CO1	மாணவர்கள் தமிழ் மொழி மற்றும் இலக்கியத்தின் தன்மைகள் குறித்து அறிந்து கொள்வார்.

CO2	தமிழ் மரபு சார்ந்த நுண்கலைகளையும் அதன் நுட்பங்களையும் புரிந்து கொள்வர்.
CO3	நிகழ்த்து கலைகளின் வகைகளையும் அதன் பண்பாட்டுச் சூழலையும் அறிந்து கொள்வர்.
CO4	பழந்தமிழரின் வாழ்க்கைச் சூழல்களை அறிந்து கொள்வர்.
CO5	இந்திய ஒருமைப்பாட்டிற்கும் வளர்ச்சிக்கும் தமிழர்கள் ஆற்றிய பங்கு குறித்து அறிவர்.

CO PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
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. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

21EC3603	DIGITAL LOGIC DESIGN	L	T	P	C
		3	0	2	4

Prerequisites for the course

- 21EC2601/ Semiconductor Devices and Circuits

Preamble

All of the foundational ideas in digital design will be covered in the course on Digital Logic Design. Beginning with Boolean algebra and the reduction of logic gates using K map and Tabulation techniques. Sequential and combinational circuit design strategies will be used after that. The topics of semiconductor memories and Hardware Description Language (HDL) will be discussed. It is a study of digital circuit optimization and design analysis of semiconductor memory circuits as well as combinatorial and sequential circuits.

UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES REDUCTION TECHNIQUES	8

Basic theorems and properties of Boolean algebra, Boolean functions-Sum of Product (SOP) and Product of Sum (POS) expressions. Positive and negative logic system. Algebraic simplification of Boolean expression NAND-NOR circuit implementations AND-OR -Invert implementations. Karnaugh map(K-map) simplification Techniques for SOP and POS functions up to five variable Don't care condition for simplification of Boolean function. Tabulation Methods.

UNIT II	COMBINATIONAL LOGIC CIRCUITS	8

Combinational Circuits- Half adder, full adder, parallel binary adder, half Subtractor , full subtractor, parallel binary subtractor, Carry look ahead Adder, BCD Adder,code converters, Decoder and Encoder, Multiplexers and Demultiplexers, Magnitude Comparator, Parity Generators and Checkers. BCD to Seven segment decoder.

UNIT III	SEQUENTIAL LOGIC CIRCUITS	8

Master/Slave Flip Flop – operation and Flip flop excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design -Moore/Mealy models, state minimization, state assignment, circuit implementation –Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS & HARDWARE DESCRIPTION LANGUAGE	8

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. Introduction to Verilog- Structure of Verilog module, Gate level Modelling for basic GATES.

UNIT V	BASIC MEMORY STRUCTURE	8

Memory Devices- ROM -PROM – EPROM – EEPROM –EAPROM, RAM –Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL).

	Total Periods	40

LABORATORY

S.NO	NAME OF THE EXPERIMENTS	HOURS	CO
1.	Create/Test 2 input basic logic gates using NOR/NAND gate	1 hours	**1**
2.	Construct a circuit employing logic gates to convert 4 bit binary to gray code.	2 hours	**2**
3.	Implement and test a half-adder circuit	2 hours	**2**
4.	Implement and test a Full subtractor circuit	2 hours	**2**
5.	Design/Test the 3X8 Decoder circuit.	2 hours	**2**
6.	Design/Test the 8X1Multiplexer circuit.	1 hours	**2**
7.	Build/Test BCD to Seven segment LED Display circuit.	2 hours	**2**
8.	Build/Test the functionality of the SR Flip-Flop.	2 hours	**4**
9.	Build/Test the working of the Shift Register.	2 hours	**4**
10.	Build/Test the working of the 4 bit Ripple Counter.	2 hours	**4**

11.	Build/Test the working of 4 bit UP - DOWN Counter.	2 hours	**4**
	Total Periods	**20**	

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO1	Optimize logic circuits using minimization techniques.
CO2	Design combinational digital circuits using logic gates.
CO3	Do the analysis and design for synchronous sequential circuits.
CO4	Analyse and design Asynchronous sequential circuits and Gate level modelling.
CO5	Design of semiconductor memories using optimized logic structure.

Text Books

1. M. Morris R. Mano and Michael D. Ciletti, Digital Design With an Introduction to the Verilog HDL, 2014, 6th Edition, Prentice Hall of India, India
2. S.Salivahanan and S.Arivazhagan "Digital circuits and Design, 5th Edition, Oxford University Press.

Reference Books

1. Charles H. Roth, Jr., Fundamentals of Logic Design, 2014, 7th Edition Reprint, Brooks/Cole, Pacific Grove, US.
2. Jain, R P , Morden Digital Electronics, TMH Education , New Delhi, 3rd Edition or latest.
3. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc,2011.
4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010.
5. "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Samir Palnitkar, Prentice Hall Professional, (2003).

Web Resources

1. http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuits-IIT-Kharagpur/lecture-08.html
2. http://www.infocobuild.com/education/audio-video-courses/electronics/DigitalCircuits-IIT-Kharagpur/lecture-11.html
3. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
4. https://www.youtube.com/watch?v=FWE0-FOoE4s
5. https://nptel.ac.in/courses/117/106/117106086/

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	
2	3	3	3										3	
3	3	3	3	3									3	
4	3	3	3										3	
5	2	3	3	2									3	

**COURSE LEVEL ASSESSMENT QUESTIONS**
COURSE OUTCOME 1:
1. What is your answer for the following question
   Sum of product expression for the function $f(W,X,Y,Z)=\sum(0,1,3,5,14)+d(8,15)$ is –

2. The Boolean function $f(A,B,C,D)=\sum(3,7,11,13,14,15)$ simplifies to -------
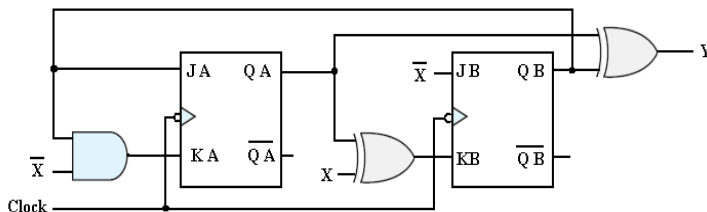
COURSE OUTCOME 2:

1. Consider the 1:4 demultiplexer circuit shown below. What would be the output
   bits for input condition S0=1, S1=1 and Din=1?
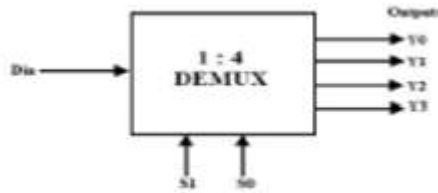
2. Identify the output (Y) of the folowing circuit
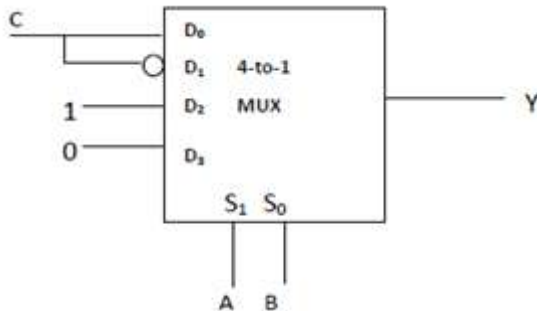
COURSE OUTCOME 3:
1. Using T Flip-flop design binary counter which counts in the sequence 000, 001, 010, 011, 100, 101, 110, 111, 000
2. Derive the transition table, state table and state diagram for moor sequential circuit shown in below figure.

COURSE OUTCOME 4:
1. Which stable state depend on an order in race ?
2. What does the construct "#5" indicate in simulation?

COURSE OUTCOME 5:
1. Implement the switching function $F(A,B,C,D)=\sum_m(1,3,5,7,8,9,14,15)$ by a static hazard free two level AND-OR gate network..
2. Implement binary to Gray code converter using PROM devices

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21EC3511	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course:

- 21CS1511/ Programming Practice Laboratory using C

Objectives:

- To Learn Java programming language.
- Be exposed to the different data structures
- Be familiar with applications using different data structures
- To implement linear and non-linear data structures.
- To implement graph traversal algorithms

S.No	List of Experiments	CO
1	Basic Programs for Java Concepts	CO1
2	Program to define inheritance and show method overriding.	CO1
3	Program to demonstrate Exception Handling.	CO1
4	Program to demonstrate Multithreading.	CO1
5	Array implementation of List Abstract Data Type (ADT)	CO2
6	Linked list implementation of List ADT	CO2
7	Stack ADT – Array and linked list implementations	CO2
8	Evaluation of a postfix expression using Stack.	CO5
9	Queue ADT – Array and linked list implementations.	CO2
10	Implementation of Binary Tree Traversals.	CO3
11	Implementation of Graph Traversals.	CO4

Total Periods : 60

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes:

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

CO 1 Apply good programming design methods for program development (APPLY)

CO 2 Design and implement Java programs for manipulating Linear Data structures (APPLY)

CO 3 Design and implement Java programs for manipulating Non-Linear Data structures. (APPLY)

CO 4 Design and implement graph traversals.(APPLY)

CO 5 Identify, implement and use the appropriate data structures for a given problem. (ANALYSE)

CO 6 Design and implement java programs with proper Exception Handling. (APPLY)

Laboratory Requirements:

- JDK8.
- Operating system: Windows

Reference Books

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. E. Balagurusamy, 2004, Programming with JAVA, 2nd Edition,Tata McGraw-Hill Publishing Co.Ltd.
3. Data Structures and Algorithms in Java, 2nd edition, Robert Lefore, SAMS publishing, 2003
4. Data Structures and Algorithms in Java, 2nd edition, M.T.Goodrich and R.Tamassia, John Wiley and Sons, Inc.

Web Resources

1.   https://www.mygreatlearning.com/blog/data-structures-using-java/

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3		3							1	2	1	2
2	3	2	3		3							1	2	2	
3	3	2	3		3							1		2	
4	3	2	3		3							1		2	
5	3	2	3		3							1		2	
6	3	2	3		3							1	2	1	

COURSE LEVEL ASSESSMENT QUESTIONS:

Course Outcome 1 (CO1): Apply good programming design methods for program development
1. Write a program for code reusability. (Apply)

Course Outcome 2 (CO2): Design and implement Java programs for manipulating Linear Data structures
1. Implement Stack ADT with its operations in java. (APPLY)

Course Outcome 3 (CO3): Design and implement Java programs for manipulating Non-Linear Data structures.
1. Implement Binary tree traversals in java. (APPLY)

Course Outcome 4 (CO4): Design and implement graph traversals
1. Implement BFS and DFS in java. (Apply)

Course Outcome 5 (CO5): Identify, implement and use the appropriate data structures for a given problem
1. Implement Polynomial Manipulations using appropriate data structure in java. (CREATE)

Course Outcome 6 (CO6): Design and implement java programs with proper Exception Handling. (APPLY)
1. Write a java program with proper Exception Handling.

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21EC3611	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course
- 21EC2611/ Semiconductor Devices and Circuits Laboratory

Preamble

The preamble of this laboratory course enables students to get practical experience in design, assembly, testing and evaluation of Rectifiers and Voltage Regulators, BJT characteristics and Amplifiers, JFET Characteristics and Amplifiers, MOSFET Characteristics and Amplifiers, Power Amplifiers, RC-Phase shift, Hartley, Colpitts and Crystal Oscillators. The students Acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier. Develop the ability to analyze and design analog electronic circuits using discrete components. Observe the amplitude and frequency responses of common amplification circuits. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis.

S.No	List of Experiments	CO
1	Frequency Response of CE amplifier	CO 1
2	Darlington Amplifier	CO 1
3	Differential Amplifiers- Transfer characteristic, CMRR	CO 2

	Measurement	
4	RC Phase shift oscillator and Wien Bridge Oscillator	**CO 2**
5	Hartley Oscillator and Colpitts Oscillator	**CO 3**
6	Single Tuned Amplifier	**CO 3**
7	Series and Shunt feedback amplifiers-Frequency response, Input and output impedance	**CO 4**
8	RC integrator and differentiator	**CO 4**
9	Design of multivibrator using PSpice	**CO 5**
10	Analysis of Frequency Response of BJT using PSpice	**CO 5**
11	Class A and Class B Power Amplifiers using PSpice	**CO 6**

S.No.	List of Projects	Related Experiment	CO
1.	Design Common Emitter Audio Amplifier	1,2,3	**CO 1, CO2**
2.	Design and construction of a guitar amplifier	1,2,3	**CO 1, CO2**
3.	Design of Darlington Pair and a Relay	1,2,3	**CO 1, CO2**
4.	Design of Light and Dark Amplifier	1,2,3	**CO 1, CO2**
5.	Power regulators and Audio amplifier of Darlington	1,2,3	**CO 1, CO2**
6.	Simple Mobile Phone Detector Circuit using Op-Amp.	1,2,3	**CO 1, CO2**
7.	Over Heat Detector with Auto Cut-Off System using Op-Amp	1,2,3	**CO 1, CO2**
8.	Triangular Wave Generator Circuit with Op Amp IC 741	1,2,3	**CO 1, CO2**
9.	Design Phase Shift Oscillator with Stripboard Version	4,5	**CO 2, CO3**
10.	Design LED Lamp Stabilised Wien Bridge Oscillator	4,5	**CO 2, CO3**
11.	Analysis of Voltage and Current Measurements	4,5	**CO 2, CO3**
12.	Design Radio receivers is the Hartley Oscillator	4,5	**CO 2, CO3**
13.	Operational Amplifier Tester Circuit	3,6,7	**CO 2, CO4**
14.	Phone Ring Amplifier Circuit	3,6,7	**CO 2, CO4**
15.	Laser Sound Transmission Circuit	3,6,7	**CO 2, CO4**
16.	Design a feedback amplifiers with Frequency response	3,6,7	**CO 2, CO4**
17.	Single Pulse RC Integrator Charging and discharging Circuit's	8,9	**CO5**
18.	Design of Astable Multivibrator Circuit using PSpice	8,9	**CO5**
19.	Online Frequency Response Analysis of Electric Machinery	10,11	**CO5, CO6**

| 20. | Build a class D power amplifier | 10,11 | **CO5, CO6** |
| 21. | Simple Boost Converter Circuit Using 555 Timer IC | 10,11 | **CO5, CO6** |

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

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

CO1	Apply the concepts of amplifiers in the design of Public Addressing System
CO2	Generate Sinusoidal wave forms of given specifications.
CO3	Design stable system using feedback concepts
CO4	Analyse various types of multivibrators
CO5	Design tuned amplifiers, integrator and differentiator.

Laboratory Requirements

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS
BC 107, BC 547, CL100- 25 each
Resistors, Capacitors, Inductors - sufficient quantities Bread Boards - 15 Nos
CRO (30MHz) – 10 Nos.
Function Generators (3MHz) – 10 Nos.
Dual Regulated Power Supplies (0 – 30V) – 10 Nos.
PC with ORCAD PSPICE Software-5 Nos

Reference Books

1. Laboratory Manual, Department of ECE, FXEC.
2. David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, D.A. Bell, 2001.
3. L. K. Maheshwari, M. M. S. Anand, "Laboratory Experiments and PSPICE Simulations in Analog Electronics", PHI, 2006

Web Resources

1. http://ncert.nic.in/textbook/pdf/leph206.pdf
2. https://www.elprocus.com/semiconductor-devices-types-and-applications/
3. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee32/
4. https://www.youtube.com/watch?v=J6QS_aCT2No
5. https://learnabout-electronics.org/Oscillators/osc34.php

CO Vs PO Mapping and CO Vs PSO Mapping

COURSE LEVEL ASSESSMENT QUESTIONS

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

COURSE OUTCOME 1:
1. Frequency Response of CE amplifier
2. Darlington Amplifier

COURSE OUTCOME 2:
1. RC Phase shift oscillator and Wien Bridge Oscillator

COURSE OUTCOME 3:
1. Hartley Oscillator and Colpitts Oscillator

COURSE OUTCOME 4:
1. Single Tuned Amplifier

COURSE OUTCOME 5:
1. RC integrator and differentiator

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21PT3901	APTITUDE - I	L	T	P	C
		0	0	2	1

Prerequisites for the course
• Basic Maths

Objectives

1. Expose the undergraduate students to solve aptitude problems using different methods and practices.
2. Expose the undergraduate students to understand and make decisions with mathematical, sttistical, and quantitative information.

UNIT I	MODULE I	6

Number system, Number series, HCF and LCM of Numbers, Factors and Decimals.

UNIT II	MODULE II	6

Square roots and cube roots, Indices and surds, Simplification and approximation, Problems on ages and numbers.

UNIT III	MODULE III	6

Percentage, Profit, loss and discount, Average, Ratio and Proportion.

UNIT IV	MODULE IV	6

Partnership and share, Alligation and mixtures, Chain rule, Mensuration.

UNIT V	MODULE V	6

Pipes and cisterns, simple interest, Compound interest, Growth and depreciation.

	Total Periods	30

Suggestive Assessment Methods

Continuous Assessment Test -1 (30 Marks)	Continuous Assessment Test -2 (30 Marks)	Model Exam (40 Marks)
MULTIPLE CHOICE QUESTIONS	MULTIPLE CHOICE QUESTIONS	MULTIPLE CHOICE QUESTIONS

Outcomes

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

CO1: Solve various concepts of number systems and their techniques in solving the HCF, LCM, Factors and Decimals.

CO2: Analyse the profit, loss and discount of real time situations and solve the average, ratio and proportion problems.

CO3: Solve the Problems on ages, Square roots, cube roots, Indices, surds, Simplification and approximation.

CO4: Solve the problems on Partnership, share, Alligation, mixtures, Chain rule, Mensuration.

CO5: Solve the problems on Pipes and cisterns, simple interest, Compound interest, Growth and depreciation.

Text Books

1. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
2. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.

Reference Books

1. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
5. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

Web Resources

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/

CO Vs PO Mapping

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

SEMESTER IV

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC4601	Analog and Digital Communication	PC	3	3	0	0	3
2	21EC4602	Applied Electromagnetics	PC	3	3	0	0	3
3	21EC4604	Principles of Computer Networks	PC	3	3	0	0	3
4	21EC4605	Control Systems	PC	3	3	0	0	3
5	21HS2103	Technology in Tamil Culture	HSSM	2	2	0	0	1
Mandatory Course								
1	21GE2M02	Environmental and Sustainable Engineering	MC	2	2	0	0	0
Theory cum Practical Courses								
1	21EC4603	Linear Integrated Circuits	PC	5	3	0	2	4
Practical Courses								
1	21EC4611	Analog and Digital Communication Laboratory	PC	4	0	0	4	2
2	21PT3902	Verbal Ability	EEC	2	0	0	2	1
			Total	27	19	0	8	**20**

21EC4601	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

Prerequisites for the course

- 21EC3601/Analog Electronics

Preamble

- This course aims at designing Analog and Digital communication systems that are used for the transmission of information from source to destination. A detailed quantitative framework for analog and digital transmission techniques is addressed.

UNIT I	ANALOG COMMUNICATION	9

Introduction to Communication Systems - Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of DSBSC, SSBSC and VSB- Theory of Frequency and Phase Modulation - PM–FM Conversion, FM–PM Conversion, Single tone, Narrow Band and Wideband FM – Transmission Bandwidth

UNIT II	DIGITAL MODULATION AND TRANSMISSION	9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Binary Phase Shift Keying (BPSK) – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency–ISI – Pulse shaping – Duo binary encoding – Eye pattern, equalizers.

UNIT III	PULSE MODULATION	9

Sampling Theorem – Natural sampling – Flattop sampling- Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM), DM - ADM, Time Division Multiplexing, Frequency Division Multiplexing.

UNIT IV	INFORMATION THEORY AND CODING	9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, Syndrome calculation, cyclic codes, Convolution Coding, Viterbi decoding.

UNIT V	SPREAD SPECTRUM AND MULTIPLE ACCESS	9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS - Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Design and implement various analog modulation techniques.
CO2	Design and implement various digital modulation techniques.
CO3	Design and implement various pulse modulation techniques.
CO4	Examine the principles behind information theory and coding.
CO5	Design and implement various spread spectrum techniques and multi-user radio communication.

Text Books
1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 4/e, TMH 2017.
2. S. Haykin "Digital Communications" John Wiley 2013.

Reference Books
1. B.P. Lathi, Zhi Ding and Hari Mohan Gupta."Modern Digital And Analog Communication Systems: Fourth Edition", 4rd edition, South Asia edition, Oxford University Press, 2017.
2. H P Hsu, Schaum Outline Series "Analog and Digital Communications" TMH 2006.
3. B.Sklar, "Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

Web Resources
1. **https://onlinecourses.nptel.ac.in/noc19_ee46/preview** (Analog Communication)
2. **https://onlinecourses.nptel.ac.in/noc21_ee30/preview** (Digital Communication)
3. **https://www.youtube.com/watch?v=TJNKoRPn-G8** (CDMA & Spread Spectrum)

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	0							1	1	2
2	3	2	3	2	0							1	1	2
3	2	2	3	2	0							1		2
4	3	2	2	3	0							1		2
5	3	2	3	3	0			2				1		2

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Sketch the one cycle of AM wave and calculate the modulation index of it in terms of Vmax and Vmin voltages (Design)
2. Design an non coherent receiver FM. (Design)

COURSE OUTCOME 2:
1. Design an QPSK modulator and demodulator with neat diagram and also compare BPSK. (Design)

2. Design a 16 QAM transmitter with the truth table. (Design)

COURSE OUTCOME 3:

1. Design a PCM modulator and demodulator with neat diagram. (Design)
2. Design a ADM modulator and demodulator with neat diagram. (Design)

COURSE OUTCOME 4:

1. Consider five messages S0, S1, S2, S3, S4 given by the probabilities 1/2, 1/4, 1/8, 1/16, 1/16. Make use of Shannon –Fano algorithm and Huffman coding algorithm to develop an efficient code. Compare the coding efficiency. (Apply)
2. Develop an viterbi decoding procedure used for decoding convolution Codes**.** (Apply)

COURSE OUTCOME 5:

1. Design a DSSS modulator and demodulator with neat diagram. (Design)
2. Design a FHSS modulator and demodulator with neat diagram. (Design)

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21EC4602	APPLIED ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- 21EC1503/Fundamentals of Electrical, Electronics and communication

Preamble

The field of applied electromagnetics has roots going back to giants of electrical engineering such as Maxwell, Faraday, Hertz, Marconi, and Tesla. In recent years it has expanded beyond antennas and radio wave propagation to include emerging areas such as micro-electromechanical systems, metamaterials, nanomagnetics, biological applications of electromagnetic fields, information technologies, and other novel devices and structures. There is a strong need for students with skills in these areas in the industries of telecommunications, defense, microwave instruments, medical devices, and other areas. These industries are growing rapidly, driven in particular by the continuing expansion of wireless communications and related technologies. This program will prepare students for a broad range of career opportunities in research and technology development in the expanding field of applied electromagnetics.

UNIT I	INTRODUCTION	9

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem

UNIT II	ELECTROSTATICS	9

Introduction- Electric Field-Electric Field Intensity -Electric Field due to discrete charges - Electric field due to continuous charge distribution, Electric Field due to charges distributed uniformly on a finite line - Electric Field on the axis of a uniformly charged circular disc and uniformly charged sheet. Electric Scalar Potential – Relationship between potential and electric field - Potential due to electrical dipole - Electric Flux Density Electrostatic energy and energy density-Gauss Law and Applications

UNIT III	MAGNETOSTATICS	9

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT IV	TIME-VARYING FIELDS AND MAXWELL's EQUATIONS	9

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields.

UNIT V	EMI/EMC CONCEPTS	9

EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans, ESD.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Solve problems based on the understanding of electric and magnetic fields in free space and in materials.
CO2	Outline the behaviour of static Electric fields in free space.
CO3	Outline the behaviour of static magnetic fields in free space.
CO4	Apply the concepts of static electric and magnetic fields in materials and Interpret guided waves in both electric and magnetic modes.
CO5	Identify the various types and mechanisms of Electromagnetic Interference.

Text Books

1. Field And Wave Electromagnetics by David K. Cheng, January 2014 (Unit I – IV)
2. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996.(Unit V)

Reference Books

1. William H Hayt, John A Buck, Engineering Electromagnetics, McGraw-Hill Higher Education,8th edition, 2011.
2. Bhag Guru and Huseyin Hiziroglu, Electromagnetic Field Theory Fundamentals, Cambridge University Press, 2nd edition, 2004
3. D.J. Griffiths, Introduction to electrodynamics, 4th ed., Pearson (India), 2013
4. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011 Edition, 2008.

Web Resources

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/
2. https://www.youtube.com/watch?v=NK-BxowMIfg
3. https://www.youtube.com/watch?v=qjsZTBZd1Ms
4. https://www.youtube.com/watch?v=X4NNGHkP-Fg
5. https://www.youtube.com/watch?v=yxbshDyGPng

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											3
2	3	2	3	2										3
3	3	2	3	3										3

4	3	2	3	3										3
5	2	3				3	2							3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Given the two points A (x=2, y=3, z=-1) and B (r=4, θ=25, φ=120 °). Solvethe spherical coordinates of A and Cartesian coordinates of B.
2. Explain the Stokes theorem with their applications.

COURSE OUTCOME 2:
1. Determine the electric flux density at (1,0,2) if there is a point charge 10Mc at(1,0,0) and a line charge of 50 mC/m along y axis.
2. Obtain a formula for the electric field intensity on the axis of a circular disc of radius b and carries uniform charge density ρs.

COURSE OUTCOME 3:
1. From the Biot Savart's law, write the expression for magnetic field intensityat a point P and distance R from the infinitely long straight current carrying conductor.
2. A circular loop located on $x^2 + y^2 = 9$, z = 0 carries a direct current of 10 A along aφ. Calculate H at (0,0,4) and (0,0,-4).

COURSE OUTCOME 4:
1. Derive the wave equation starting from Maxwell's equation for free space .
2. Derive the Maxwell's equation both in integral form and differential form of Ampere's law, Faraday's law and Gauss law.

COURSE OUTCOME 5:
1. Explain the different sources of EMI in detail. Give example.
2. Give an account of radiation hazards.

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21EC4604	**PRINCIPLES OF COMPUTER NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisites for the course
- Basics of Network Concepts

Preamble
- The objectives of this course are to provide a comprehensive and in-depth understanding of the concepts of computer networks, extend the students" knowledge in error detection and error correction, network protocols, the upper layers of the OSI model, security and provide knowledge in knowing emerging trends in networking technologies

UNIT I	**FUNDAMENTALS AND PHYSICAL LAYER**	**9**

Overview, data communications, networks ,types, Protocol Layering, TCP/IP protocol – layers , OSI Model - layers, multiplexing, topologies, transmission media, packet switching- error detection and correction-ATM

UNIT II	**DATA LINK LAYER AND INTERNETWORKING**	**9**

HDLC –-controlled access-Ethernet (802.3) - Wireless LANs – IEEE 802.11 – Bluetooth – WiMax–IPV4 Address – IPv6 Addressing- Network layer protocols (IP, ICMP, Mobile IP)

UNIT III	**ROUTING**	**9**

Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Intradomain protocols – DVMRP, MOSPF,PIM – Interdomain routing Protocols – IGMP.

UNIT IV	**TRANSPORT AND APPLICATION LAYER**	**9**

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – Flow, Error and Congestion Control - Congestion avoidance (DEC bit, RED) - World Wide Web and HTTP – DNS- Electronic Mail (SMTP, POP3, IMAP, MIME) - Data-Flow Characteristics- Flow Control To Improve Qos.

UNIT V	NETWORK SECURITY AND COMPUTING	9

Cryptography and Network Security – Introduction - Confidentiality - Other Aspects Of Security - Firewalls- Network slicing-Mobile edge cloud-content distribution-Software Defined Networks

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Clearly understand the building blocks of networks and its physical layer.
CO2	Trace the flow of information from one node to another node in the network and understand the various MAC Protocols and internetworking
CO3	Illustrate the various routing concepts, mechanisms and protocols
CO4	Describe the services and techniques of Transport Layer and application layer
CO5	Illustrate various security techniques and security devices used in communication networks

Text Books

1. Behrouz A. Forouzan, "Data communication and Networking with TCP/IP protocol suite", sixth Edition, Tata McGraw Hill, 2021
2. Frank H.P. Fitzek , Fabrizio Granelli , Patrick Seeling "Computing in Communication Networks -From Theory to Practice", Academic Press, 2020.

Reference Books

1. William Stallings,"Data and Computer Communications",Tenth Edition,Pearson Education,2014
2. Oliver.C.lbe"Fundamentals of Data Communication Networks",Wiley,2018
3. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2016

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. https://beginnersbook.com/category/computer-network/

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	1	1	1						1	1	3	
2	3	3	1	1	1						1	1	3	
3	3	3	1	1	1						1	1	3	
4	3	3	1	1	1						1	1	3	
5	3	3	1	1	1						1	1	3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:
1. Illustrate TCP/IP suite with examples
2. Analyze error detection and correction methods

COURSE OUTCOME 2:
1. Distinguish IPv4 and IPv6
2. Discuss the IEEE 802.11 standards.

COURSE OUTCOME 3:
1. Find the shortest path using distance vector routing for a given network
2. Compare and contrast various multicast routing protocols.

COURSE OUTCOME 4:
1. Distinguish TCP and UDP
2. Elaborate on protocols related to Electronic mail.

COURSE OUTCOME 5:
1. Discuss on various types of firewalls
2. Give a detailed study on computing trends in communication networks

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21EC4605	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisites for the course

- 21MA2201/Partial Differential Equation and Application of Fourier Series
- 21EC3602/Signals and Systems

Preamble

To introduce the components and their representation of control systems and to learn various methods for analysing the time response, frequency response and stability of the systems and also learn the various approach for the state variable analysis.

UNIT I	SYSTEM MODELLING AND REPRESENTATION	9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Systems-Transfer Function Models-Electrical Analogy. Block diagram Models-Signal flow graphs models.

UNIT II	TIME RESPONSE ANALYSIS	9

Standard test signals – Time response specifications-Time response of First and Second order system for step input and ramp input - poles & zeros-effect of additional pole & additional zero-Steady state error constants-Basics of P, PI, PD, and PID Controller.

UNIT III	FREQUENCY RESPONSE ANALYSIS & DESIGN	9

Frequency domain specifications- Frequency response of standard second order system- Bode Plot - Polar Plot- Design Procedure of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation.

UNIT IV	STABILITY ANALYSIS	9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion- Root locus concept & guidelines for sketching root locus-Nyquist stability criterion.

UNIT V	STATE VARIABLE REPRESENTATION	9

Introduction to state space analysis- State models of linear systems - Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability- State transition matrix, State space representation of discrete time system

	Total Periods	45

Suggestive Assessment Methods		
Continuous Assessment Test (20 Marks)	**Formative Assessment Test (20 Marks)**	**End Semester Exams (60 Marks)**
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes	
Upon completion of the course, the students will be able to:	
CO1	Understand the various control system components and their representations
CO2	Analyze the various time domain parameters
CO3	Analyze the Bode plot and polar plot.
CO4	Apply the concepts of various system stability criterions.
CO5	Design various transfer functions of digital control system using state variable models

Text Books

1. M.Gopal, "Control System – Principles and Design" , Tata McGraw Hill, 4th Edition, 2012
2. Nagrath.J and Gopal.M," Control System Engineering", New Age International Publishers, 2017

Reference Books

1. Ogata K, "Modern Control Engineering", Prentice Hall of India, New Delhi, 2013.
2. Gopal.M, "Digital Control and State Variable Methods", McGraw- Hill, 4th Edition, 2012.
3. Benjamin Kuo, ―Automatic Control Systems‖, Prentice Hall of India, New Delhi, 2010.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_de09/preview
2. https://www.youtube.com/watch?v=f4WGCQXqfnw
3. https://www.youtube.com/watch?v=VSDLCdKfzMo
4. https://www.youtube.com/watch?v=zY-pRRlFxbI
5. https://www.youtube.com/watch?v=sUDoTw_LIbk

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							3	
2	3	3	3			1							3	
3	3	3	3										3	
4	3	3	2	2		1							3	
5	3	3	3										3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (Understand)

1. Write the differential equation governing the mechanical rotational system. And obtain its transfer function $\frac{\theta_1(s)}{T(s)}$
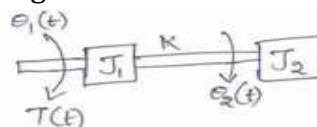
2. Draw the signal flow graph for the following system and find its transfer function using Mason's gain formula

$$x_2 = a_{12}x_1 + a_{22}x_2 + a_{32}x_3$$
$$x_3 = a_{23}x_2 + a_{43}x_4$$
$$x_4 = a_{24}x_2 + a_{34}x_3 + a_{44}x_4$$

$$x_5 = a_{25}x_2 + a_{45}x_4$$

Course Outcome 2 – Analyse

1. The system with the open loop transfer function 1/s (1+s) is:

2.Given a unity feedback system with G (s) =K/ s (s+4). What is the value of K for a damping ratio of 0.5?

Course Outcome 3 – Analyse

1. The polar plot of a transfer function passes through the critical point (-1, 0). Gain margin is

2. The forward path transfer function of a unity feedback system is given by G(s) = 100/ $(s^2+10s+100)$. Sketch the Bode plot for the above transfer function.

Course Outcome 4 - Apply

1. First column elements of the Routh's tabulation are 3, 5, -3/4, ½, 2. It means that there are:

2. The characteristic equation of a control system is given by $s^6+2s^5+8s^4+12s^3+20s^2+16s+16=0$. The number of the roots of the equation which lie on the imaginary axis of s-plane

Course Outcome 5 - Design

1. According to the property of state transition method, e0 is equal to _____

2. For a system with the transfer function H(s) = 3(s-2)/s^3+4s^2-2s+1, the matrix A in the state space form is equal to

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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 acquaint students 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 CONSTRUCTION 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 technical skills of Tamil culture.
CO5	To enumerate the technical development that Tamil has achieved in the field of science and computer.

CO PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
1		1			1		1	1	2	1		3
2		2	2		2	1	3	2	1	2		2
3		2	3	1	2	1	1	1	2	1		2
4			2				2	1	2	2		2
5			2				1	2	1	3		1

TEXT-CUM-REFERENCEBOOKS

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

21HS2103	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		2	0	0	1

முன்னுரை (Preamble)

இந்தப் பாடத்திட்டம் பொறியியல் பயிலும் முதலாம் ஆண்டு மாணவர்களின் இரண்டாம் பருவத்திற்குரியது. தமிழ் மரபு சார்ந்த தொழில்நுட்ப சிந்தனையை வளர்த்து பல்வேறு தொழில்நுட்பங்களின் அடிப்படை கூறுகளைத் தமிழரின் பண்பாடு மற்றும் வரலாற்றின் மூலம் மாணவர்களை அறியச் செய்தல்.

பாடநெறிக்கான முன்நிபந்தனைகள்(Prerequisites for the course)

தமிழ் மொழியில் எழுத படிக்க தெரிந்திருத்தல் அவசியம்.

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	6

சங்க காலத்தில் நெசவுத்தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	6

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்து பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல் , மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக்கலை

அலகு III	உற்பத்தித் தொழில் நுட்பம்	6

கப்பல் கட்டும் கலை - உலோகவியல் - நகைத் தொழில்நுட்பம் - இரும்பு தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்று சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்பு துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்

அலகு IV	வேளாண்மை மற்றும் நீர் பாசன தொழில்நுட்பம்	6

அணை , ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்து குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்

அலகு V	அறிவியல் தமிழ் மற்றும் கணினித் தமிழ்	6

அறிவியல் தமிழின் வளர்ச்சி - கணினித் தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

Total Periods	**30**

எதிர்பார்க்கும் படிப்பின் முடிவுகள்

CO1	மாணவர்கள் பண்டைத் தமிழரின் தொழில்நுட்பங்களை அறிந்து கொள்வர்.

CO2	பண்டைத் தமிழரின் தொழில்நுட்பத் திறனை மதிப்பிடுதல்.
CO3	தாய் மொழியில் பல்வேறு உற்பத்தி தொழில்நுட்பங்களைக் குறித்து சிந்திக்கும் திறனை அடைவார்.
CO4	தமிழரின் வேளாண்மை மற்றும் நீர் மேலாண்மை தொழில்நுட்ப திறன்களை மீட்டு உருவாக்கம் செய்தல் குறித்து அறிதல்.
CO5	அறிவியல் மற்றும் கணினி துறையில் தமிழ்ப் பெற்றுள்ள தொழில் நுட்ப வளர்ச்சியை அறிதல்.

Course Outcomes:

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

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
1		1			1		1	1	2	1		3
2		2	2		2	1	3	2	1	2		2
3		2	3	1	2	1	1	1	2	1		2
4			2				2	1	2	2		2
5			2				1	2	1	3		1

   TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முனைவர் இல. சுந்தரம்(விகடன் பிரசுரம்).
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4. பொருநை - ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

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.
. 21CY1401/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 commonplants, 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 - Soil pollution - Solid waste management - E-waste management.
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	NA	NA

Outcomes

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

1	Extract the knowledge on the interdisciplinary and holistic nature of the environment. (Understand)
2	Discover the problems related to environmental degradation. (Apply)
3	Sketch the significance of natural resources on the quality of life. (Apply)
4	Solve the issues in areas of sustainability. (Apply)
5	Articulate knowledge on the concepts of sustainable habitat (Apply)

Text Books

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.(UNIT-1,2.3)
2. Nibin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-HillProfessional.(UNIT-4,5)

Reference Books

1. 1.G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
2. 2.Rajagobalan.R.'Environmental studies-From Crisis to cure' Oxford University Press,2005.

Web Resources

1. NPTEL Lecture: https://www.youtube.com/watch?v=hihFHam_wNE
2. NPTEL Lecture: https://www.youtube.com/watch?v=DNUYxyaYh3g

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	1				2	3					2		
2	3	2				2	3					2		
3	3		1	1		2	3					2		
4	3	2	1	1		2	3					2		
5	3	2	1	1		2	3					2		

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1 Students will be able to extract the knowledge on the interdisciplinary and holistic nature of the environment.   (Understand)
1.   Describe the Multidisciplinary nature of Tirunelveli District.
2.   Demonstrate the regulation of Ecosystem
COURSE OUTCOME 2: Students will be able to discover the problems related to environmental degradation.   (Apply)
1. Demonstrate the control measures of Air and water Pollution

2. Account the problem and suitable remedial measures for floods in the rainy season.

COURSE OUTCOME 3: Students will be able to Sketch the significance of natural resources on the quality of life.   (Apply)

1. Highlight the control and effects of deforestation.
2. Label the role of individual in conservation of natural resources

COURSE OUTCOME 4: Students will be able to Solve the issues in areas of sustainability. (Apply)

1. Outline the term "sustainable development"
2. Compare the major limitations of the Air act, 1972 and Water act, 1980.

COURSE OUTCOME 5: Students will be able to articulate knowledge on the concepts of sustainable habitat   (Apply)**.**

1. Narrate the concept and procedure for Environment Impact Assessment.
2. Elucidate the prevention of pollution from various industries.

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21EC4603	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Prerequisites for the course
- 21EC3601/Analog Electronics
- 21EC3603/Digital Logic Design

Preamble
- The course aims at Operational Amplifier, Voltage Regulators and PLL, Analog and Digital Conversion using IC741. Experiments explore design of Schmitt Trigger, Monostable and Astable Multivibrator, Filters, Differentiator and Integarator.

UNIT I	**OPERATIONAL AMPLIFIER**	**8**

Manufacturing process of monolithic ICs – Construction of monolithic bipolar transistor – Monolithic Capacitors – Inductors. Differential gain – CMRR, General operational amplifier stages – internal circuit diagrams of IC 741 – DC and AC performance characteristics – slew rate operational amplifier.

UNIT II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS**	**8**

Advantages of ICs over discrete components – Open and closed loop configurations- Sign Changer – Scale Changer –Voltage Follower – Adder – Subtractor – Instrumentation amplifier – Integrator – Differentiator – Low–pass, High–pass and Band–pass filters - Comparators – Schmitt trigger – Multivibrators –V to I and I to V converters.

UNIT III	**VOLTAGE REGULATORS AND PLL**	**8**

Timer IC 555 –Timer applications – LM317 Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator– Switching Regulators, Monolithic switching regulator Operation of the basic PLL – Closed loop analysis – Voltage controlled oscillator – Monolithic PLL IC 565 – application of PLL for AM detection – FM detection – Frequency synthesizing.

UNIT IV	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**	**8**

Analog and Digital Data Conversions – specifications – D/A converter– weighted resistor type, R–2R Ladder type – Voltage Mode and Current Mode– high speed sample–and–hold circuits – A/D Converters– Flash type – Counter type-Successive Approximation type – Single Slope, Dual Slope

UNIT V	ANALOG MULTIPLIER AND SPECIAL FUNCTION ICS	8

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell – Variable transconductance technique – analog multiplier and phase detection, DC-DC converters– Switched capacitor filter IC MF10 – Frequency to Voltage and Voltage to Frequency converters – Audio Power amplifier – Video Amplifier, ASLKv2010 Features.

	Total Periods	40

LABORATORY

S.NO	NAME OF THE EXPERIMENTS	HOURS	CO
1.	Design and Testing of Inverting and Non Inverting amplifier using Op amp IC 741.	2 hours	**1**
2.	Design and Testing of Integrator and Differentiator using Op amp IC 741.	2 hours	**1**
3.	Design a circuit for Active LPF, HPF and BPF using Op amp IC 741.	2 hours	**2**
4.	Design and Testing of Astable Multivibrator using IC 741	2 hours	**2**
5.	Design and Testing of Monostable Multivibrator using IC 741	2 hours	**2**
6.	Design and Testing of Schmitt Trigger using Op amp IC 741	2 hours	**3**
7.	Construct a circuit of Astable Multivibrator using IC 555.	2 hours	**3**
8.	Construct a circuit of Monostable Multivibrator using IC 555.	2 hours	**3**
9.	Design and testing of R-2R Ladder Type D- A Converter using Op-amp IC 741.	2 hours	**4**
10.	Simulate the experiments Active LPF and HPF, Astable and Monostable Multivibrator using IC 555.	2 hours	**5**
	Total Periods	20	

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO1	Analyze the open and closed loop configuration and AC, DC Characteristics of an op–amp.
CO2	Apply the concept of op amp characteristics in different operational applications
CO3	Use analog multiplier and PLL for detection of modulated signals.
CO4	Design various ADC and DAC converters based on the specifications.
CO5	Design special function ICs

Text Books

1. S.Salivahanan& V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", 3rd Edition, TMH, 2015.
2. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,4th Edition, 2015.

Reference Books

1. Ramakant A.Gayakwad, "OP–AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", 3rd Edition, Tata McGraw–Hill, 2007.
3. B.S.Sonde, "System design using Integrated Circuits" , 2nd Edition, New Age Pub, 2001

Web Resources

1. https://www.youtube.com/watch?v=7FYHt5XviKc
2. https://www.youtube.com/watch?v=-rFOCGT7Xyw
3. https://www.youtube.com/watch?v=Nf7_PFtGd-M
4. https://www.youtube.com/watch?v=HicZcgdGxZY
5. https://www.youtube.com/watch?v=_xGqfXiUkqk

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	3	3	3										3	
3	3	2	3										3	
4	3	3	3										3	
5	3	3	3	1									3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Analyze when an Op-Amp is used in a circuit for amplifying AC Signal by considering output voltage will be small signal and large signal.
2. Derive the functional parameters for an inverting mode negative feedback gain circuit with a 741op-amp in IC inverting mode, with R1=1Kohm, Rf=40Kohm and compute Af, Rif, Rof, BW, offset voltage.

COURSE OUTCOME 2:
1. With neat figures describe the circuit using Op Amps on the functioning of
   (i) Integrator and double integrator circuit
   (ii) First order High pass Filter
2. Determine the output voltage V_0 and the current I_0 in the circuit as shown below.
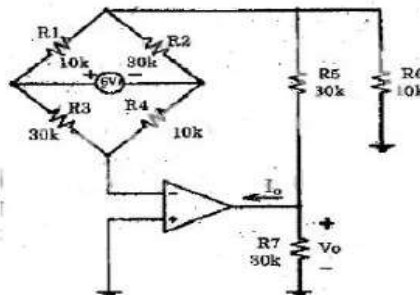
3. Assume that an op-amp has I_{B1} = 400 nA and I_{B2} = 300 nA. Determine the average bias current IB and the offset current IOS.

COURSE OUTCOME 3:
1. Summarise the working principle of IC 723 general purpose voltage regulators.
2. Design and draw the wave forms of 1KHZ square wave form generator using 555Timer for duty cycle i) D=25% ii) D=50%

COURSE OUTCOME 4:
1. Describe the working of Weighted resistor and R-2R Ladder DAC in detail.
2. Design Flash and Successive approximation ADC in detail.

COURSE OUTCOME 5:
1. Analyze the four variable transconductance amplifier Technique.

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21EC4611	ANALOG AND DIGITAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

Prerequisites for the course

- 21EC3611/Analog Electronics Laboratory

Preamble

The course "21EC4611 ANALOG AND DIGITAL COMMUNICATION LABORATORY" is offered in the fourth semester concurrent with the course on "Analog and Digital Communication Systems". The purpose of this course is to give hands on training to the students in understanding the theory of communications and practicing sessions used in analog and digital communication systems. This will improve the understanding capability of the communications and simulation capability of the communications.

S.No	List of Experiments	CO
1	Signal Sampling and reconstruction.	CO 1
2	AM Modulator and Demodulator	CO 2
3	FM Modulator and Demodulator	CO 2
4	Pulse Code Modulation and Demodulation	CO 3
5	Delta Modulation and Demodulation	CO 3
6	Simulation of ASK, FSK, and BPSK generation schemes	CO 4
7	Simulation of QPSK and QAM generation schemes	CO 4
8	Simulation of signal constellations of QPSK and QAM	CO 4
9	Simulation of ASK, FSK and BPSK detection schemes	CO 4
10	Communication link simulation	CO 4
11	Simulation of Linear Block and Cyclic error control coding schemes	CO 5
12	Simulation of Convolutional coding scheme	CO 5

S.No.	List of Projects	Related Experiment	CO
1.	Remote Industrial Security System	1,2,3	CO 1
2.	Wireless Weather Monitoring based on GSM	1,2,3	CO 2
3.	Bluetooth Controlled Electronic Home Appliances	1,2,3	CO 2
4.	Image Coding using Shannon Fano Code	5	CO 2
5.	Image Coding using Huffman Code	5	CO 3
6.	Centralized Monitoring System for Taxies	1,2,3	CO 3
7.	Zigbee Based Defense Robot	2,3	CO 3
8.	Wireless Power Transfer	1,2,3	CO 5
9.	TV Remote Control Jammer	1,2,3	CO 5
10.	FM Remote Encoder/Decoder Circuit	2,3	CO 5
11.	Simulation of MSK	4	CO 4

12.	Cell Phone Detector:	**2,3**	**CO 4**
13.	Simulation of DPSK	**4**	**CO 4**

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

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

CO1	Demonstrate the knowledge in sampling and reconstruct of the signal.
CO2	Demonstrate the knowledge in modulating and demodulating of signals.
CO3	Demonstrate the knowledge in various pulse coding schemes.
CO4	Simulate any digital modulation techniques.
CO5	Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system.

Laboratory Requirements

- Kits for Signal Sampling, AM, FM, PCM and DM Schemes.
- CROs – 15 Nos.
- MATLAB / SCILAB or equivalent software package for simulation experiments.
- PCs - 10 Nos.

Reference Books

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 4/e, TMH 2017.
2. S. Haykin "Digital Communications" John Wiley 2013.
3. B.P. Lathi, Zhi Ding and Hari Mohan Gupta."Modern Digital And Analog Communication Systems: Fourth Edition", 4rd edition, South Asia edition, Oxford University Press, 2017.
4. H P Hsu, Schaum Outline Series "Analog and Digital Communications" TMH 2006.
5. B.Sklar, "Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

Web Resources

1. **https://in.mathworks.com/help/comm/ug/error-detection-and-correction.html**
2. **https://www.youtube.com/watch?v=UkdyGhle_Vc**
3. **https://www.youtube.com/watch?v=IxNCmkDsZjM**

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
2	2	2	3	3										2
3	3	3		3										2
4	3	3		3										2
5	2	2	3	3										2

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Generate a PAM signal using PAM modulator and detect the message signal from PAM signal by using PAM demodulator.

2. Define Sampling. Generate signal Sampling and reconstruction.

COURSE OUTCOME 2:
3. Transmit a modulating signal using AM transmitter and receive the signal back using AM receiver
4. Transmit a modulating signal using FM transmitter and receiver signal.

COURSE OUTCOME 3:
1. Transmit an analog message signal in its digital form using Delta modulator and reconstruct back the original signal.
2. Generate a PCM signal using PCM modulator and detect the message signal from PCM signal by using PCM demodulator.

COURSE OUTCOME 4:
1. Generate a Frequency Shift Keying signal using MATLAB
2. Generate and Detect a QPSK signal using MATLAB

COURSE OUTCOME 5:
1. Simulation of Error control coding schemes using MATLAB
2. Simulation of Linear Block and Cyclic error control coding schemes

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21PT3902	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	6

Articles, Tenses, Voices, Preposition, Conjunctions, Subject-verb agreement, Adverbials.

Module II	6

Parts of speech, Simple, Complex & Compound Sentences, Direct & Indirect Speech, Kinds of Sentences, Degrees of Comparison, Clauses.

Module III	6

Reading Comprehension, Analogies, Synonyms & Antonyms, Idioms and Phrases

Module IV	6

Para jumbles, Phrasal verbs, Modifiers, Punctuations, Misspelled words.

Module V	6

Verbal Syllogism, Figures of Speech, Word Completion, Sentence Completion, One word Substitutes

	Total Periods	**30**

Suggested Assessment Activities:
- MCQ test through Google forms or other online test platforms.
  Eg. JavaPoint - Verbal Ability https://www.javatpoint.com/verbal-ability

Suggestive Assessment Methods

Continuous Assessment Test -1 (30 Marks)	**Continuous Assessment Test -2 (30 Marks)**	**Model Exam (40 Marks)**
MULTIPLE CHOICE QUESTIONS	**MULTIPLE CHOICE QUESTIONS**	**MULTIPLE CHOICE QUESTIONS**

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

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

SEMESTER V

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21MG5101	Total Quality Management	HSSM	3	3	0	0	3
2	21HS3101	Ethics and Values	HSSM	3	3	0	0	3
5	21EC5601	Microprocessor and Microcontroller	PC	3	3	0	0	3
6	21EC5602	Wireless Communication Systems	PC	3	3	0	0	3
7		Professional Elective – I	PE	3	3	0	0	3
8		Open Elective I	OE	3	3	0	0	3
Theory cum Practical Courses								
1	21EC5603	Discrete Time Signal Processing	PC	5	3	0	2	4
Practical Courses								
1	21EC5611	Microprocessor and Microcontroller Laboratory	PC	4	0	0	4	2
2	21PT3903	Aptitude - II	EEC	2	0	0	2	1
			Total	29	21	0	8	**25**

21MG5101	**TOTAL QUALITY MANAGEMENT**	L	T	P	C
		3	0	0	3

Prerequisites for the course

- Basic Management concepts

Preamble

- This subject enables students to learn the various aspects of quality management, principles, practices, and its implementation in the industry environment and aware of international/national Quality standards.

Objectives

- To understand the need for quality and its evolution over time.
- To equip with a thorough understanding of quality management tools and techniques.
- To enable them to effectively implement these tools and techniques to optimize quality management practices.

UNIT I	INTRODUCTION	9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of productand service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customercomplaints, 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-SpecificStandards— 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)
Descriptive Answers-CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

COURSE OUTCOMES

CO 1	To familiarized with the basic concept and framework of Total Quality management.
CO 2	To Understand the contribution of Quality Gurus in TQM Journey.
CO 3	To provide a comprehensive understanding of the traditional tools and equipping with the knowledge and skills to drive quality improvement initiatives effectively.
CO 4	To Explain the various types of Techniques andfoster their ability to drive organizational improvement and enhance quality management practices.
CO 5	To Apply various Quality Systems and Auditing on implementation of TQM.

Text Books

1. Dale H.Besterfiled, Carol B.Michna, Glen H. Besterfield, MaryB.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. SubburajRamasamy, 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 Resources

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

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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
1. To help students distinguish between values and skills.
2. To help students identify what they 'really want to be' in their life and profession.
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. 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 fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Suggested Activities:
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 Activities:
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 in Human-Human Relationship	9

1. Understanding harmony in the Family- the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of *Nyaya* (justice) and program for its fulfillment to ensure *Ubhay-tripti* (mutual happiness)
3. Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
4. Understanding the meaning of *Vishwas*; Difference between intention and competence
5. Understanding the meaning of *Samman* (respect), Difference between respect and differentiation; the other salient values in relationship
6. 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 Activities:
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- recyclability and 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 Activities:
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 Activities:
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 (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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 in their life and profession

CO2 Distinguish between values and skills, happiness and accumulation of physical facilities, 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 life and 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 strategy to 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PO2
1						2	1	3	1	1	1	1		
2						2	1	3	1	1	1	1		
3						2	2	3	1	1	1	1		
4						1	2	3	1	1	1	2		
5						1	2	3	1	1	1	2		

Assessment Pattern

SUGGESTED 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

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21EC5601	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

Prerequisites for the course

- 21EC3603/Digital Logic Design

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.

Objectives

1. To study the architecture of 8086 microprocessor.
2. To introduce the basic configurations and Multiprocessor configurations.
3. To learn the design aspects of I/O and Memory Interfacing circuits.
4. Be familiar with the interfacing, programming and application in Microcontroller 8086.
5. To study the Architecture of 8051 microcontroller and PIC16F877.
6. Be familiar with the Interfacing in Microcontroller 8051.

UNIT I	THE 8086 MICROPROCESSOR	9

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines.

UNIT II	8086 SYSTEM BUS STRUCTURE	9

8086 signals – Basic configurations: Minimum mode and Maximum mode – System bus timing – System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, closely coupled and loosely Coupled configurations – Bus Arbitrations.

UNIT III	I/O INTERFACING	9

Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface– Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display, LCD display, Keyboard display interface and Alarm Controller.

UNIT IV	MICROCONTROLLER	9

Architecture of 8051 – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming- PIC16C74A -features-advantages-Instruction Set.

UNIT V	INTERFACING MICROCONTROLLER	9

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Explicit and write assembly language program for 8086 microprocessors.
CO2	Illustrate the basic configurations and Multiprocessor configurations.
CO3	Design and interface various I/O devices using peripheral devices with 8086 microprocessors.
CO4	Explicit and write assembly language program for microcontroller.
CO5	Design and implement 8051 microcontroller-based systems.

Text Books

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family – Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2015.(Unit 1-3)
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011. (Unit 4-5)

Reference Books

1. Doughlas V.Hall, — Microprocessors and Interfacing, Programming and Hardware‖, TMH,2012.
2. K.Ray,K.M.Bhurchandi, "Advanced "Microprocessors and Peripherals" 3 rd edition, Tata McGrawHill, 2012.

Web Resources

1. https://nptel.ac.in/courses/117104072 (Unit 4 -PIC16C74A)
2. Microprocessors and Interfacing - Course (nptel.ac.in) (Unit 1-3)
3. Microprocessors And Microcontrollers - Course (nptel.ac.in) (Unit 4-5)

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	2						1			2	1	
2	2	1										1	1	
3	3	1	3						1		1	2	2	
4	3	1	1						1			1	1	
5	3	1	3						1		1	2	2	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Draw and explain the architecture of 8086?
2. Write an assembly language program to perform addition using 8086 microprocessors?

COURSE OUTCOME 2:

1. Draw and explain bus timing to read and write in a memory location?
2. Name the multiprocessor configurations

COURSE OUTCOME 3:

1. Draw and explain the DMA controller?
2. Design a traffic light controller using 8086?

COURSE OUTCOME 4:

1. Draw and explain the architecture of 8051 Microcontroller?
2. Write an assembly language program to perform subtraction using 8051 Microcontroller?

COURSE OUTCOME 5:

1. Write a program to interface Stepper Motor using 8051 microcontroller?
2. Write a program to interface Sensors using 8051 microcontroller?

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21EC5602	WIRELESS COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

Preamble

Wireless communications systems describe the fundamentals of wireless communication systems. Explore various applications of wireless communications technology.

Prerequisites for the course

21EC4601- Analog and Digital Communication

Objective

- To understand the fundamentals of wireless communication systems.
- To learn about statistical multipath models and capacity.
- To explore BER for modulation techniques.
- To Characterize the structure of receiver and receive diversity
- To Optimize different wireless systems and standards.

UNIT I	FUNDAMENTALS OF WIRELESS COMMUNICATION SYSTEMS	9

Introduction, Evolution of Wireless Communication System, Examples of Wireless Communication System – Cellular concept – Frequency Reuse – Channel assignment – Hand off,Path loss and shadowing: Radio Wave Propagation, Transmit and Receive Signal Models, Free-Space Path Loss, Ray Tracing, Empirical Path Loss Models, Simplified Path Loss Model, Shadow Fading and multipath, Combined Path Loss and Shadowing

UNIT II	STATISTICAL MULTIPATH MODELS AND CAPACITY ANALYSIS	9

Time-Varying Channel Impulse Response, Narrowband Fading Models, Wideband Fading Models Capacity Analysis: Capacity of Flat fading Channels, Channel and system model, Channel Distribution Information (CDI) Known, Channel Side Information at Receiver, Channel Side Information at transmitter and receiver, Capacity of frequency selective fading Channels, Time Invariant Channels, Time varying Channel.

UNIT III	BER ANALYSIS AND TRANSMIT DIVERSITY	9

Digital Modulation and Detection: Signal Space analysis, pass band modulation principles, Amplitude and Phase Modulation, Frequency modulation, Pulse shaping, Error probability analysis in fading channels, Transmit Diversity: Channel known at transmitter, Channel unknown at transmitter- Alamouti scheme.

UNIT IV	RECEIVER STRUCTURES AND RECEIVE DIVERSITY	9

Maximum Likelihood Receiver, Zero forcing receiver, Minimum Mean Square Error Receiver, V-BLAST Receiver, Receive Diversity: Selection combining, Equal Gain combining, Threshold Combining, Maximal Ratio Combining, Spatial Multiplexing in MIMO, Moment Generating functions in diversity analysis.

UNIT V	WIRELESS SYSTEMS AND STANDARDS	9

AMPS & ETACS System overview – Call handling – GSM System – Services and features – Architecture – Radio Subsystem – GSM Call – Frame Structure – Signal Processing – CDMA Digital Cellular Standard (IS-95) – Frequency & Channel Specification – Forward CDMA channel

– Reverse CDMA channel. Introduction to OFDM system – Cyclic prefix – Matrix representation case study: IEEE 802.11a wireless LAN.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Understand the fundamentals of wireless communication systems.
CO2	Scrutinize statistical multipath models and capacity.
CO3	Analyze BER for modulation techniques.
CO4	Investigate the structure of receiver and receive diversity
CO5	Examine different wireless systems and standards.

Text Books

1. Randy L. Haupt , "Wireless Communications Systems An Introduction", Wiley Publication, First edition,2020.[Unit-I-IV]
2. Aditya.K.Jegannatham, "Principles of Modern Wireless Communication Systems", Tata McGraw Hill, 2016.[Unit-V]

Reference Books

1. Andrea Goldsmith, " Wireless Communications", Cambridge University Press, 2005
2. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communications", Cambridge University Press, 2006.
3. Rias Muhamed, Jeffrey G.Andrews, Jun Zhang, Arunaba Ghosh, "Fundamentals of LTE", Prentice Hall, 2010.
4. A.Paulraj, R. Nabar and D Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2003.
5. John G. Proakis, "Digital Communications", McGraw Hill, 2000

Web Resources

1. https://nptel.ac.in/courses/117/102/117102062/.[Unit-I-V]

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				1		3
2	3	3	3	1								2		3
3	3	2	3	2								3		3
4	3	3	2	3										3
5	3	2	3					2						3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:
1. State the standard form of AMPS?
2. List the characteristics of wireless communication system?

COURSE OUTCOME 2:
1. Demonstrate the three types of fading.
2. Evaluate multipath delay.

COURSE OUTCOME 3:
1. Examine the modulation techniques used to convert analog signal into digital signal ?
2. Illustrate the sequence of operations in PCM.

COURSE OUTCOME 4:
1. Investigate the performance of MIMO in wireless system.
2. Discriminate the factor which has the greatest influence on data rates in MIMO.

COURSE OUTCOME 5:
1. Analyze which modulation technique used for ETACS and state the reasons.
2. Compare the performance of forward and reverse CDMA channel.

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21EC5603	**DISCRETE TIME SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

Preamble

- Digital signal processing is the process of digitizing real-world signals like audio, video, temperature, position, pressure and then manipulating them mathematically. The information is then represented as discrete frequency, time or space so that it can be processed, analyzed and synthesized digitally. DSP suppresses noise during transmission without compromising communication. DSP is used primarily in areas of audio signal, speech processing, RADAR, seismology, SONAR, Voice recognition, financial signals, digital communications, digital synthesizers and biomedicine. This course will introduce the learners to know various filter design and constructing various digital signal processors. This can be helpful to acquire knowledge on various applications of DSP processor.

Prerequisites for the course

- 21EC3602 / Signals and Systems

Objective

- To analyse the digital signals using various digital transforms DFT, FFT etc
- To design and develop the basic IIR filters.
- To design and develop the basic FIR filters.
- To interpret the finite word length effects on functioning of digital filters.
- To design the programme using Instruction set of DSP Processors.

UNIT I	DISCRETE FOURIER TRANSFORM	8

Discrete Signals and Systems-Introduction to DFT-Properties of DFT-Circular Convolution-Filtering methods based on DFT – overlap save and overlap add method- FFT Algorithms-Decimation in time Algorithms- Decimation in frequency Algorithms, Comparison of DIT and DIF-Use of FFT in Linear Filtering.

UNIT II	INFINITE IMPULSE RESPONSE FILTER DESIGN	8

Structures of IIR Filter- Analog filter design, Butterworth Filter, Chebyshev Filter- Discrete time IIR filter from analog filter(LPF, HPF, BPF, BRF) - IIR filter design by Impulse Invariance, Bilinear transformation,-Approximation of derivatives , filter design using frequency translation.

UNIT III	FINITE IMPULSE RESPONSE FILTER DESIGN	8

Magnitude and Phase response of Digital Filter-Filter design using windowing techniques, Rectangular Window, Hamming Window, Hanning Window- FIR filter structures - linear phase structure, direct form I & II realizations-Design of Optimal Linear Phase FIR Filter.

UNIT IV	EFFECTS OF FINITE WORD LENGTH	8

Rounding and Truncation Errors - quantization effects in ADC – Output noise Power from a Digital System - coefficient quantization error in direct form realization of IIR and FIR Filters - overflow error - limit cycle oscillations-product quantization- scaling- coefficient quantization error in the computation of DFT.

UNIT V	DIGITAL SIGNAL PROCESSOR AND APPLICATIONS	8

DSP Architecture of TMS320C5X- TMS320C5X Assembly Language Instructions- Instruction Pipelining in C5X- Application Programs in C5X. Adaptive Filters: Introduction, Applications of adaptive filtering to equalization.

	Total Periods	40

LABORATORY

S.NO	NAME OF THE EXPERIMENTS	HOURS	CO
1.	To represent basic signals like:Unit Impulse, Ramp, Unit Step, Exponential	2 hours	1
2.	To generate discrete sine and cosine signals with given sampling frequency.	2 hours	1
3.	To perform convolution between two vectors using MATLAB.	2 hours	1
4.	To perform cross correlation between two vectors using MATLAB.	2 hours	1
5.	To compute DFT and IDFT of a given sequence using MATLAB.	2 hours	1
6.	To perform linear convolution of two sequence using DFT using MATLAB.	2 hours	1
7.	To design a Type 1 Chebyshev IIR highpass filter using MATLAB.	2 hours	2
8.	To design an IIR Butterworth bandpass filter using MATLAB.	2 hours	2
9.	To generate rectangular, hamming and hanning window using MATLAB.	2 hours	3
10.	To study coefficient quantization effects on the frequency response of a cascade form IIR filter using MATLAB.	2 hours	4
	Total Periods	20	

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO1	Analyse the digital signals using various digital transforms DFT, FFT etc
CO2	Design the basic IIR filter.
CO3	Design the basic FIR filter

| CO4 | Interpret the finite word length effects on functioning of digital filters. |
| CO5 | Design the programme using Instruction set of DSP Processors. |

Text Books

1. Alan V Oppenheim, Ronald W Schafer, "Discrete Time Signal Processing", 3rd Edition, Pearson Education 2010 [Unit- I-IV]
2. Avtarsingh, S.Srinivasan, "DSP Implementation using DSP microprocessor with Examples from TMS32C54XX", Thamson / Brooks cole Publishers, 2003. [Unit- V]

Reference Books

1. Li Tan , Jean Jiang, "Digital Signal Processing fundamentals and Applications", Academic Press, 2nd edition,2013
2. I. feacher, and Barrie W..Jervis, "Digital Signal processing -A Practical Approach", second edition, Emmanuel Pearson Educations, Analog Devices and NXP

Web Resources

1. https://nptel.ac.in/courses/117102060 [Unit- I- V]

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	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

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Given a discrete time signal $x[k]$ defined by $x[k] = 1$, for $-2 \leq k \leq 2$ and 0, for $|k| > 2$. Then, $y[k] = x[3k-2]$ is _____.
2. The time system which operates with a continuous time signal and produces a continuous time output signal is _____

COURSE OUTCOME 2:

1. Design a digital Butterworth filter satisfying the constraints $0.8 \leq | H(\omega)| \leq 1.0$; $0 \leq \omega \leq \pi/4$ | $H(\omega)| \leq 0.2$; $\pi/2 \leq \omega \leq \pi$. Apply Bilinear transformation method.
2. Convert the analog filter with transfer function $H(s)=2/(s+1) (s+2)$ into digital filter using Impulse Invarient method.

COURSE OUTCOME 3:

1. Design an FIR filter for the ideal frequency response response using Hamming window with N=7 $Hd(e^{j\omega})= e^{j3\omega}$; $- \pi/8 <w< \pi/8$ 0 ; $\pi/8 <w< \pi$
2. Design an FIR filter for the ideal frequency response using Hanning window with N=7 $H_d(\omega)$ ={ $e^{-j2\omega}$; $-\pi/8 \leq \omega \leq \pi/8$
                       0   ; Otherwise.

COURSE OUTCOME 4:

1. The effects caused due to finite word lengths are
2. How many types of quantization error are there in the finite word registers?

COURSE OUTCOME 5:

1. In DSP Processor, what kind of queuing is undertaken/executed through instruction register and instruction cache?
2. Program Sequence plays a crucial role in maintaining the track of _____

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21EC5611	MICROPROCESSOR AND MICROCONTROLLER LABORATORY	L	T	P	C
		0	0	4	2

Preamble

This laboratory course is designed to provide hands on training to the students to familiarize and program microprocessors and microcontrollers. In addition, students will be exposed to a teamwork setting where they will learn the skills needed to plan, prepare, and deploy embedded systems applications.

Prerequisites for the course

- 21EC3603/Digital Logic Design

Objectives

1. To Introduce ALP concepts, features and Coding methods
2. Write ALP for arithmetic and logical operations in 8086 and 8051
3. Differentiate Serial and Parallel Interface
4. Interface different I/Os with Microprocessors
5. Be familiar with Keil and Proteus

S.No	List of Experiments	CO
	8086 Programs using Kits and EMU8086	
1	Arithmetic and Logical operation of single precision data	1
2	Block move	1
3	Matrix operations	1
4	Coping a string of data from one segment to other segment	1
5	Sorting and Searching 16 bit data in an array	1
	8051 Experiments using kits, Keil and Proteus tool	
6	Basic arithmetic operations	2
7	Logical operations	2
8	Basic programs to understand the Keil IDE for 8051	3
9	Developing the sketch program for blinking the LEDs	3
10	Design a system for stepper motor control application	3

	Peripherals and Interfacing Experiments	
11	Traffic light controller	**4**
12	Key board and Display	**4**
13	Serial interface and Parallel interface	**5**
14	D/A interface and Waveform Generation	**5**

S.No.	List of Projects	Related Experiment	CO
1	Digit Up Down Counter	1	1
2	A Basic 16-bit calculator	1,6	1
3	5 Channel IR Remote Control System using Microcontroller	8	3
4	Auto Intensity Control of Street Lights	9	3
5	Automatic Railway Gate Controller with High Speed Alerting System	9	3
6	Digital Temperature Sensor	13	4
7	Bipolar LED Driver Circuit	13	4
8	Water Level Indicator	11	4
9	Delay using 8051 Timers	11	4
10	3 LED Bike Light using PIC	9	3
11	Temperature Controlled Fan (DC Motor based with PWM)	10	3
12	Real time Car Battery Monitoring and Low Voltage Alert System	12	5
13	Real Time Burglar Alarm System	12	5
14	Automatic College Bell System	8	3
15	Boolean Algebra Calculator	1	1

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

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

CO1	Design and implement Programmes for Arithmetic and logical operations.
CO2	Execute Programs in 8051.
CO3	Write, compile, debug, link and execute ASM program for the given 8051 target
CO4	Make use of 8086 ALP code for accessing and interfacing keyboard and display unit.
CO5	Apply the programing knowledge for understanding of communication standards in 8086

Laboratory Requirements

Hardware:
- 8086 development kits – 15 nos
- Interfacing Units – Each 5 nos
- Microcontroller – 15 nos

Software:
- Intel Desktop Systems with Keil and Proteus – 15 nos

Reference Books
1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
2. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012

Web Resources
1. https://nptel.ac.in/courses/117104072
2. https://www.electronicshub.org/water-level-controller-using-8051-microcontroller/
3. https://circuitdigest.com/microcontroller-projects/digital-thermometer-using-lm35-8051
4. https://www.youtube.com/watch?v=tgmOjawziUA

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		3			2	2		2	2	3	
2	3	3	3		3			2	2		2	2	3	
3	3	3	3		3			2	2		2	2	3	
4	3	3	3		3			2	2		2	2	3	
5	3	3	3		3			2	2		2	2	3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Write an 8086 ALP to subtract two numbers 825DH - 1213H.
2. Write an 8086 ALP to perform the following:
   Get 5 numbers starting from location 4200H. Arrange them in such a manner that the least number occupies the last position.

COURSE OUTCOME 2:
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 3:
1. Write a C code for blinking the LEDs and execute the program in keil platform.
2. Write a C code to run a stepper motor.

COURSE OUTCOME 4:
1. Interface 8255 with 8086 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.
2. Interface 8279 with 8086 and write an ALP to display the word 'HELPUS'

COURSE OUTCOME 5:
1. Write an 8086 ALP to generate a saw tooth wave at the output of DAC.
2. Write an 8086 ALP to generate a square wave at the output of DAC.

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21PT3903	**APTITUDE - II**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

Prerequisites for the course

- Basic Maths

Objectives

1. Expose the undergraduate students to solve aptitude problems using different methods and practices.
2. Expose the undergraduate students to critique and evaluate quantitative arguments that utilize mathematical, statistical, and quantitative information.

UNIT I	**MODULE I**	**6**

Time, Speed and distance, Time and work, Problems on Trains

UNIT II	**MODULE II**	**6**

Clocks, Blood Relations, Number Puzzles, Logical Puzzles.

UNIT III	**MODULE III**	**6**

Concepts on Syllogisms, Problems involving Coding and Decoding methods Elementary algebra, Progression.

UNIT IV	**MODULE IV**	**6**

Permutation and combination, Probability, Geometry, Calendar

UNIT V	**MODULE V**	**6**

Boats and Streams, Races. Data interpretation, Data sufficiency.

	Total Periods	**30**

Suggestive Assessment Methods

Continuous Assessment Test -1 (30 Marks)	**Continuous Assessment Test -2 (30 Marks)**	**Model Exam (40 Marks)**
MULTIPLE CHOICE QUESTIONS	MULTIPLE CHOICE QUESTIONS	MULTIPLE CHOICE QUESTIONS

Outcomes

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

CO1: Solve various concepts of Time, Speed and distance, Time and work and Problems on Trains
CO2: Analyse the problems on Clocks, Blood Relations, Number Puzzles, Logical Puzzles.
CO3: Analyse the Concepts on Syllogisms, Problems involving Coding and Decoding methods Elementary algebra and Progression
CO4: Solve the problems on Permutation and combination, Probability, Geometry and Calendar
CO5: Solve the problems on Boats and Streams, Races. Data interpretation and Data sufficiency.

Text Books

1. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
2. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.

Reference Books

1. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.

2. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.

3. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.

4. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

Web Resources

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/

CO Vs PO Mapping

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

SEMESTER VI

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC6601	VLSI Design	PC	3	3	0	0	3
2		Professional Elective – II	PE	3	3	0	0	3
3		Professional Elective – III	PE	3	3	0	0	3
4		Open Elective – II	OE	3	3	0	0	3
5		Open Elective – III	OE	3	3	0	0	3
Theory cum Practical Courses								
1	21EC6602	Transmission lines and Radiation Systems	PC	5	3	0	2	4
Practical Courses								
1	21EC6611	VLSI Design Laboratory	PC	4	0	0	4	2
2	21PT3904	Reasoning	EEC	2	0	0	2	1
3	21EC6911	Project Work - I/Internship	EEC	4	0	0	4	2
			Total	30	18	0	12	**24**

21EC6601	VLSI DESIGN	L	T	P	C
		3	0	0	3

Preamble

The course aims at understanding the basic concepts of Digital CMOS VLSI circuit by studying logic design, physical structure and fabrication of semiconductor devices and how they are combined to build systems for efficient data processing. It also aims at ASIC physical design flow, including logic synthesis, floor-planning, placement and routing. Students also understand the design of digital components using HDL.

Prerequisites for the course

- 21EC3603/Digital Logic Design
- 21EC4603/ Linear Integrated Circuits

Objectives:

- To explore the concepts of CMOS Technology
- To design the combinational logic circuit.
- To familiarize with the sequential logic circuit design concepts.
- To explore the design procedures of arithmetic building blocks and testing.
- To learn the digital design concepts using HDL.

UNIT I	CMOS TECHNOLOGY	9

MOS Transistor Theory - Ideal I-V and C-V Characteristics of MOS Transistor, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modelling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore 's constant, Logical Effort.

UNIT II	COMBINATIONAL LOGIC CIRCUITS	9

Combinational Circuit Design: Circuit Families – Static CMOS, Ratioed Circuits, Dynamic CMOS Circuits, Pass-transistor logic Circuits, Low power Logic Design, Comparison of CMOS Circuit Families.

UNIT III	SEQUENTIAL LOGIC CIRCUITS	9

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV	DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING	9

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing, Manufacturing test principles- Design for testability. Full Custom ASICs, Standard-Cell Based ASICs, Gate Array-Based ASICs. Structured Gate Array and Architecture of Generic FPGA.

UNIT V	DIGITAL DESIGN WITH HDL	9

Design Methodologies – Modules – Instances – Test bench – Operators – Number Specification – Identifiers and Keywords – Data Types – Modules and Ports – Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, Multiway Branching, Loops, Sequential and Parallel Blocks - Design of combinational and sequential circuits using Gate-Level Modeling, Dataflow Modeling and BehavioralModeling.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Explore the inverter characteristics and realize modeling of CMOS.
CO2	Design combinational logic using various logic styles, satisfying static and dynamic requirements.
CO3	Design the timing issues of sequential logic and memories.
CO4	Analyse the classification of ASIC and FPGA architectures and performance of the arithmetic building blocks.
CO5	Model the digital system components using HDL

Text Books

1. Weste and Harris, "CMOS VLSI DESIGN:A Circuit and Systems Perspective", 4 th Edition, Pearson Education, (2015)(UNIT- I,II,III,IV,V)

Reference Books

1. Sung Mo Kang, Yusuf Leblebici and Chulwoo Kim, CMOS Digital Integrated Circuits, Mc Graw Hill India, Fourth Edition, 2016.
2. A. Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Prentice Hall of India, 3rd Edition, (2007)
3. R. Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, (2005)
4. Michael John Sebastian Smith, "Applications Specific Integrated Circuits", Pearson Education, Ninth Indian reprint,13th edition,(2004)
5. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A Design Perspective", Prentice Hall of India, 2nd Edition, (2003)
6. Uyemura, John P, "Introduction to VLSI Circuits and Systems". Wiley & Sons, 8th Reprint 2009.

Web Resources
1.http://ocw.mit.edu/courses/electrical-engineering-andcomputer-science/6-374-analysis-and-design-of-digital-integrated-circuits/.
2. https://nptel.ac.in/courses/108/107/108107129/
3. https://nptel.ac.in/courses/106/105/106105161/

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		1	1				1	3	
2	3	2	1	1	1		1	1				1	3	
3	3	2	1	1	1		1	1				2	3	
4	3	2	1	2	2		1	1				2	3	
5	3	2	3	2	3		1	1				1	3	

COURSE LEVEL ASSESSMENT QUESTIONS
Course Outcome 1
1. What are the transistor provided by CMOS technology?
2. List out the uses of stick diagram.
Course Outcome 2
1. What is the need for swithch level modelling in CMOS?
2. Infer the uses of ratioed circuits.
Course Outcome 3:
1. Identify the technique where multiple instructions are overlapped during execution
2. Why is clock gating needed?
Course Outcome 4:
1. What is a shift register in FPGA?
2. List out the features of ASIC design.
Course outcome 5:
1. Why HDL is used in VLSI?
2. State the gate level ,modelling.

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			L	**T**	**P**	**C**
21EC6602	**TRANSMISSION LINES AND RADIATION SYSTEMS**		**3**	**0**	**2**	**4**

Preamble

To study the various types of transmission lines and also discuss the losses associated in the line. To understand about the transmission lines and their losses for high frequency. In order to match the impedance and calculate the parameters using Smith chart. To give insight into the antenna parameter and radiation phenomena and also to create awareness about the different types of

propagation of radio waves for the special antenna.

Prerequisites for the course

- 21EC4602 / Applied Electromagnetics

Objective

- To introduce the various types of transmission lines and its characteristics
- To impart knowledge about high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using smith chart
- To understand the fundamentals and parameters of the antenna
- To impart knowledge about the array antenna and special antennas.

UNIT I	**TRANSMISSION LINE THEORY**	**8**

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Line not terminated in Z0 - Reflection coefficient - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT II	**HIGH FREQUENCY TRANSMISSION LINES**	**8**

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines.

UNIT III	**IMPEDANCEMATCHING IN HIGH FREQUENCY LINES**	**8**

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single stub matching using smith chart.

UNIT IV	**FUNDAMENTALS OF RADIATION**	**8**

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole, Yagi array.

UNIT V	**ARRAYS AND SPECIAL ANTENNAS**	**8**

N element linear array, Pattern multiplication, Broadside and End fire array - Principle of frequency independent antennas – Helical antenna, Log periodic. Modern antennas-Reconfigurable antenna, Active antenna, Dielectric antennas, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern.

	Total Periods	**40**

LABORATORY

S.NO	NAME OF THE EXPERIMENTS	HOURS	CO
1.	2D Radiation Pattern of the antenna.	2 hours	**4**
2.	3D Radiation Pattern of the antenna.	2 hours	**4**
3.	Design of Dipole antenna.	2 hours	**4**
4.	Simulation of Dipole antenna.	2 hours	**4**
5.	Design of Horn antenna.	2 hours	**5**
6.	Simulation of Horn antenna.	2 hours	**5**
7.	Design of Patch antenna.	2 hours	**5**
8.	Simulation of the Patch antenna.	2 hours	**5**
9.	Antenna Array	2 hours	**5**

10.	Log Periodic Antenna applications using dielectric resonators	2 hours	4
	Total Periods		**20**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (30 Marks)	End Semester Exams (50 Marks)
• Descriptive Answers-CAT-1, CAT-2	• Lab Experiment • Lab Model exam	• Descriptive Answers

Outcomes

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

CO1: Explain the propagation of signals through transmission lines.
CO2: Analyze signal propagation at Radio frequencies.
CO3: Design stub matching andProblem-solving by smith chart.
CO4: Analyze the various parameter of antennasand wave propagation
CO5: Analyze the array and special antenna and its working principles.

Text Books

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015 [Unit 1 – 3]
2. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fourth Edition, Tata McGraw-Hill, 2006 [Unit 4]
3. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007 [unit 5]

Reference Books

1. John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2008
2. Edward C.Jordan and Keith G.Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006

Web Resources

1. https://archive.nptel.ac.in/courses/108/106/108106157/ [Unit 1 – 3]
2. https://archive.nptel.ac.in/courses/108/101/108101092/ [Unit 4 – 5]

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	3								1	3	
2	3	3	2	3								1	3	
3	3	3	3	3									3	
4	3	3	2	2	1							1	3	
5	3	3	2	2	1								3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:

1. Find the characteristic impedance expression in terms of the inductance and capacitance parameters.
2. When a transmission line has a load impedance same as that of the characteristic impedance, the line is said to be

COURSE OUTCOME 2:
1. Find the reflection coefficient of the wave with SWR of 3.5.
2. The maximum impedance of a 50 ohm transmission line with SWR of 3 is

COURSE OUTCOME 3:
1. Complex load impedance can be converted to real load impedance by
2. If a single section quarter wave transformer is used for impedance matching at some frequency, then the length of the matching line is:

COURSE OUTCOME 4:
1. The region of the field that angular field distribution is independent of the distance from the antenna is called as _____
2. The receiving antenna is designed to have ____ side-lobe-ratio and ____ SNR.

COURSE OUTCOME 5:
1. The receiving antenna is designed to have ____ side-lobe-ratio and ____ SNR.To avoid aliasing____
2. What is the value of magnification of the Cassegrain antenna if its sub-reflector eccentricity is 2?

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21EC6611	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

Preamble

VLSI is mainly used to design electronic components like microprocessors and memory chips, which require millions of transistors.VLSI affords IC designers the ability to design utilizing less space,time and power. Typically, electronic circuits incorporate a CPU, RAM, ROM, and other peripherals on a single PCBA. However, very large-scale integration (VLSI) technology affords an IC designer the ability to add all of these into one chip.

Prerequisites for the course
- 21EC3603/Digital Logic Design
- 21EC4603/ Linear Integrated Circuits

Objective
- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To learn about timing and area constraints in digital circuits.
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms

S.No	List of Experiments	CO
1	Simulation of Basic Logic Gates	1
2	Design and Simulation of Half adder and Full adder	2
3	Design and Simulation of Half subtractor and Full subtractor	3

4	Design and Simulation, Placement and routing of Encoder and Decoder	**4**
5	Design and Simulation, Placement and routing of Multiplexer and Demultiplexer.	**4**
6	Design and Simulation of Ripple Carry Adder and 8 bit multiplier	**3**
7	Design and Simulation of up/Down counter and Flip Flops	**2**
8	Design and Simulation of ALU.	**1**
9	Design and simulation of 8-Bit Shift Register with shift Right, shift Left, Load and Synchronous reset.	**1**
10	Simple layouts of Inverter, NAND2 and NOR2 gates	**5**

S.No.	List of Projects	Related Experiment	CO
1.	Car Parking System	7	4
2.	Traffic Light Controller	4	4
3.	Alarm Clock on FPGA	5	2
4.	Tic Tac Toe Game in Verilog	1	1
5.	PWM Generator	7	4
6.	button debouncing on FPGA	5	2
7.	32-bit 5-stage Pipelined MIPS Processor in Verilog	8	1
8.	Plate License Recognition	3	3
9.	FIFO memory	9	1
10.	Carry-Look-Ahead Multiplier	6	3
11.	Verilog code for a Microcontroller	4	4
12.	button debouncing on FPGA	10	5
13.	VEDIC MULTIPLIER	6	3
14.	DSP Butterfly unit	2	2
15.	Fibonacci Number Generator	6	3

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

Upon completion of the course, the students will be able to:	
CO1	Write HDL code and design basic as well as advanced digital integrated circuit.
CO2	Implement digital circuits in FPGA using HDL.
CO3	Realize digital circuits satisfying timing and area constraints .
CO4	Synthesize, Place and Route the digital IPs
CO5	Design, simulate and extract the layout of Analog IC Blocks using EDA tools

Laboratory Requirements

- PC with Windows.
- Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards
- Cadence/Synopsis/ Mentor Graphics/Tanner/ MICROWIND-2 and DSCH-2/equivalent EDA

Tools

Reference Books

1. Charles H.Roth jr., "Fundamentals of Logic Design" Thomson Learning, 2013.
2. Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson , 2003.

Web Resources

1. https://www.javatpoint.com/verilog.
2. https://www.coursera.org/courses?query=verilog.
3. http://verilog-code.blogspot.com/p/verilog-codesprojects.html.
4. https://www.fpga4student.com/p/verilog-project.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	1	1	1	1	1			1	1	1	1		3
2	3	2	1		1	1			1	1	1	1		3
3	3	2	1	1	2	1			1		1	2		3
4	3		1	1	1	1			1	1	1	2		3
5	3	2	1		3	1	1		1		1	1		3

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		L	**T**	**P**	**C**
21PT3904	**REASONING**	**0**	**0**	**2**	**1**

Prerequisites for the course

- Foundational English
- Verbal Ability

Objectives

To strengthen the interpersonal skills and branding it to social network by the effective use of social media and social interactions.

UNIT I	**Interpersonal Skill**	**6**

Interpersonal Communication, Peer Communication, Image Building and Personal Branding, Delegation and compliance, Responsibility, Creation of accountability

UNIT II	**Social Media**	**6**

Effective use of social media, Types of social media, Moderating personal information, Social media for Job/Profession, Networking on social media, Maximizing network with social media

UNIT III	**Social Interaction**	**6**

Event management, Event management methods, Effective techniques for better event management, Influencing skill, Building relationships, Persistence and resilience

UNIT IV	**Non Verbal Communication**	**6**

Proximecs, Types of Proximecs, Rapport building, Negotiation Skill, Effective negotiation strategies. Conflict resolution, Styles of conflict resolution

UNIT V	Reasoning Ability	6
Analytical Reasoning Data Arrangement (Linear and circular & Cross Variable Relationship), Ordering/ranking/grouping, Selection Decision table		

	Total Periods	30

Suggestive Assessment Methods

Continuous Assessment Test-1 (30 Marks)	Continuous Assessment Test-2 (30 Marks)	Model Exam (40 Marks)
1. DESCRIPTIVE QUESTIONS 2. MULTIPLE CHOICE QUESTIONS	1. DESCRIPTIVE QUESTIONS 2. MULTIPLE CHOICE QUESTIONS	1. DESCRIPTIVE QUESTIONS 2. MULTIPLE CHOICE QUESTIONS

Outcomes

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

CO1: Improve their interpersonal skills through proper communication.

CO2: Acquire wide knowledge on social Media and its interaction

CO3: Understanding the various strategies for building relationships among peers

CO4: Improve negotiation skills in academic and social contexts

CO5: Interpret the analytic data in decision table.

Text Books

1. ETHNUS, Apti mithra, 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 Resources

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

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

SEMESTER VII

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Theory Courses								
1	21EC7601	Microwave and Optical Communication	PC	3	3	0	0	3
2	21EC7602	Embedded and IoT	PC	3	3	0	0	3
3		Professional Elective - IV	PE	3	3	0	0	3
4		Professional Elective - V	PE	3	3	0	0	3
5		Professional Elective - VI	PE	3	3	0	0	3
6		Open Elective IV	OE	3	3	0	0	3
Practical Courses								
1	21EC7611	Advanced Communication Laboratory	PC	4	0	0	4	2
2	21EC7612	Embedded and IoT Laboratory	PC	4	0	0	4	2
			Total	26	18	0	8	**22**

21EC7601	MICROWAVE AND OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

Preamble

- This course offers a gradual approach to optical communications with emphasis on latest developments in coherent optical communications.
- This course is indented to provide rigorous treatment of the fundamentals of microwave engineering. Design of different passive and some active microwave circuits/subsystems will be covered in detail.

Prerequisites for the course

- 21EC6602 / Transmission lines and Radiation Systems

Objective

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers.
- To instill knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques.

UNIT I	INTRODUCTION TO OPTICAL FIBERS	9

Evolution of fiber optic system- Element of an Optical Fiber Transmission link-- Total internal reflection-Acceptance angle –Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations -Mode theory of Circular Wave guides- Overview of Modes-Key Modal conceptsLinearly Polarized Modes -Single Mode Fibers-Graded Index fiber structure.

UNIT II	SIGNAL DEGRADATION OPTICAL FIBERS	9

Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination -Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.

UNIT III	MICROWAVE PASSIVE AND ACTIVE DEVICES	9

Microwave frequency range, significance of microwave frequency range - applications of microwaves- Properties of Scattering Matrix-Microwave T & E junctions -Magic Tee - two hole directional couplers- Ferrites –Matched Termination - Isolator-Circulator - Principles of tunnel diodes - Varactor and Step recovery diodes -Gunn diode oscillator- IMPATT and TRAPATT devices.

UNIT IV	MICROWAVE GENERATION	9

Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Derivation of Two cavity Klystron Amplifier, Derivation of Reflex Klystron oscillator, Traveling wave tube amplifier and Derivation of Cylindrical Magnetron oscillator.

UNIT V	MICROWAVE MEASUREMENTS	9

Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, Low VSWR and High VSWR, Q factor, Scattering coefficients, Attenuation.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Describe the basic elements in optical fibers, different modes and configurations.
CO2	Explain the transmission characteristics associated with dispersion and polarization techniques.
CO3	Explain the active & passive microwave devices & components used in Microwave communication systems.
CO4	Design Microwave signals using tubes for high frequency applications.
CO5	Measure and analyze Microwave signal and parameters.

Text Books

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016. [Unit- I-II]
2. Annapurna Das, Sisir K Das "Microwave Engineering" Mc Graw Hill India (2014) [Unit- III-V]

Reference Books

1. John M.Senior, "Optical fiber communication", Pearson Education, second edition.2007.
2. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
3. David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 2013.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee42/preview
2. https://onlinecourses.nptel.ac.in/noc19_ee68/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		1	1	1				1		3

2	3	2	2	2		1	1	1				1		3
3	3	3	3	2		1	1	1				1		3
4	3	3	3	2		1	1	1				1		3
5	3	2	3	2		1	1	1						3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. (a) Using Maxwell's theorem, explain electromagnetic theory of propagation.
   (b) Classify the fibers.
2. (a) Draw the fundamental optical communication link.
   (b) Explain each blocks of optical communication link

COURSE OUTCOME 2:
1. Explain and derive mathematical expressions for
   i) Waveguide Dispersion
   ii) Material Dispersion
2. Explain pulse broadening & its effect on information carrying capacity of fiber

COURSE OUTCOME 3:
1. Show that the scattering matrix for a E plane Tee is given by $[S] = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} & \frac{1}{\sqrt{2}} \\ \frac{1}{2} & \frac{1}{2} & -\frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 \end{bmatrix}$

2. With the help of Ridley-Watkins-Hilsum (RWH) theory, explain how negative resistance can be created in the electron in the lower energy band will be transferred into higher energy band.

COURSE OUTCOME 4:
1. Draw the schematic of two cavity Klystron amplifier and explain the process of velocity modulation and bunching. Also derive the equation of velocity modulation.
2. Describe the cross sectional view of magnetron tube and explain how bunching occurs with equations of electron trajectory and derive the expression for Hull cut-off voltage.

COURSE OUTCOME 5:
1. Explain the principle operation of i) VSWR meter ii) Power meter.
2. Discuss the measurement of power at microwave frequency in detail.

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		L	T	P	C
21EC7602	**EMBEDDED AND IOT**	3	0	0	3

Preamble
- This course helps the students with good knowledge of Designing Embedded and IOT Systems for various applications. Knowledge for the design and analysis of Embedded and IOT Systems for Electronics Engineering students.

Prerequisites for the course

- 21EC5601 /Microprocessor and Microcontroller

Objective

- To get familiarized with the embedded hardware architecture
- To understand the basics of RTOS and the attributes of various communication protocols.
- To build knowledge on Embedded C programming and realize the concept of peripheral interfacing.
- To get introduced with the concept of IoT and architecture of IoT systems

UNIT I	EMBEDDED HARDWARE ARCHITECTURE	9

CISC Architecture:- 8051 Microcontroller - Architecture - RISC Architecture:- overview of PIC 16F87x family - PIC16F877A - Architecture - Timers - Interrupts - Serial ports - Introduction to ARM - LPC4088 Architecture-Embedded Systems- Processor Embedded into a System- Example of Embedded Systems

UNIT II	REAL TIME OPERATING SYSTEM & COMMUNICATION INTERFACES	9

Real Time Operating System – OS Services, Process Management, Timer functions, Event functions, Memory Management, Device, File and I/O subsystem, Basic design using a RTOS-Communication Interfaces

UNIT III	EMBEDDED PROGRAMMING AND PERIPHERALINTERFACING	9

Embedded C Programming for Embedded Applications - Input and output devices Interface, ADC Interface - DAC Interface - PWM Generation - sensor Interface.

UNIT IV	INTRODUCTION TO INTERNET OF THINGS	9

IoT Definition and Characteristics - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies - Levels of IoT Deployment - IoT Device Management- Domain specific IoTs.

UNIT V	IoT IMPLEMENTATION TOOLS AND IIoT	9

IoT gateways - IoT analytics platforms - IoTapplication development using Raspberry Pi - Introduction to IIoT - IIoT Middleware Platforms - Industrial Internet Security.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
- Descriptive Answers- CAT-1, CAT-2	- Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	- Descriptive Answers

Outcomes

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

CO1	Understand the concept of embedded system and its architectural features
CO2	Develop embedded software using Embedded C and Python.
CO3	Integrate/Interface real world field devices with microcontrollers.
CO4	Acquire real world signals and perform remote process monitoring utilizing the concept of IoT.
CO5	Design and implement IoT enabled embedded control strategy for a given application.

Text Books

3. Rajkamal, "Embedded System: Architecture, Programming and Design", TMH3, 2011 [Unit- I-III]
4. The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)

Reference Books

4. Muhammad Ali Mazidi, Shujen Chen, Sepehr Naimi, Sarmad Naimi, "Embedded Programming Using C Language", 1st Edition, Freescale ARM Cortex-M.
5. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 2017.

Web Resources

1. https://nptel.ac.in/courses/108102045
2. https://nptel.ac.in/courses/128108016

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	2			2	2		1	3	
2	3	2	3	2	3	2			2	2		1	3	
3	3	2	3	2	3	2			2	2		1	3	
4	3	2	3	2	3	2			2	2		1	3	
5	3	2	3	2	3	2			2	2		1	3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Describe the memory organization in the PIC16F877A microcontroller.(Understand)
2. What are the key characteristics of RISC architecture?(Understand)

COURSE OUTCOME 2:
1. Design a task scheduling algorithm for an RTOS that ensures strict priority-based task execution. Explain how the algorithm works and how it handles priority inversion. (Design)
2. Design a communication interface between an embedded system and an external device using the UART (Universal Asynchronous Receiver-Transmitter) protocol. Explain the key steps involved in the design process.(Design)

COURSE OUTCOME 3:
1. Design a C program to interface an embedded system with an LCD display. Explain the key steps involved in the program's design.(Design)
2. Design a C program to interface an embedded system with an external sensor using a serial communication protocol (e.g., SPI or I2C). Explain the key steps involved in the program's design.(Design)

COURSE OUTCOME 4:
1. Explain the different layers in the IoT architecture and their respective functions. (Understand)
2. How does the connectivity between different IoT layers work?(Remember)

COURSE OUTCOME 5:
1. Design an IoT application using Raspberry Pi that monitors environmental conditions (such as temperature, humidity, and air quality) in a room and sends real-time alerts to a user's

mobile device. Explain the key components and steps involved in the application design. (Design)

2. Design an IoT application using Raspberry Pi that controls and automates the lighting system in a smart home. Explain the key components and steps involved in the application design. (Design)

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21EC7611	ADVANCED COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

Preamble

- The Advanced Communication System Laboratory covers design and verification of the concepts of optical and microwave communication. In particular, ACS Laboratory conducts experiments in fiber optic characteristics, Gain, radiation pattern measurement, S-matrix characteristics of microwave components and Gunn diode characteristics.

Prerequisites for the lab

- 21EC6602 / Transmission lines and Radiation Systems

Objective

- Understand the working principle of optical sources, detector, fibers and simple optical Communication link.
- Understand the measurement of Bit Error Rate, Pulse broadening.
- Know about the behavior of microwave components.
- Measure S-Matrix characteristics of E-Plane Tee, H-Plane Tee, Magic Tee, Directional Coupler and Circulator.

S.No	List of Experiments	CO
1	Fiber optic Analog and Digital Link Characterization - frequency response (analog), Eye diagram and BER (digital).	CO2
2	Single mode fiber characteristics.	CO1
3	Measurement of Propagation or Attenuation Loss, bending loss in the optical fiber	CO1
4	Setting up 1300nm LD unit to setup a 1300nm fiber optic link or a 1550nm LD unit to setup a 1550nm fiber optic link.	CO1
5	Computer to Computer communication using RS232 interface via Fiber Optic Link.	CO1
6	Estimation of numerical aperture and normalized frequency parameter for optical fiber.	CO1
7	Mode Characteristics of Reflex Klystron.	CO3
8	Determination of S-matrix for E-plane, H-Plane and Magic Tee.	CO4
9	Determination of S-matrix for circulator and multi hole Directional Coupler.	CO4
10	Determination of V-I characteristics of Gunn diode.	CO3
11	Radiation Pattern and Gain Measurement of Parabolic Reflector Antenna, Horn Antenna.	CO5

S.No.	List of Projects	Related Experiment	CO
1.	Li-Fi Based Text Communication	1,2,3,4,5,6	1,2
2.	Microwave Radar for Object Detection	7,8,9,11	3,4,5
3.	Automatic Plant Watering System Using Optical Fiber	1,2,3,4,5,6	1,2
4.	Build a Laser Communication System	1,2,3,4,5,6	1,2
5.	Lifi based indoor navigation system for visually impaired people	1,2,3,4,5,6	1,2
6.	Wireless Data Transmission Through Visible Light	1,2,3,4,5,6	1,2

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)	End Semester Exams (40 Marks)
Lab Experiment, Model Exam	Lab Exam

Outcomes

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

CO1	Analyze the performance of simple optical link by measurement of losses and analyzing the mode characteristics of fiber.
CO2	Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.
CO3	Analyze the Mode Characteristics of Reflex Klystron and Gunn Diode.
CO4	Analyze the S-Matrix characteristics of E-Plane Tee, H-Plane Tee, Magic Tee, Directional Coupler and Circulator.
CO5	Analyze the radiation of pattern of antenna.

Laboratory Requirements

- Trainer kit for determining the mode characteristics- 01
- Kit for measuring Numerical aperture and Attenuation of fiber-02
- Microwave Gunn Oscillator Test Bench- 02
- Microwave Test Bench at X Band – 03
- Microwave Antenna Setup at X Band – 01

Reference Books

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016.
2. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
3. David M. Pozar, "Microwave Engineering", Wiley India (P) Ltd, New Delhi, 2013.
4. Annapurna Das, Sisir K Das "Microwave Engineering" Mc Graw Hill India, 2014.

Web Resources

1. https://www.youtube.com/@advancedcommunicationlab8147/videos

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	1	1	1	2	2	3			3
2	3	3	2	1	1	1	1	1	2	2	3			3
3	3	3	2	1	1	1	1	1	2	2	3			3
4	3	3	2	1	1	1	1	1	2	2	3			3
5	3	3	2	1	1	1	1	1	2	2	3			3

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21EC7612	EMBEDDED AND IOT LABORATORY	L	T	P	C
		0	0	4	2

Preamble

1. To develop skills to work with various modules in embedded processors.
2. To work with various sensors and actuators.
3. To create IoT dashboards using various cloud servers

Prerequisites for the lab

   21EC5611/ Microprocessor and microcontroller lab

Objective

1. To understand about the Embedded Processors
2. To understand the MSP 430 development board
3. To study about CC3200 Launch pad
4. To design various cloud servers.

S.No	List of Experiments	CO
1	Embedded System design using MSP 430 Microcontroller. • Humidity/ Temperature sensor • PIR Sensor & Ultrasonic sensor • DC and Servo motor interfacing	1
2	Embedded System design using Energia IDE with CC3200.	1
3	Exercise of ARM CORTEX M4 • Flashing of LEDS. • Interfacing keyboard and LCD	2
4	1. Study and Configure Raspberry Pi. 2. WAP for LED blink using Raspberry Pi.	3
5	Creation of own Web Server and Web page for Monitoring and control applications.	3
6	Study and implement MQTT protocol using Arduino and Raspberry pi	4
7	Exercises on cloud application using Thing speak cloud server.	5
8	Exercises on Cloud application using Ad fruit cloud	5
9	Exercises on Cloud application using IBM cloud	5

10	Creating an IoT dashboard using Cayenne project builder	**5**

S.No.	List of Projects	Related Experiment	CO
1.	Embedded System design using MSP 430 Microcontroller - PIR Sensor & Ultrasonic sensor		1
2.	Embedded System design using MSP 430 Microcontroller- Humidity/ Temperature sensor using MSP430		1
3.	Embedded System design using MSP 430 Microcontroller - DC and Servo motor interfacing		1
4.	Interfacing Keyboard and LCD		2
5.	Design and Implement traffic light controller using Raspberry pi		3
6.	Determine the value of analogue input using Raspberry pi		3
7.	Motion detection using Raspberry pi		3
8.	Distance measurement using Raspberry pi		3
9.	RED Dashboard		4
10.	ESP01 ESP8266 Projects using Blynk Google Assistant		5

Suggestive Assessment Methods

Lab Components Assessments (60 Marks)		End Semester Exams (40 Marks)
Lab Experiment, Model Exam		Lab Exam

Outcomes

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

CO1	Interface Embedded Processors with I/O devices
CO2	Design an embedded system using MSP 430.
CO3	Design ARM based wireless Embedded systems.
CO4	Designing Embedded Systems using CC3200 Launch pad.
CO5	Design IoT Application using various cloud server.

Laboratory Requirements

MSP 430 Microcontroller-3
Raspberry pi-3
ARM CORTEX M4-3
Energia IDE with CC3200-3

Reference Books

1. Iot Based Projects by Dr. Rajesh Singh Dr. Anita Gehlot Dr. Lovi Raj Gupta NavjotRathourMahendra Swain Bhupendra Singh, BPB Publications

Web Resources

1. 96 Projects tagged with "MSP430" | Hackaday.io
2. Top 10 Raspberry Pi Projects for 2022 - YouTube

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	3	3	3	3	3	1		3	2	3	3	3	
2	2	3	3	3	3	3	1		3	2	3	3	3	
3	2	3	3	3	3	3	1		3	2	3	3	3	
4	2	3	3	3	3	3	1		3	2	3	3	3	
5	2	3	3	3	3	3	1		3	2	2	3	3	

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List of Professional Electives Courses

S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective I								
1	21EC5701	Medical Electronics	5	3	0	0	3	Electronics
2	21EC5702	Information Theory and Coding Techniques	5	3	0	0	3	Communication
3	21EC5703	Computer Architecture and Organization	5	3	0	0	3	Embedded
4	21EC5704	Wireless Networks	5	3	0	0	3	Networks
5	21EC5705	Robotics and Artificial Intelligence	5	3	0	0	3	Robotics
6	21EC5706	VLSI Signal Processing	5	3	0	0	3	Semiconductor

21EC5701	**MEDICAL ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

- The course deals with Medical electronics– a multidisciplinary area. The course will discuss all the vital features of Medical Electronic at three major levels, Electrical, Non Electrical, and Biosensors level. This course covers the technology advancements of various Medical electronic Eqipments and discusses the Current trends in Medical electronic measurements.

Prerequisites for the course

- 21EC3601/ Analog Electronics

Objective

- To gain knowledge about the various physiological parameters and methods of recording and measuring.
- To study about the various assist devices used in the hospitals.
- To gain knowledge about equipment used for physical medicine.
- To gain knowledge about the various recently developed diagnostic and therapeutic techniques.

UNIT I	ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING	9

Origin of Biopotential, half-cell potential, Design of Bio amplifier, Bio potential electrodes, ECG, EEG, PCG, EOG, ERG, EMG-recorders, typical waveforms and signal characteristics.

UNIT II	BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT	9

pH, pO_2, pCO_2, Blood flow meter, Cardiac output, Respiratory, Blood pressure, Temperature and Pulse measurement, spectrophotometer, flame photometer, auto analyser, Biosensors, Blood glucose sensors, Manual and Automatic Counting of RBC, WBC and Platelets

UNIT III	ASSIST DEVICES	9

Cardiac pacemakers, DC Defibrillator, Dialyser, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems, Plethysmography technique

UNIT IV	PHYSICAL MEDICINE AND BIOTELEMETRY	9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry, Detection of various physiological parameters using impedance technique

UNIT V	RECENT TRENDS IN MEDICAL INSTRUMENTATION	9

Telemedicine, Insulin Pumps, Radio pill, Robotic surgery,. Introduction to Wearable Technology in healthcare - Design challenges, smart wearable sensors, smart wearable textiles.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Understand the human body electro- physiological parameters and recording of bio-potentials
CO 2	Comprehend the non-electrical and biochemical physiological parameters and their measurement.
CO 3	Elucidate the working of various diagnostic and therapeutic assist devices used in the hospitals
CO 4	Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies and bio-telemetry principles and methods
CO 5	Understand about recent trends in medical instrumentation.

Text Books

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007. [Unit- I-IV]
2. L.A Geddes and L.E.Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and Sons, Reprint 2008 [Unit- V]

Reference Books

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, Third edition, New Delhi, 2014.
2. John G.Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India Edition, 2007
3. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.
4. Kabilan, R., "Bio Medical Instumentation- Medical Electronics", Scholars' Press, India, 2021.

Web Resources

1. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee32/ [Unit- I- V]

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				1	1	1			1	3		3
2	3		2	2		1	1	1			1	3		3
3	3	3				1	1	1			1	3		3

| 4 | 3 | 3 | | 2 | | 1 | 1 | 1 | | | 1 | 3 | | 3 |
| 5 | 3 | 3 | | | 3 | 1 | 1 | 1 | | | 1 | 3 | | 3 |

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Half-cell potential (Apply)
2. Bio potential electrodes (Apply)
COURSE OUTCOME 2:
1. Bio chemical measures ………….
2. When the energy transfer takes from one circuit to other circuit _____
COURSE OUTCOME 3:
1. What are the 4 common issues with pacemakers?
2. What are the benefits of a heart pacemaker?
COURSE OUTCOME 4:
1. Diathermy means ………..
2. A low impedance is due to
COURSE OUTCOME 5:
1. Telemedicine allows hospitals to optimize the use of their personnel by
2. ……………… is the use of medical information exchanged from one site to another via electronic communications to improve patients' health status

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21EC5702	INFORMATION THEORY AND CODING TECHNIQUES	L	T	P	C
		3	0	0	3

Preamble

Information theory is a mathematical approach to the study of coding of information along with the quantification, storage, and communication of information. Coding theory is the study of the properties of codes and their respective fitness for specific applications. Codes are used for data compression, cryptography, error detection and correction, data transmission and data storage.

Prerequisites for the course

* 21EC4601/ Analog and Digital Communication

Objective

* Understand error–control coding.
* Understand encoding and decoding of digital data streams.
* Be familiar with the methods for the generation of these codes and their decoding techniques.
* Be aware of compression and decompression techniques.
* Learn the concepts of multimedia communication.

UNIT I	INFORMATION ENTROPY FUNDAMENTALS	9

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels –Mutual Information- channel capacity – channel coding Theorem – Channel capacity Theorem.

UNIT II	DATA AND VOICE CODING	9

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive subband coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT III	ERROR CONTROL CODING	` 9

Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – Convolutional codes.

UNIT IV	COMPRESSION TECHNIQUES	9

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards

UNIT V	AUDIO AND VIDEO CODING	9

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – IMAGE AND VIDEO Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I, B, P frames, Motion estimation, Motion compensation, H.261, MPEG standard.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers-CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Learn the fundamentals of Information theory and coding techniques.
CO2	Design the different data and voice coding techniques.
CO3	Analyze the error–control techniques with suitable examples
CO4	Interpret the compression and decompression techniques.
CO5	Apply the concepts of multimedia communication.

TEXT BOOK(S):

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2007. (Unit 1-3)
2. Khalid Sayood, "Introduction to Data Compression,", Third Edition, Asia 2005.(Unit 4,5)

Reference Books

1. Mark Nelson, "Data Compression Book", BPB Publication 1992.
2. Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995
3. Ranjan Bose, Information Theory, Coding and Cryptography, Publication,2005

Web Resources
> 1.https://nptel.ac.in/courses/117101053 (Unit 1-3)
> 2. https://nptel.ac.in/courses/108102117(Unit 4,5)

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										3
2	3	3	2	1										3
3	3	3	2	1										3
4	3	3	2	1										3
5	3	3	2	1										3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. List the coding theorem.
2. Illustrate about Channel capacity.
COURSE OUTCOME 2:
1. State the Differential Pulse code modulation.
2. Compare PCM with Adaptive PCM
COURSE OUTCOME 3:
1. What is hamming distance?
2. Discuss about the syndrome properties of liner block codes.
COURSE OUTCOME 4:
1. What are "make-up codes" and termination codes in digitization of documents?
2. How arithmetic coding is advantages over Huffman coding for text compression?
COURSE OUTCOME 5:
1. Explain CELP principles.
2. Draw the frame format in MPEG audio encoder.

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21EC5703	COMPUTER ARCHITECTURE AND ORGANIZATION	L	T	P	C
		3	0	0	3

Preamble

In this introduction, the term architecture is taken to include instruction set architecture (the programmer's abstraction of a computer), organization or micro architecture (the internal implementation of a computer at the register and functional unit level), and system architecture (the organization of the computer at the cache, and the bus level). Computer architecture also underpins other areas of the computing curriculum such as operating systems (input/output, memory technology) and high level languages (pointers, parameter passing).

Prerequisites for the course

- 21EC3603 / Digital Logic Design

OBJECTIVES:

- To make students understand the basic structure and operation of digital computer.
- To familiarize with implementation of fixed point and floating-point arithmetic operations.
- To study the design of data path unit and control unit for processor.
- To understand the concept of various memories and interfacing.
- To introduce the parallel processing technique.

UNIT I	COMPUTER ORGANIZATION & INSTRUCTIONS	9

Basic Functional units of Computers: Functional units, basic Operational concepts, Bus structures. Software, Performance, Multiprocessors, Multicomputer. Data Representation: Signed number representation, fixed and floating point Representations. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.

UNIT II	COMPUTER ARITHMETIC	9

Addition and subtraction, multiplication Algorithms, Division Algorithms. Floating Point arithmetic, High performance arithmetic, Subword parallelism. Error detection and correction codes.

UNIT III	THE PROCESSOR	9

Introduction, Logic Design Conventions, Building a Datapath - A Simple Implementation scheme – An Overview of Pipelining - Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.

UNIT IV	MEMORY AND I/O ORGANIZATION	9

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Serial Bus Architectures. Peripheral devices, Input-output subsystems, I/O device interface, I/O Processor, DMA, interrupts and exceptions. I/O device interfaces – SCII, USB**.**

UNIT V	ADVANCED COMPUTER ARCHITECTURE	9

Pipelining and Vector Processing: Basic concepts, Instruction level Parallelism Throughput and Speedup, Pipeline hazards. Hardware multithreading, Multicore and shared memory Multiprocessors. Introduction to Graphics Processing Units, Clusters and Warehouse scale computers -Introduction to Multiprocessor network topologies.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Identify and explain the basic structure and functional units of a digital computer.
CO2	Design processing unit using the concepts of ALU and control logic design.
CO3	Analyze some of the design issues in terms of speed, cost, performance.
CO4	Design circuits for interfacing memor y and I/O with processor.
CO5	Comprehend the features and performance parameters of different types of computer architectures.

Text Books
1. Computer Organization – Carl Hamacher, Zvonks Vranesic, SafeaZaky, Vth Edition, McGraw Hill.
2. David A. Patterson and John L. Hennessey, "Computer Organization and Design", Fifth edition, Morgan Kauffman / Elsevier, 2014.
Reference Books
1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organization", Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings "Computer Organization and Architecture", Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014.
4. Computer Architecture and Organization", 3rd Edition by John P. Hayes,WCB/McGraw-Hill
5. "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.
Web Resources
1. https://www.youtube.com/watch?v=DDmJtHFCNos&t=3s
2. https://www.youtube.com/watch?v=eOjlXcYJx_w
3. https://www.youtube.com/watch?v=DDmJtHFCNos
4. https://www.youtube.com/watch?v=cipkWLPAsKE
5. https://www.youtube.com/watch?v=v7iefsovo9M

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	3	
2	3	3	3	3								1	3	
3	3	3	3	3								1	3	
4	3	2	3	2								1	3	
5	3	2	2	2								1	3	

COURSE LEVEL ASSESSMENT QUESTIONS
 COURSE OUTCOME 1:
1. Which access does a register file rely on to properly function?
2. What is the binary representation of instructions?
 COURSE OUTCOME 2:
1. Which two elements are required to implement R-Format arithmetic logic unit (ALU) operations?
2. Which component of a computer moderates the action of its other components?
 COURSE OUTCOME 3:
1. How would you express the speedup factor in a pipelined architecture?
2. How would you represent the space diagram for six segment pipeline and solve the time it takes to process eight tables.
 COURSE OUTCOME 4:

1. How can you overcome the lag in the operating speeds of the i/o device and the processor we use ?
2. How would you represent the virtual address space?

COURSE OUTCOME 5:
1. How would you explain the compiler technique that is used to expose ILP?
2. How the multiple subwords are packed into the word and how it processes into whole words?

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21EC5704	**WIRELESS NETWORKS**	L	T	P	C
		3	0	0	3

Preamble
- Wireless networks play an increasingly important role in the world of communications. This course provides an introduction to various current and next generation wireless networking technologies, and undertakes a detailed exploration of fundamental architectural and design principles used at all layers. Related protocols and their performance are studied using formal analytical tools and realistic simulations.

Prerequisites for the course
- 21EC4604/ Principles of Computer Networks

Objectives
1. To understand the concept about Wireless networks, protocol stack and standards.
2. To understand and analyse the network layer solutions for Wireless networks.
3. To study about fundamentals of 3G Services, its protocols and applications.
4. To have in depth knowledge on internetworking of WLAN and WWAN.
5. To learn about evolution of 4G Networks, its architecture and applications.

UNIT I	**WIRELESS LAN**	9

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN-Bluetooth: Architecture, WPAN – IEEE 802.15.4, GSM System Architecture

UNIT II	**MOBILE NETWORK LAYER**	9

Introduction - Mobile IP: Entities and Terminology, IP packet delivery, Agent discovery, Registration, Tunneling and Encapsulation, IPV6-IP micro-mobility support, cellular IP, HAWAII-Mobile IP: Session initiation protocol - Mobile ad-hoc network: Routing, Dynamic source routing

UNIT III	**3G OVERVIEW**	9

3G: Introduction, Overview of UMTS, UMTS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, CDMA2000 - Radio and Network components, Network structure, TD-CDMA, TD – SCDMA.

UNIT IV	**INTERNETWORKING BETWEEN WLANS AND WWANS**	9

Introduction, Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Internetworking Architecture for WLAN and GPRS, System Description with Tight coupling, System Description with Loose Coupling, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT V	**4G & BEYOND**	9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE Network Architecture and Protocol, Advanced Broadband Wireless Access and Services, Mobile Virtual Network Operator.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers-CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Understand the different Wireless LAN and Hiper LAN standards.
CO2	Design the mobile IP concepts, latest wireless protocols and standards.
CO3	Understand the 3G networks and its architecture.
CO4	Understand the characteristics and transport technologies used across generations of cellular networks and choose the suitable network depending on the availability and requirement.
CO5	Understand the 4G & Beyond networks and its architecture.

Text Books

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012. [Unit- I-III]
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007. [Unit- IV-V]

Reference Books

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013.

Web Resources

1. https://nptel.ac.in/courses/106105160

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				1	1				1		3
2	3	1	1				1	1				1		3
3	3	1	1				1	1				1		3
4	3	1	1				1	1				1		3
5	3	1	1				1	1				1		3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:
1. What is WLAN IEEE 802.11 explain with neat diagrams its general architecture.
2. Draw and explain the architecture and layers of HIPERLANs.

COURSE OUTCOME 2:
1. Explain about Mobile IP-IP packet delivery and agent discovery working principle in detail.
2. What is MANET? Discuss in detail about Routing protocol used in MANET?

COURSE OUTCOME 3:
1. With neat diagram explain the UTMS Terrestrial radio access network overview.
2. Describe about 3GPP architecture with neat illustrations.

COURSE OUTCOME 4:
1. Explain internetworking schemes to connect WLAN and 3G networks.
2. Explain internetworking system description architectures for WLAN and GPRS.

COURSE OUTCOME 5:
1. With neat diagram explain the IMS Architecture in detail.
2. Explain LTE Network Architecture and Protocol.

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21EC5705	ROBOTICS AND ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Preamble
- The course will start with a brief introduction to robots and robotics and explains about robotic kinematics, elements, drives, sensors and applications.
- It also covers basic ideas and techniques underlying the design of intelligent computer systems, including the introduction to Artificial Intelligence, problem solving techniques and Natural Language Processing.

Prerequisites for the course
- 21CS2501/Introduction to Computing using Python

UNIT I	INTRODUCTION TO ROBOTICS	9

Fundamentals of Robotics, A Historical Perspective of Robots , Classification of Robots, Major Components of a Robot, Fixed versus Flexible Automation, Economic Considerations, Sociological Consequences of Robots, Robotic Applications: Current and Future, Basic Components of a Robot System, The Robot System in an Application, Functions of a Robot System, Specifications of Robot Systems

UNIT II	ROBOT ELEMENTS AND END EFFECTORS	9

Robot joints and links, Kinematic Chains: The Manipulator, End effectors, Resolution, Repeatability, and Accuracy of a Manipulator, Forces Encountered in Moving Coordinate Systems, Lagrangian Analysis of a Manipulator, Stepper Motors, Brushless DC Motors, Direct-Drive Actuator, Hydraulic Actuators, Pneumatic Systems, Servo Amplifiers

UNIT III	ROBOT SENSORS AND APPLICATIONS	9

Sensors in robot – Touch sensors-Tactile sensor, Proximity and range sensor, Slip Sensors, Force and Torque Sensors, Light sensors, Pressure sensors, Introduction to Machine Vision, Industrial applications of robots, Medical, Space, Underwater Applications, Future Applications

UNIT IV	INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM SOLVING	9

Introduction to Artificial Intelligence (AI), Intelligent Agents, Solving problems by searching, beyond classical search, adversarial search, constraint satisfaction problems, Logical agents, First-order logic, Classical planning, planning and acting in the real world, Knowledge representation, Learning – knowledge in learning, learning probabilistic models, reinforcement learning

UNIT V	UNDERSTANDING NATURAL LANGUAGES	9

Natural Language Processing, Natural language for communication, Perception, Robotic perception, planning to move, Planning uncertain movements, moving, robotic software architectures, application domains, Ethics and risks of developing AI

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Identify the different classifications of robots, their major components and specifications.
CO2	Elucidate about robot kinematics, end effectors, motors, drives and actuators.
CO3	Employ various sensors for better performance and industrial and non-industrial applications of robots.
CO4	Apply various heuristic search techniques and learning algorithms for solving problems with AI.
CO5	Analyse natural language processing for robotic perception and identifying the risks of AI

Text Books

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003 [Unit I-III].
2. S. Russel, P. Norvig, "Artificial Intelligence - A Modern Approach", 3rdEdition, Pearson Education Ltd., 2014 [Unit IV-V].

Reference Books

1. Saeed B. Niku, "Introduction to Robotics: Analysis, Control, Applications", 3rd Edition, Wiley, 2019.
2. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers, 1998.
5. Utpal Chakraborty, "Artificial Intelligence for All", BPB Publications, 2020.

Web Resources

1. https://nptel.ac.in/courses/107106090
2. https://onlinecourses.nptel.ac.in/noc21_me76/preview
3. https://onlinecourses.nptel.ac.in/noc23_me07/preview
4. https://nptel.ac.in/courses/106105077
5. https://nptel.ac.in/courses/106105079

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	3	3	2	1	1							3	
2	3	3	2	3	1								3	
3	2	2	2	1	3	1	1	1					3	
4	2	3	3	2	1	1	1	2					3	
5	1	2	3	2	2	2	1	3					3	

COURSE LEVEL ASSESSMENT QUESTIONS
 COURSE OUTCOME 1:
   1. Illustrate the components of a robot system. (Understand)
 COURSE OUTCOME 2:
   1. The links and joints of a manipulator form a _____ (Understand)
 COURSE OUTCOME 3:
   1. Brief out how robots are employed in real time underwater applications. (Apply)
 COURSE OUTCOME 4:
   1. Illustrate how agents react with environments. (Apply)
 COURSE OUTCOME 5:
   1. Explore the planning of uncertain movements in Robotics (Analyze)

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		L	T	P	C
21EC5706	**VLSI SIGNAL PROCESSING**	3	0	0	3

 Preamble

- This course aims at providing a comprehensive coverage of some of the important techniques for designing efficient VLSI architectures for DSP. Towards this, architectural optimization at various levels will be considered

 Prerequisites for the course

- 21EC3602/ Signals and Systems

Objectives

- To design DSP architectures that is suitable for VLSI implementation for a given algorithm.
- To Design the DSP architecture using IIR and FIR filters by applying parallel processing, retiming, folding and unfolding techniques.
- To address issues related to high performance VLSI architectures such as pipelining styles.
- To learn high-level algorithms that reduces the number of multipliers, area of implementation and power consumption.

UNIT I	PIPELINING AND PARALLEL PROCESSING	9

Introduction to DSP Systems, Typical DSP algorithms, Data flow graph representations, Loop bound and Iteration bound, Longest Path Matrix algorithm; Pipelining and Parallel processing of FIR digital filters, Pipelining and Parallel processing for low power.

UNIT II	RETIMING AND ALGORITHMIC STRENGTH REDUCTION	9

Retiming - definitions and properties; Unfolding – an algorithm for Unfolding, properties of unfolding, sample period reduction and parallel processing application; Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT algorithm architecture transformation, Odd-Even Merge-Sort architecture, Parallel Rank-Order filters.

UNIT III	FAST CONVOLUTION AND COMBINED PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS	9

Fast convolution – Cook-Toom algorithm, Modified Cook-Took algorithm; Pipelined and parallel recursive adaptive filters, Look- Ahead pipelining in first- order IIR filters, Look- Ahead pipelining with power-of-two decomposition, Clustered Look-Ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters, pipelined adaptive digital filters, relaxed look-ahead, pipelined LMS adaptive filter.

UNIT IV	BIT-LEVEL ARITHMETIC ARCHITECTURES	9

Bit-Level Arithmetic Architectures- parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry-save multiplier, 4x 4 bit Baugh-Wooley carry-save multiplication tabular form and implementation, Bit-serial FIR filter, CSD representation, CSD multiplication using Horner's rule for precision improvement, Distributed Arithmetic

UNIT V	CLOCKING STYLES	9

Numerical Strength Reduction – subexpression elimination, Multiple Constant Multiplications, Synchronous pipelining and Clocking styles, Clock skew in edge-triggered single-phase clocking, Wave pipelining.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO.1	Understand VLSI design methodology for signal processing systems. Be familiar with VLSI algorithms and architectures for DSP.
CO.2	Explore and modify the design equations leading to efficient DSP architectures.
CO.3	Design and analysis of IIR digital filters using parallel processing. Implementing Cook, Toom Algorithm, Winogard Algorithm
CO.4	Design fast and area efficient multiplier architectures.

CO.5	Designing a high speed VLSI circuit using clocked logic styles

Text Books

1. KeshabK.Parhi, "VLSI Digital Signal Processing Systems", Design and implementation Wiley, Inter Science, Reprint 2008.(Unit I-III)
2. Fundamentals of Modern VLSI Devices 3rd Edition by Yuan Taur (Author), Tak H. Ning,Third Edition, 2022 (Unit IV-V)

Reference Books

1. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw-Hill, 1994.
2. S.Y. Kung, H.J. White House, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall, 1985.
3. Jose E. France, YannisT sividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.-

Web Resources
1. nptel.ac.in/courses/108105157

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	
2	3	3	2										3	
3	3	3			3								3	
4	3	3											3	
5	3	3											3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: (Understand)

In a DFG, the delay of each path is increased 3 times. Will the critical path

(a) increase, (b) decrease, (c) remain same, (d) increase or decrease depending on the DFG.

COURSE OUTCOME 2:

In the DFG below, each node takes time T to complete its job. Also,
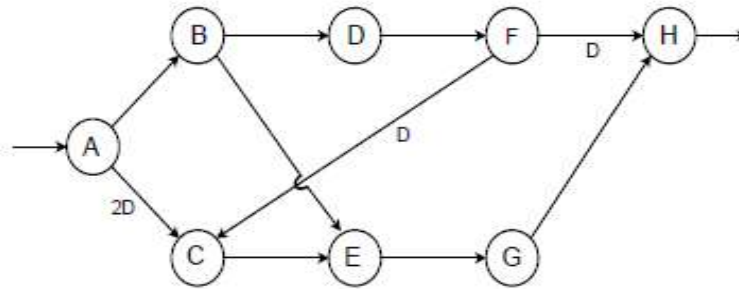
Figure 1: Figure for problems 2-7.

function of each node is time-invariant. Then, the minimum clock period that can be employed is

(a) $2T$ (b) $3T$, (c) $4T$, (d) $5T$.

COURSE OUTCOME 3:

The DFG shown below is retimed with $r(A) = 1$, $r(B) = 0$, $r(C) = 1$, $r(D) = 1$, $r(F) = 2$, $r(E) = 1$, $r(G) = 2$, $r(H) = 3$. If each node takes T u.t., then, the critical path after retiming will be

(a) 4T (b) 3T (c) 2T (d) T.
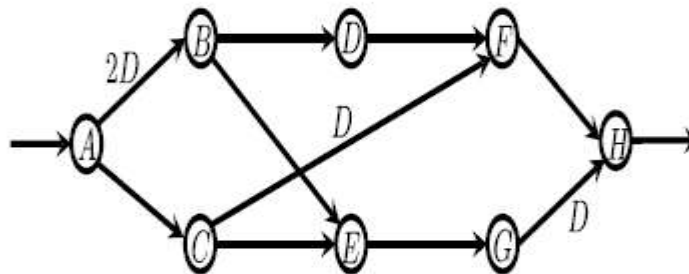
COURSE OUTCOME 4:

A bit parallel architecture has the following advantage over bit serial architecture :

(a) it can process faster input, (b) it requires less hardware, (c) it can both process faster input and requires less hardware, (d) it does not require switches.

COURSE OUTCOME 5:

Consider a bit serial implementation of the FIR filter : $y(n) = -\frac{15}{16}x(n) + \frac{1}{4}x(n-1)$. Let the wordlength be W bits and the adders are separated by pipeline latches. Then, if the LSB of $x(n)$ enters the system at $(Wn + 0)$-th cycle, then, the LSB of $y(n)$ will show up in the cycle

(a) $Wn + 1$ (b) $Wn + 3$ (c) $Wn + 5$, (d) $Wn + 4$.

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S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective II								
1	21EC6701	Solid State Devices	6	3	0	0	3	Electronics
2	21EC6702	Satellite Communication and Broadcasting	6	3	0	0	3	Communication
3	21EC6703	Advanced Microprocessors and Microcontrollers	6	3	0	0	3	Embedded
4	21EC6704	Cryptography and Network Security	6	3	0	0	3	Networks
5	21EC6705	Sensors, Actuators and Interface Electronics	6	3	0	0	3	Robotics
6	21EC6706	Mixed Signal IC Design	6	3	0	0	3	Semiconductor

21EC6701	**SOLID STATE DEVICES**	L	T	P	C
		3	0	0	3

Preamble

- Solid state devices course is designed with five objectives as follows. i). to recall the basics of semiconductor, to introduce the different junctions and fabrication of PN junctions, ii). to understand the different types of FETs apart from MOSFET, and to understand the MOS capacitors, iii). To review the photo diodes, light emitting diodes and lasers, iv). To familiarizehigh frequency, high power devices and nano electronic devices, v). To survey the integrated circuits completely.

Prerequisites for the course

21EC2601/Semiconductor Devices and Circuits

UNIT I	SEMICONDUCTOR AND JUNCTIONS	9

Introduction to semiconductor: Energy Bands, Charge Carriers, Junctions: Fabrication of p-n Junctions, Equilibrium Conditions, Forward- and Reverse-Biased Junctions; Steady State Conditions, Reverse-Bias Breakdown, Transient and A-C Conditions, Deviations from the Simple Theory, Metal–Semiconductor Junctions, Heterojunctions

UNIT II	FIELD-EFFECT TRANSISTORS AND MOS CAPACITORS	9

Field-Effect Transistors: The Metal–Semiconductor FET, The Metal–Insulator–Semiconductor FET, Advanced MOSFET Structures, MOS Capacitors: Ideal MOS Capacitor, SiO_2-Si MOS Capacitor, Carrier Transport in MOS Capacitors

UNIT III	OPTOELECTRONIC DEVICES	9

Photodiodes: Current and Voltage in an Illuminated Junction, Solar Cells, Photodetectors - Gain, Bandwidth, and Signal-to-Noise Ratio, Light-Emitting Diodes: Light-Emitting Materials, Fiber-Optic Communications, Lasers, Semiconductor Lasers

UNIT IV	HIGH-POWER DEVICES AND NANO ELECTRONIC DEVICES	9

The IMPATT Diode, the Gunn Diode, the p-n-p-n Diode, the Semiconductor-Controlled Rectifier, Insulated-Gate Bipolar Transistor, Nanoelectronic Devices

UNIT V	INTEGRATED CIRCUITS	9

Background, Evolution of Integrated Circuits, Monolithic Device Elements Charge Transfer Devices, Ultra Large-Scale Integration (ULSI), Testing, Bonding, and Packaging.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Explore the different types of junctions in semiconductor devices
CO2	Select the appropriate FET device or MOS capacitance for the specific application
CO3	Categories the properties ofphoto diodes, light emitting diodes and lasers
CO4	Analyse the high frequency, high power devices and nano electronic devices
CO5	Use the suitable semiconductor device for the IC design

Text Books

1. Ben G. Streetman and Sanjay Kumar Banerjee, Solid State Electronic Device, Seventh Edition, Pearson Education Limited 2016

Reference Books

1. S.M.Sze, M.K.Lee, Semiconductors Devices, Physics and Technology, 3rd Edition, Wiley, 2012
2. Robert Pierret, "Semiconductor Device Fundamentals," Pearson Education, 2006
3. J.Millman and C.C.Halkias : Electronic devices and Circuits, McGraw Hill, 1976.
4. B.G.Streetman : Solid state devices, (4/e), PHI, 1995.
5. N.H.E.Weste, D. Harris, "CMOS VLSI Design (3/e)", Pearson, 2005.

Web Resources

   1.https://archive.nptel.ac.in/courses/117/106/117106091/

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	2									3	
3	3	3	3										3	
4	3	3	3	2									3	
5	3	3	3										3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. How will you form a Reverse-Biased Junctions?
2. Explain the Transient and A-C Conditions

COURSE OUTCOME 2:

1. State the applications of The Metal–Insulator–Semiconductor FET with specific conditions
2. When will you use the SiO_2-Si MOS Capacitor?

COURSE OUTCOME 3:
1. Short note on Solar Cells
2. Explain the light emitting diode for Fiber-Optic Communications

COURSE OUTCOME 4:
1. Analyze the Semiconductor-Controlled Rectifier
2. Review the Nanoelectronic Devices

COURSE OUTCOME 5:
1. Which semiconductor device will be selected for the radio frequency integrated circuit?
2. Which semiconductor device will be budget friendly for the Testing, Bonding, and Packaging process?

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21EC6702	SATELLITE COMMUNICATION AND BROADCASTING	L	T	P	C
		3	0	0	3

Preamble

- To enable the student to become familiar with satellites and satellite services.

Prerequisites for the course

- 21EC4601/ Analog and Digital communication
- 21EC5602/ Wireless Communication Systems

Objective

- To Understand the basics of satellite orbits
- To Understand the satellite segment and earth segment
- To Analyze the various methods of satellite access
- To Understand the applications of satellites
- To Understand the basics of satellite Networks

UNIT I	SATELLITE ORBITS	9

Kepler"s Laws, Newton"s law, orbital parameters, orbital perturbations, Inclined orbit, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage, Launching orbit.

UNIT II	SPACE SEGMENT	9

Spacecraft Technology- Structure, Primary power, Altitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and Command-Transponders-The Antenna Subsystem, Anik satellites, Advanced Tiros-N Spacecraft.

UNIT III	SATELLITE LINK DESIGN	9

Space link, Transmission Losses, Link power budget Equation, System Noise, Carrier to Noise ratio, The Uplink, Down Link, Effects of rain, Combined Uplink and downlink C/N Ratio, Inter modulation Noise, Inter satellite Links, Interference, Antenna Gain function.

UNIT IV	SATELLITE ACCESS TECHNIQUES AND SERVICES	9

Modulation and Multiplexing: Voice, Data, Video, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods. Mobile satellite services: GSM, GPS Position Location Principles.

UNIT V	DIRECT BROADCAST SATELLITES	9

Introduction, orbital Spacing, Power rating and number of transponder, Bit rate for digital Television, Forward Error Correction, Home Receiver Outdoor Unit (ODU), Home Receiver Indoor Unit (IDU), Down link Analysis, Uplink, HDTV

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Summarize the satellite orbits and Launching.
CO2	Summarize the earth segment and space segment.
CO3	Analyze the satellite Link design and Interference Analysis
CO4	Interpret the various satellite Access and services.
CO5	Analyze the Digital Broadcast satellite systems.

Text Books

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017. (Unit I-IV)
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication",2nd Edition, Wiley Publications,2002 (Unit V)

Reference Books

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003

Web Resources

1. https://www.digimat.in/nptel/courses/video/117105131/L01.html/ [Unit- I- V]
2. https://nptel.ac.in/courses/117105131 [Unit- I- V]

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	2	2											3
3	3	2	2											3
4	3	1	2											3
5	3	1	2											3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:

1. A satellite is orbiting in the equatorial plane with a period from perigee to perigee of 12 h. Given that the eccentricity is 0.002, Investigate the semimajor axis. The earth's equatorial radius is 6378.1414 km
2. Show the different types of satellite orbits and discuss their merits and demerits.

COURSE OUTCOME 2:
1. Construct the communication payload and supporting subsystems used in satellite.
2. Describe the term antenna and discuss in detail about the various antenna used in the satellite

COURSE OUTCOME 3:
1. Infer the term noise temperature of absorptive networks and show that at room temperature the noise factor of a lossy network is equal to its power loss.
   1.   Analyze the link design with frequency reuse concept in detail.

COURSE OUTCOME 4:
   1.   Evaluate the techniques of compression and encryption used in satellite communication with general block diagram
   2.   The code waveform in a CDMA system spreads the carriers over the full 36 MHz bandwidth of the channel, and the roll off factor for the filtering is 0.4. The information bit rate is 64 kb/s, and the system uses BPSK. Calculate the processing gain in decibels. Given that the BER must not exceed 10-5 , give an estimate of the maximum number of channels that can access the system and throughput.

COURSE OUTCOME 5:
1. Generalize the Principles of home receiver ODU and IDU in detail.
2. Write the features of digital TV broadcast. List the various factors of home receiver unit

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21EC6703	**ADVANCED MICROPROCESSORS AND MICROCONTROLLERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Prerequisites for the course					

21EC5601/Microprocessor and Microcontroller

Preamble

This course helps the students to understand the concepts of the Pentium, ARM and Microcontroller. This course also aids to thrive their programming skills to solve real world problems. This course will serve as foundation for the advanced studies in the area of Hardware design and Embedded System Design.

Objectives

*   To explore the concepts of Pentium architecture.
*   To familiarize with the ARM concepts.
*   To impart the knowledge on ARM Application Development.
*   To explore the fundamental concepts in MOTOROLA 68HC11.
*   To design the PIC interfacing applications.

UNIT I	**HIGH PERFORMANCE CISCARCHITECTURE–PENTIUM**	**9**

CPU Architecture-Bus Operations –Pipelining –Branch prediction –floating point unit-Operating Modes–Paging –Multitasking –Exception and Interrupts –Instruction set –addressing modes –MMX Architecture-Hyper Threading in Pentium.

UNIT II	HIGH PERFORMANCE RISC ARCHITECTURE–ARM	9

Arcon RISC Machine –Architectural Inheritance –Core & Architectures -Registers –Pipeline -Interrupts–ARM organization -ARM processor family –Co-processors-ARM instruction set- Load –Store instruction-Program status register instructions-Loading constants-Software interrupt instructions, Thumb Instruction set-Instruction cycle timings -The ARM Programmer"s model –ARM Development tools

UNIT III	ARMAPPLICATIONDEVELOPMENT	9

Introduction to DSP on ARM –FIR filter –IIR filter –Exception handling – Interrupts –Interrupt handling Schemes-Firmware and boot loader –Memory Management units –Multitasking, Memory organization in a virtual memory system- Translational look aside buffer-Future ARM Technologies.

UNIT IV	MOTOROLA68HC11MICROCONTROLLERS	9

Architecture-Instruction set- Addressing modes –Operating modes-Timers-EEPROM-Interrupt system -Serial Communication Interface –A/D Converter PWM and UART

UNIT V	PIC MICROCONTROLLER	9

CPU Architecture –Instruction set –interrupts-Timers-I^{2}C Interfacing –UART-A/D Converter -Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers-CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Explore the Pentium architecture for a specific real world application.
CO2	Comprehend the ARM processor cores and development tools.
CO3	Analyze the ARM Application Development.
CO4	Explore the Motorola 68HC11 Microcontroller and its application.
CO5	Design interfacing circuits of various devices with PIC microcontroller.

Text Books

1. James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.(Unit-I)
2. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer"s Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004. (Unit- II,III)
3. Rajkamal, "Microcontrollers Architecture, Programming, Interfacing and System Design," Pearson,2012.(Unit-IV)
4. John. B.Peatman, " Design with PIC Microcontroller", Prentice Hall, 3rd Edition,2004.(Unit-V)

Reference Books

1. Gene.H.Miller,"Micro ComputerEngineering", PearsonEducation, 2003.
2. Steve Furber, "ARM System –On –Chip architecture", Addision Wesley, 2000.(Unit- II)
3. Barry.B.Brey," The Intel Microprocessors Architecture, Programming and Interfacing," Prentice Hall, 2002.
4. David Seal, ARM Architecture Reference Manual, Addison- Wesley, 2nd Edition, 2009, ISBN:978-0201737196
5. A.K. Ray and K.M. Bhurchandi - Advanced Microprocessors and Peripherals 3e-Tata Mcgraw Hill ,2012.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_ee42/preview
2.https://nptel.ac.in/courses/108102045
3.https://www.udemy.com/course/pic-microcontroller-architecture-and-embedded-c-programming/

CO Vs PO Mapping and CO Vs PSO Mapping

	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	1									1		2
2	3	1	2	1	1									2
3	3	2	2	1	1							1		2
4	3	2	2	2	1							2		2
5	3	2	2	2	1							2		2

COURSE LEVEL ASSESSMENT QUESTIONS
Course Outcome 1
1. Understand the concept of CISC.
1. CISC stands for --------.
2. Both the CISC and RISC architectures have been developed to reduce the ------------.
Course Outcome 2
1. Ability to learn the RISC architecture
1. The ARM stands for --------------.
2.The Sun micro systems processors usually follow ____ architecture.
Course Outcome 3
1. Ability to analyze the ARM Architecture and its applications in future technologies.
1.ARM Processors were basically designed for -------------.
2. The address space in ARM is ----------.
Course Outcome 4
1. Ability to analyze the 68HC11 processor operation, the working principle of PWM and UART.
1. ----------------- microcontroller is used in engine management system.
2.Is 68HC11 computer Byte addressable?
Course Outcome 5
1. Ability to understand the process of PIC microcontroller.
1. PIC microcontroller refers to ----------.
2. -----------instruction is applicable to set any bit while performing bitwise operation settings.

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21EC6704	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

Preamble

- The aim of this course is to introduce the student to the areas of cryptography and cryptanalysis. To gain a fundamental grasp of the algorithms that is used to protect consumers online as well as some of the design decisions that went into creating them. In order to stop future attacks, the course places a strong emphasis on providing students with a fundamental understanding of previous cryptosystem attacks.

Prerequisites for the course

- 21EC4604 - Principles of Computer Networks

Objective

- To understand the fundamentals of network security, basic concepts in number theory and finite fields.
- To Scrutinize different cryptographic operations of symmetric cryptographic algorithms.
- To explore cryptographic operations of public key cryptography.
- To Optimize Authentication and hash algorithms to simulate different applications.
- To Discriminate various Security practices and System security standards

UNIT I	INTRODUCTION AND NUMBER THEORY	9

Computer Security- The OSI security Architecture- Security Attacks, services, Mechanisms-A network security model, Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, Rotor machines, Steganography). Basic concepts in number theory and finite fields: Divisibility and division algorithm

UNIT II	BLOCK CIPHERS AND THE DATA ENCRYPTION STANDARD	9

Block Cipher Principles, The Data Encryption Standard(DES)– Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Advanced Encryption Standard – AES structure-AES Round Functions– AES Key Expansion

UNIT III	PUBLIC KEY CRYPTOGRAPHY	9

Principles of Public key cryptosystems- The RSA Algorithm- Diffie Hellman key exchange – ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography-Pseudo random number Generation based on an Assymetric Cipher

UNIT IV	MESSAGE AUTHENTICATION AND INTEGRITY	9

Cryptographic Hash Function-Secure Hash Algorithm-Message Authentication codes-Security of MACs-MACs Based on Hash Function-MACs based on Block Ciphers-Digital Signatures-ElGamal Digital Signature Scheme-Schnorr Digital Signature Scheme-Digital Signature Standard.

UNIT V	SECURITY PRACTICE & SYSTEM SECURITY	9

Electronic Mail security -Pretty Good Privacy, S/MIME, Domain keys Identified Mail, IP Security-Transport-Level Security-web Security, Secure Sockets Layer, Transport Layer Security- Wireless network Security

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Understand the fundamentals of network security, basic concepts in number theory and finite fields
CO2	Comprehend different cryptographic operations of symmetric cryptographic algorithms
CO3	Analyse cryptographic operations of public key cryptography
CO4	Optimize Authentication and hash algorithms to simulate different applications.
CO5	Discriminate various Security practices and System security standards

Text Books

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 8th Edition, (2016) [Unit-I-IV]
2. Introduction to Modern Cryptography, CRC Press Jonathan Katz, Yehuda Lindell , 2020.[Unit-V]

Reference Books

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007.
2. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security, Second Edition, Private Communication in Public World", PHI 2002.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_cs21

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	2	2										3
3	3	3	3	3										3
4	3	3	3	3										3
5	3	3									3	3		3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. State Steganography.
2. Analyze Classical encryption technique.

COURSE OUTCOME 2:
1. Compare stream cipher with block cipher with example.
2. Identify the technique in which encryption algorithm is performed three times using three keys and explain it briefly.

COURSE OUTCOME 3:
1. Evaluate the performance of message authentication.
2. Differentiate MAC and Hash function.

COURSE OUTCOME 4:
1. Compare Schnorr and Elgamal digital Signature scheme
2. Analyze the needs for authentication applications.

COURSE OUTCOME 5:
1. Correlate Secure Sockets Layer, Transport Layer Security.
2. Analyses the security issues in transport layer

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21EC5705	**SENSORS, ACTUATORS AND INTERFACE ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

Sensor is a device which produces electrical output in response to a specified measurand. Sensors play a vital role in manufacturing, machinery, aerospace, medicine and robotics. Most of the advancements of present day would be not possible without sensors. The main purpose of offering this course is to elaborate the theoretical and practical aspects of sensors, their classifications, static and dynamic characteristics, recent trends and their applications in automation.

Prerequisites for the course

- Fundamentals of Measurements systems and Semiconductor devices

Objectives

1. Understand static and dynamic characteristics of measurement systems
2. To study the different types of resistive and reactive sensors
3. Understand the basic concept of self-generating sensors.
4. Understand the actuators drive characteristics and applications
5. To introduce the basic concepts digital sensors and semiconductor device sensors

UNIT I	INTRODUCTION TO MEASUREMENT SYSTEMS	9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static characteristics of measurement systems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors, random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response.

UNIT II	RESISTIVE AND REACTIVE SENSORS	9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.

UNIT III	SELF-GENERATING SENSORS	9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT IV	ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS	9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V	DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS	9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Analyse different measurement system characteristics.
CO 2	Discern resistive and Reactive Sensors
CO 3	Design and development solutions for sensors and actuators.
CO 4	Analyse the development and application of sensors and actuator
CO 5	Analyse the acquired data and measured results

Text Books

1. D.Patranabis, "Sensors and Transducers", TMH 2003. (Unit I, II, III)
2. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011. (Unit IV, V)

Reference Books

1. D. Johnson, "Process Control Instrumentation Technology", John Wiley and Sons.2011.
2. E.O. Doeblin, "Measurement System : Applications and Design", McGraw Hill publications,2012
3. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
4. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc19_ee41/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 10	PO1 11	PO1 12	PSO 1	PSO 2

1	3	2	2									3	3	
2	3	2	2									3	3	
3	3	2										3	3	
4	3	2										3	3	
5	3	2										3	3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Analyse different measurement system characteristics.
1. Describe the Static and dynamic characteristics of measurement systems.
2. Explain the different methods of correction techniques

COURSE OUTCOME 2: Understand Resistive and Reactive Sensors
1. Annotating with suitable diagram explain the Reactance variation and electromagnetic sensors
2. Interpret the Interference of different sensors.

COURSE OUTCOME 3: Analysing the structure and working operation of Self- generating sensors.
1. Organizing the Signal conditioning for self-generating sensors.
2. Explaining the thermoelectric and electrochemical sensors.

COURSE OUTCOME 4: Compare different Actuators and its working.
1. Testing the DC Motor control in Different Actuators
2. Experiment the Digital to resolver converter

COURSE OUTCOME 5: Evaluate digital sensors and semiconductor device   sensors.
1. Evaluate the working of Vibrating wire stain gauge
2. Reviewing the different components in quartz digital thermometer

COURSE OUTCOME 6: Evaluate semiconductor device sensors.
1. Comment the Sensor based semiconductor devices and its applications
2. Assessing the photodiodes and phototransistors with suitable diagrams.

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21EC6706	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

Preamble

The course "Mixed Signal IC Design" is offered as an elective subject in continuation with core subject Digital Logic Circuit Design & Analog Electronics. This course is to bridge the link between analog world and digital world as in the name of mixed signal circuit. It is performed by sampling and hold circuit, DAC, ADC, filters, Data Converter Architecture and Oscillators.

Prerequisites for the course

- 21EC3603/Digital Logic Design

Objectives

1. To understand the basic concepts of mixed signal processing

2. Understand the various integrated based filters and topologies
3. Learn the data converters architecture, modeling and signal to noise ratio
4. Study the integrated circuit of oscillators and PLLs

UNIT I	CHARACTERISTICS OF MIXED SIGNAL PROCESSING	9

Analog versus Discrete Time signals, A/D conversion, Sample and Hold Characteristics, DAC specifications – Nonlinearity, offset, gain error, latency, SNR, dynamic range. ADC specifications – Quantization error, nonlinearity, missing codes, Aliasing, aperture error. Mixed signal layout issues.

UNIT II	ANALOG AND DIGITAL CMOS FILTERS	9

Analog Filters: Integrator Building Blocks, Lowpass Filters, Active-RC Integrators, MOSFET-C Integrators, Discrete-Time Integrators, Filtering Topologies. Digital Filters: Sinc-Shaped Digital Filters, Lowpass Sinc Filters, Bandpass and Highpass Sinc Filters, Filtering Topologies.

UNIT III	DATA CONVERTER ARCHITECTURES	9

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

UNIT IV	DATA CONVERTER MODELING AND SNR	9

Sampling and Aliasing: A modeling approach, Impulse sampling, Decimation, The sample and Hold, Interpolation. Data converter SNR: Quantization noise, Signal-to-Noise Ratio (SNR) An overview, Clock Jitter, Improving SNR using Averaging - Using feedback to improve SNR.

UNIT V	OSCILLATORS AND PLL	9

Oscillators: General consideration, Ring oscillators, LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops- Applications.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Examine the basic operational and design principles of mixed signals.
CO 2	Analyze the characteristics of IC based CMOS filters.
CO 3	Describe the functionality of Data Converter Architectures.
CO 4	Identify the signal to noise ratio and modelling methods of mixed signals.
CO 5	Design oscillators and phase lock loop circuit for signal analysis.

Text Books

1. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2017. [Unit-I, IV]
2. Analog Integrated Circuit Design, Tony Chan Carusone, David A. Johns, Kenneth W. Martin, Wiley Press, 2nd Edition, 2011 [Unit-II, III]
3. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprints 2010. [Unit-V]

Reference Books

1. CMOS Analog Circuit Design , Phillips E. Allen and Douglas R. Holberg, Oxford Press International Edition, 3rd Edition, 2013
2. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
3. R. Schreier, G. Temes, "Understanding Delta-Sigma Data Converters", Wiley-IEEE Press, 2004.
4. BehzadRazavi, "Principles of data conversion system design", IEEE press, 1995.

Web Resources

1. http://www.infocobuild.com/education/audio-video-courses/electronics/VLSIDataConversion-IIT-Madras/lecture-05.html [Unit-I, II]
2. https://www.youtube.com/watch?v=nigEcGE2Ql0[Unit-III]
3. https://archive.nptel.ac.in/courses/108/104/108104098/ [Unit-IV]
4. https://www.digimat.in/nptel/courses/video/108106184/L33.html [Unit-V]

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										3	
2	3	3	3										3	
3	3	3	3										3	
4	3	3	3										3	
5	2	3	3	2									3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1

1. Give the classification of ADC architectures based on the conversion rate. Also explain the static and dynamic characteristics of ADCs
2. A binary input 000 is fed to a 3bit DAC/ADC. The resultant output is 101. Find the type of error?

COURSE OUTCOME 2:

1. The magnitude function $|H(\omega)|$ can be zero at some frequencies, but it cannot be zero over any finite band of frequencies. Justify the answer.
2. $H_R(\omega)$ and $H_I(\omega)$ are interdependent and cannot be specified independently when the system is causal. Justify the answer.

COURSE OUTCOME 3:

1. Draw the schematic of 4 bit resistor based binary weighted D/A converter and explain its operation. What are the advantages of binary weighted converters?
2. How to overcome the design limitation of binary weighted resistor type DAC?

COURSE OUTCOME 4:

1. Give the schematic of a simple sample and hold circuit using a MOS switch
2. What is output signal when a signal x(t)=cos(2*pi*40*t) is sampled with a sampling frequency of 20Hz?

COURSE OUTCOME 5:

1. Draw the block diagram of a charge pump PLL and explain the functions of each block.
2. Differentiate the working of analog PLL circuits from digital PLL Circuits. With the help of necessary waveforms, explain about the non-ideal effects in PLLs.

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S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective III								
1	21EC6707	Nanoelectronic Devices and Circuits	6	3	0	0	3	Electronics
2	21EC6708	Multimedia Compression and Communication	6	3	0	0	3	Communication
3	21EC6709	ARM based Digital Signal Processing	6	3	0	0	3	Embedded
4	21EC6710	Blockchain Principles	6	3	0	0	3	Networks
5	21EC6711	Automation System Design	6	3	0	0	3	Robotics
6	21EC6712	CMOS Analog IC Design	6	3	0	0	3	Semiconductor

21EC6707	NANOELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Preamble

Nanoelectronics is the term used in the field of nanotechnology for electronic components and research on improvements of electronics such as display, size, and power consumption of the device for the practical use. This includes research on memory chips and surface physical modifications on the electronic devices.

Prerequisites for the course

- 21EC2601/Semicondutor Devices and Circuits

Objective

- The field of nanoelectronics aims to enable the continued realization of this law by using new methods and materials to build electronic devices with feature sizes on the nanoscale.
- Describe the solid-state physics and quantum mechanics that govern the operation and electrical characteristics of nanoelectronics devices.

UNIT I	CIRCUIT, DIODES AND NANO ELECTRONICS	9

Introduction–Nano electronic devices, Circuit theory voltage and current division, source transformation -Mesh current and node voltage method of analysis for D.C and A.C. circuits, Network theorems -Superposition theorem, Reciprocity theorem, Tunnel Diode with the help of energy band diagrams, Varactor Diode, SCR.

UNIT II	NANO DEVICES AND FILTERS	9

Properties of Nanomaterials, Production of Nanomaterials, Nano-sensors-Miniaturization of Biosensors, Nanomaterial Based Biosensors. Electron Transfer of Biomolecules, Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT III	BJT, NANO STRUCTURES	9

Introduction-NPN -PNP -Operations-Early Effect-Current equations – Input and Output characteristics of CE, CB, CC. Nanostructures: Zero-, One-, Two- and Three- dimensional structure, Size control of metal Nanoparticles and their properties: Optical, Electronic, Magnetic properties; Surface plasmon Resonance, Change of bandgap; Application: catalysis, electronic devices

UNIT IV	SUPERCONDUCTING DEVICES	9

Basics - Macroscopic model- Super conducting switching Devices – Cryotron- Josephson Tunnelling Devices- Elementary circuits – Associative or Content – Addressable Memory - SQUID – Flux Quantum device –Magnetic Flux Quantum – Quantum Cellular Automata- Quantum computer with Single Flux devices – SFQD- RSFQD – Application of superconducting devices

UNIT V	NANO SEMICONDUCTOR AND APPLICATIONS	9

Nano Semiconductors: Nanoscale electronic devices including CMOS, Potentiometric sensors etc., MRAM devices, Spintronic devices including spin valves, Thermo Electric Materials (TEM): Applications.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Analyse electrical circuits, semiconductor devices under various conditions.
CO2	Design nano devices and circuitsand design and analyse simple rectifiers and voltage regulators using diodes.
CO3	Explain the structure and working operation of Transistor configurations and nano structures.
CO4	Analyse the super conducting devices, Ability to describe the behaviour of special purpose diodes.
CO5	Design the Nano semiconductor devices and Ability to characterise Materials, design and analyse simple BJT and MOSFET circuits.

Text Books

1. Quantum wells, Wires &Dots, Theoretical & Computational Physics of Semiconductors Nano-structures, Paul Harrison. (Unit1-3)
2. Polymer nanocomposites: Edited by Yiu-Wing Mai and Zhong-Zhen Yu, first published 2006, Woodhead Publishing Limited and CRC Press LLC, USA. (Unit 4-5)

Reference Books

1. Encyclopedia of Nanotechnology- Hari Singh Nalwa
2. Springer Handbook of Nanotechnology - Bharat Bhusan
3. Handbook of Semiconductor Nanostructures and Nanodevices Vol 1-5- A. A. Balandin, K. L. Wang.
4. Nanostructures and Nanomaterials - Synthesis, Properties and Applications - Cao, Guozhong.

Web Resources

1. https://www.nanowerk.com/nanoelectronics.php
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2858563/
3. https://nptel.ac.in/courses/117108047

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		2		1					1	1	3	
2	3	2	1	1		1	1				1	1	3	
3	3	2	3								1	1	3	
4	3	1	1	1		2	1				1	1	3	
5	3	2	1								1	1	3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Explain in detail about the I-V characteristics of SCR

COURSE OUTCOME 2: A series RLC circuit as shown in the figure below has R = 5Ω,L= 2H and C = 0.5F.The supply voltage is 10 V DC . Find a) The current in the circuit when there is no initial charge on the capacitor. b) The current in the circuit when the capacitor has initial voltage of 5V c) Repeat question (a) when the resistance is changed to 4 Ω

COURSE OUTCOME 3: Explain in detail CE configuration of BJT.

COURSE OUTCOME 4: What is SQUID? Explain the term critical magnetic field in superconductor.

COURSE OUTCOME 5: Explain in detail TE material and its applications.

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21EC6708	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

Preamble

Multimedia is the major source of information in today's era. Audio, video and image signals require vast amount of data for its representation and storage. Compression of data is required to reduce the storage requirement, processing time and transmission time. This course enables the learner to study the various representations of multimedia such as text, audio, image and video. It deals with necessity and fundamentals of compression techniques, various compression mechanisms and standards. It also deals with how multimedia content is distributed over networks.

Prerequisites for the course

- 21EC4604-Principles of Computer Networks,
- 21EC4601- Analog and Digital Communication

Objectives

1.	To enrich in the fundamentals of multimedia and text compression algorithms
2.	To acquire knowledge in image processing algorithms and image formation concepts
3.	To acquire knowledge in video compression algorithms and color models .
4.	To learn principles of audio compression algorithms

5. To get comprehensive learning in multimedia communication and networking techniques

UNIT I	LOSSLESS AND LOSSYCOMPRESSION ALGORITHMS	9

Components of Multimedia – Lossless Compression – Text Compression – Run Length Coding – Variable Length Coding – Shannon Fano Coding – Huffman and Adaptive Huffman Coding – Dictionary Based Coding – Arithmetic Coding – Lossy Compression Algorithms– rate distortion theory-Quantization – Transform Coding – Wavelet Based Coding

UNIT II	IMAGE PROCESSING AND CODING	9

Image Formation – CIE Chromaticity Diagram – CIELAB Color Model- Color Models: RGB, CMY, HSV,Printer Gamuts– Color Balancing – Gamma Correction – Image compression standards: JPEG, JPEG-2000, JPEG-LS, JBIG , GIF, PNG, TIFF, BMP,PS and PDF.

UNIT III	VIDEO PROCESSING AND CODING	9

Video Color Transforms: YUV, YIQ, YCbCr – Chroma Subsampling – Standard Digital Video Formats –HDTV – UHDTV – CIF – QCIF – Video Compression based on Motion Compensation – Search for Motion Vectors –– H.264 -H.265– Motion Compensation in MPEG –MPEG-4, MPEG-7

UNIT IV	AUDIO PROCESSING AND CODING	9

Digitization of Audio: DPCM, ADPCM – Digital Audio – Synthetic Sounds, Musical Instrument Digital Interface – Vocoders – LPC, CELP, MPEG Audio compression-frequency masking, temporal masking - MPEG Audio -MPEG 2, MPEG-4 – Dolby AC1.

UNIT V	MULTIMEDIA COMMUNICATIONS AND NETWORKING	9

Quality-of-Service for Multimedia Communications, Protocols for Multimedia Transmission and Interaction-Real-Time Transport Protocol, RTP Control Protocol, Real-Time Streaming Protocol, Content Distribution Networks (CDNs), Broadcast/Multicast Video-on-Demand ,HTTP-Based Media Streaming

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Design lossy and lossless compression algorithms
CO2	Explicit the principles and standards of image processing algorithms
CO3	Classify different video compression algorithms and various color models.
CO4	Describe the performance of various audio compression algorithms for multimedia applications.
CO5	Describe the concepts in multimedia communication and networking techniques

Text Books

1. Mark S. Drew, Zee Nian Li, "Fundamentals of Multimedia", Prentice Hall, 2021. (units 1-5)

Reference Books

1. Ranjan Parekh, "Principles of Multimedia", McGraw Hill Education, Second Edition, 2017
2. Shi, Yun Q., Sun, Huifang. "Image and video compression for multimedia engineering: fundamentals, algorithms, and standards", CRC Press, 2019.
3. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education, 2007.

Web Resources
- https://nptel.ac.in/courses/117/105/117105083 [units 1,2,3]
- https://nptel.ac.in/courses/117/105/117105081 [units 2,3,4]
- https://nptel.ac.in/courses/106/105/106105082 [unit 5]

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								2		3
2	3	3	2	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

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1
1. Determine the code word value for the probabilities of character set encode the string
"went$" using arithmetic coding algorithm..
        e=0.3; n=0.3; t=0.2; w=0.1; $=0.1
2. A discrete memory less source has a alphabet of five symbols whose probability are given below.
Symbol   :   A   B   C   D   E
Probability :   0.2   0.2   0.1   0.1   0.4
Compute the Huffman code and calculate the efficiency
  COURSE OUTCOME 2:
   1. Compare and contrast Color Models: RGB, CMY and LMS
   2. Explain with a neat sketch JPEG 2000 and JPEG LS
  COURSE OUTCOME 3:
   1. Elaborate in detail and compare various Video Color Transforms YUV, YIQ, YcbCr
   2. With necessary explanations compare the various Standard Digital VideoFormats :CIF ,QCIF , HDTV and UHDTV
  COURSE OUTCOME 4:
   1. Summarize on the audio compression formats MPEG 2 and MPEG 4
   2. Illustrate with necessary diagrams mp3 format and home theatre systems.
COURSE OUTCOME 5:
1. Elaborate on the protocols for multimedia Transmission and Interaction
2. Elaborate on Broadcast/Multicast Video-on-Demand and HTTP-Based Media Streaming

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21EC6709	ARM BASED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Preamble

The course "ARM based Digital Signal Processing" is offered as an elective subject in continuation with core subject Discrete Time Signal Processing. This course describes the architecture and instruction set of STM32F405XX processor and various ARM processors to design and implement digital filters for real world applications.

Prerequisites for the course

- 21EC5603 / Discrete Time Signal Processing
- 21EC5601 / Microprocessor and Microcontroller

Objectives

1. Explore the concepts of DSP and its transform.
2. To study the function block diagram and working of STM32F405XX PROCESSOR
3. Understand the use of STM32F4 for DSP application.
4. Be familiar with the ARM fundamentals.
5. Understand the use of ARM processor for DSP application

UNIT I	DSP BASICS	9

Definition of DSP Systems - Sampling - DSP Transformations – DFT – FFT- DCT- DWT – Filters - Finite Impulse Response Filter - Infinite Impulse Response filter - Wave Digital Filters - Adaptive Filtering - DSP Functionality Characteristics- DSP Processors

UNIT II	STM32F405XX PROCESSOR	9

Introduction- Features of STM32F40XX processor - Functional overview - Pinouts and pin description - Power supply supervisor – USART – Timer and Watchdog – Electrical Characteristics – Memory Characteristics

UNIT III	STM32F4 DISCOVERY KIT FOR DSP APPLICATION	9

STM32F4, Architecture, Properties of the STM32F4 Discovery Kit - STM32Cube Embedded Software Package - STM32F407VGT6 Microcontroller Peripheral Usage - Measuring Execution Time by Setting Core Clock Frequency - STM32F4 Discovery Kit Onboard Accelerometer - The AUP Audio Card - Acquiring Sensor Data as a Digital Signal

UNIT IV	ARM FUNDAMENTALS	9

ARM7 Processor CPU Core Architecture - memory organization – addressing modes – The ARM Programmer's model - Registers – Pipeline - Interrupts – Interrupt Structure – ARM Instruction Set – Simple Assembly Programs

UNIT V	ARM PROCESSOR FOR DSP APPLICATION	9

Introduction to DSP on ARM- DSP on the ARM7TDMI- DSP on the ARM9TDMI - DSP on the StrongARM - DSP on the ARM9E - DSP on the ARM10E - DSP on the Intel XScale - FIR Filters – IIR Filters – DFT

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Examine the theory and transform methods to process discrete time signals
CO 2	Realize the architecture and mode of operation of STM32F405XX Processor
CO 3	Explore the implementation concepts of DSP using STM32F4 Discovery Kit.
CO 4	Make use of ARM7 Processor CPU Core Architecture's ALP for simple real time applications.
CO 5	Apply the theory and implementation aspects of DSP in ARM based processor platform.

Text Books

1. Cem Unsalan, M. Yerkin Yuccel, H. Deniz Gurham, "Digital Signal Processing Using ARM Cortex-M based microcontrollers, Theory and Practice", ARM Education Media, 2018. [Unit-III]
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide Designing and Optimizing System Software", 2004 by Elsevier [Unit- IV, V]
3. Roger Woods, John McAllister, Gaye Lightbody, Ying Yi, "FPGA-based Implementation of Signal Processing Systems", 2017 John Wiley & Sons, Ltd [Unit- I]
4. STM32F405xx STM32F407xx, Datasheet, August 2020 [Unit- II]

Reference Books

1. Donald S. Reay, "Digital Signal Processing Using The Arm® Cortex®-M4", 2016 by John Wiley & Sons Ltd
2. Joseph Yiu, "The Definitive Guide to ARM_ Cortex_-M3 and Cortex-M4 Processors", 2014 Elsevier Inc

Web Resources

1. https://www.youtube.com/watch?v=6dFnpz_AEyA [Unit- I]
2. https://www.ti.com/product/DRA783 [Unit- II]
3. https://www.youtube.com/watch?v=QIPQOnVablY [Unit- III]
4. https://www.youtube.com/watch?v=4VRtujwa_b8 [Unit- IV]
5. https://www.arm.com/resources/education/online-courses/digital-signal-processing [Unit- V]

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											3
2	3	3	3											3
3	3	3	3	3										3
4	3	3	3	2	2									3
5	3	2	3	3										3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1

1. If the system is initially relaxed at time n=0 and memory equals to zero, then the response of such state is called as _____
2. An LTI system is said to be causal if and only if?

COURSE OUTCOME 2:
1. In the branch instructions of STM32F405XX, what does the mnemonic BVC imply?
2. In STM32F405XX Processor, which memory segment provides interfacing to external memory mapped peripherals and also serves as extra data storage space?

COURSE OUTCOME 3:
1. How are the instructions executed in STM32F405XX DSP Processor?
2. In the process of pipelining, which instructions are fetched from the memory by the STM32F405XX DSP Processor during the execution of current instruction?

COURSE OUTCOME 4:
1. In ARM processor, which operation/s is/are performed by Compare Select & Store Unit (CSSU)?
2. In ARM7 architecture, how many previously executed instructions are stored in instruction cache of cache memory?

COURSE OUTCOME 5:
1. Which interrupt controller is present in ARM9E processor?
2. What does API stand for?

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21EC6710	BLOCKCHAIN PRINCIPLES	L	T	P	C
		3	0	0	3

Preamble

Blockchain Principles course is designed with five objectives as follows. i). to recall the basics of Cryptography and to study the basics of blockchain, ii). to understand the bitcoin and the benefits of blockchain outside of currencies, iii). to review the Blockchain Technology for IoT Applications, iv). to familiarize Blockchain Technology for Smart Cities. v). to survey Blockchain Technology for Industry 4.0

Prerequisites for the course

    21EC4604 – Principles of Computer Networks

UNIT I	BLOCKCHAIN AND CRYPTOGRAPHY	9

The growth of blockchain technology, Distributed systems, Blockchain, Symmetric Cryptography,Public Key Cryptography, Enterprise Blockchain: Enterprise solutions and blockchain, Limiting factors, Requirements, Enterprise blockchain versus public blockchain

UNIT II	BITCOIN AND BLOCKCHAIN OUTSIDE OF CURRENCIES	9

Bitcoinan overview, Cryptographic keys, Transactions, Blockchain, Mining,Blockchain Outside of Currencies: The Internet of Things, Government, Health, Finance, Media,

UNIT III	BLOCKCHAIN TECHNOLOGY FOR IOT APPLICATIONS	9

Requirement of Engineering and Its Role in a Blockchain Enabled Internet of Things, Blockchain Technology in Education Domain, A Decentralized and Autonomous Model to Administer University Examinations, Facial Recognition Data Management in Blockchain

UNIT IV	BLOCKCHAIN TECHNOLOGY FOR SMART CITIES	9

Introducing Blockchain for Smart City Technologies and Applications, Blockchain for Intelligent Gas Monitoring in Smart City Scenario, Automatic No-Helmet Penalizing System, An Architecture for e-Health Recommender Systems Based on Similarity of Patients' Symptoms

UNIT V	BLOCKCHAIN TECHNOLOGY FOR INDUSTRY 4.0	9

Blockchain and Industry 4.0: Overview, Convergence, and Analysis, Blockchain Technology for Data Management in Industry 4.0, Engineering 4.0: Future with Disruptive Technologies, The Opportunities of Blockchain in Health 4.0

Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO 1	Understand the Cryptography techniques and the basics of blockchain
CO 2	Describe the Bitcoin and applications of Blockchain Outside of Currencies
CO 3	Design the appropriate Blockchain Technology for IoT Applications
CO 4	Analyse the Blockchain Technology for Smart Cities
CO 5	Design the suitable Blockchain Technology for Industry 4.0

Text Books

1. Imran Bashir, Mastering Blockchain, Third Edition, Packt Publishing, 2020 (Unit I & II)
2. Seok-Won Lee, Irish Singh, Masoud Mohammadian, Blockchain Technology for IoT Applications, Springer, 2021 (Unit III)
3. Dhananjay Singh, Navin Singh Rajput, Blockchain Technology for Smart Cities, Springer, 2020 (Unit IV)
4. Rodrigo da Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, Blockchain Technology for Industry 4.0, Springer, 2020 (Unit V)

Reference Books

1. Antonio Fernandez Anta, Chryssis Georgiou, Maurice Herlihy, Maria Potop-Butucaru, Principles of Blockchain Systems, Morgan & Claypool Publishers, 2021
2. Bin Cao, Lei Zhang, Mugen Peng, Muhammad Ali Imran, Wireless Blockchain: Principles, Technologies and Applications, IEEE Press, 2022

Web Resources

1.https://nptel.ac.in/courses/106105235

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	3										3
2	3	3	3	3										3
3	3	3	3	2										3
4	3	3	3	3										3
5	3	3	3	2										3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Explain the Public Key Cryptography
2. Compare the enterprise blockchain versus public blockchain

COURSE OUTCOME 2:
1. Short note on Blockchain Outside of Currencies
2. Give an overview on Bitcoin

COURSE OUTCOME 3:
1. How will you use the Blockchain Technology in Education Domain?
2. Design a Facial Recognition Data stream in Blockchain

COURSE OUTCOME 4:
1. Review the Blockchain for Intelligent Gas Monitoring in Smart City Scenario
2. Analyse an Architecture for e-Health Recommender Systems Based on Similarity of Patients' Symptoms

COURSE OUTCOME 5:
1. Design a Data Management system for Industry 4.0 using Blockchain technology
2. Survey the Opportunities of Blockchain in Health 4.0

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21EC6711	AUTOMATION SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Prerequisites for the course
- 21EC6705/Sensors, Actuators and Interface Electronics

Preamble

This course helps the student to basic idea of Automation. Students are introduced to the basic design consideration of system design automation.

UNIT I	INTRODUCTION TO PROCESS AUTOMATION	9

Process Automation – paper industry, packaging industry, food processing industry, Integrated design issues in automation systems, the Mechatronics design process- benefits, modeling of electromechanical systems, bond graph technique, Automation migration strategy - building blocks of automation systems.

UNIT II	SELECTION OF MOTION COMPONENTS	9

Selection of motor for automation system, Calculation of inertia force for motor, LM Guide ways, Ball screws, Selection, from the manufacturer's catalogue based on the applications.

UNIT III	TRANSFER LINES AND AUTOMATED ASSEMBLY	9

General terminology-takt time, setup time and cycle time, Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines - modular fixturing - Flow line balancing.

UNIT IV	DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY	9

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion, Analysis of an assembly, General rules for product design for automation – Application of high speed automatic assembly.

UNIT V	SYSTEM INTEGRATION	9

Issues and systematic approaches, design and simulation using CIROS software, economics of automation systems design and implementation

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Familiarise with process automation.
CO2	Understand the different types of motion components.
CO3	Understand the different types of transfer lines and automated assembly
CO4	Discuss about the design for hight speed automatic assembly
CO5	Describe the system integration.

Text Books

1. Mikell P Groove, "Automation Production Systems and Computer Integrated Manufacturing", Pearson education, New Delhi, 2016.
2. Geoffery Boothroyd, "Assembly Automation and Product Design", CRC Press, USA, 2016

Reference Books

1. Devadas Shetty , "Mechatronics System Design", PWS Publishing Company, USA, 2010.
2. Wilfried Voss, "A Comprehensible Guide to Servo Motor Sizing", Copperhill Technologies Corporation, Massachusetts, 2007.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc22_me123/preview
2. 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	3	3	3	2							3	3	3
2	3	3	3	2	2	1						3	3	3
3	3	3	3	2	2	2						3	3	3
4	3	3	3	3	3	3	3					3	3	3
5	3	3	3	1	1	2	3	1	1	1	1	3	3	3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. List the levels of Process automation. (Understand)
2. Analyze the benefits of design process. (Analyze)

COURSE OUTCOME 2:
1. State the process of selection of motor(Understand)
2. Write the procedure for calculation interia force (Analyze)

COURSE OUTCOME 3:
1. State about takt time, setup time and cycle time. (Apply)
2. Discuss about automated assembly (Analyze)

COURSE OUTCOME 4:
1. Discuss about Process automation. (Analyze)
2. Write the general rules for product design for automation. (Remember)

COURSE OUTCOME 5:
1. Issues and systematic approaches, design and simulation   using CIROS software. (Analyze)
2. Explain about economics of automation systems design and implementation (Understand)

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21EC6712	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

Preamble
- This course starts with a brief introduction to analog design and explains about MOS devices characteristics, MOS transistors, current mirrors and CMOS Op Amp.
- It also covers the ideas underlying the characteristics of noise, feedback topologies and switched circuits.

Prerequisites for the course
- 21EC3601/ Analog Electronics

Objectives
1. To learn about the characteristics and model of MOS devices
2. To familiarize the concepts of analog CMOS circuits, switches and current mirrors
3. To gain knowledge on CMOS amplifiers, Op Amps and their characteristics
4. To analyze the frequency response of amplifiers, representation of noise and effect of feedback
5. To learn the concepts of switched capacitor circuits

UNIT I	MOS DEVICE PHYSICS	9

Introduction to Analog Design - General consideration of MOS devices – MOS IV Characteristics – Second Order Effects-MOS Device Model – MOS device layout - Device capacitance- Small signal model- Spice models- NMOS versus PMOS devices – Long channel versus short channel devices

UNIT II	ANALOG CMOS SUB CIRCUITS AND CURRENT MIRRORS	9

MOS Transistor - nMOS and pMOS Transistor – MOS Switch- MOS Diode- Current Sinks and Sources - Basic current mirrors - Cascode current mirrors -Active current mirrors - Current and voltage references – Bandgap references

UNIT III	CMOS AMPLIFIERS AND OPAMPS	9

Differential amplifiers – Cascode amplifiers – Current amplifiers – Output amplifiers - High gain amplifier architectures – Design of CMOS OpAmps- Design of two stage OpAmps – Cascode OpAmps – High speed/frequency OpAmps – Differential output OpAmps - micropower OpAmps- Low noise OpAmps – Low voltage OpAmps.

UNIT IV	FREQUENCY RESPONSE OF AMPLIFIERS, NOISE AND EFFECT OF FEEDBACK	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 - Representation of noise in circuits - Noise in single stage amplifiers - Noise in differential pairs - Noise Bandwidth- Feedback topologies - Effect of loading - Effect of feedback on Noise.

UNIT V	SWITCHED CAPACITOR CIRCUITS	9

Switched capacitor circuits - Switched capacitor amplifiers - Switched capacitor integrators- z-Domain models of two phase switched capacitor circuits – First order switched capacitor circuits-Second order switched capacitor circuits- CMOS processing technology – Layout and packaging

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
Descriptive Answers- CAT-1, CAT-2	Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	Descriptive Answers

Outcomes

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

CO1	Analyze the characteristics and model of MOS devices
CO2	Elucidate the concepts of analog CMOS circuits, switches and current mirrors
CO3	Design various types of CMOS amplifiers and OpAmps
CO4	Determine of the frequency response of amplifiers, representation of noise and effect of feedback
CO5	Design various levels of switched capacitor circuits

Text Books

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001, 33rd reprint, 2016 [Unit I-V].

Reference Books

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Second Edition, Oxford University Press, 2004.
2. R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley – Blackwell, 2019.
3. A.B.Bhattacharyya, "Compact MOSFET Models for VLSI Design", John Wiley & Sons Ltd., 2009.
4. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009
5. Mikael Sahrling, "Analog Circuit Simulators for IC Designers", Springer, 2020.

Web Resources

1. https://nptel.ac.in/courses/117/101/117101105/
2. https://onlinecourses.nptel.ac.in/noc21ee51/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	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2	3	3	2	2								3	
2	2	3	3	2									3	

3	3	3	2	2			2	1					3	
4	2	3	2	2			2	1					3	
5	1	3	3	2	2		1	1					3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
   1. Demonstrate MOS device model with necessary illustrations (Analyze)
COURSE OUTCOME 2:
  1. Describe the large signal analysis of active current mirror (Understand)
COURSE OUTCOME 3:
   1. Design a two stage CMOS amplifier to meet the important specifications. (Analyze)
COURSE OUTCOME 4:
   1. Explore the different feedback topologies (Analyze)
COURSE OUTCOME 5:
   1. Categorize the first order and second order switched capacitor circuits (Analyze)

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List of Professional Electives Courses

S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective IV								
1	21EC7701	Design and Fabrication of Electronic Product	7	3	0	0	3	Electronics
2	21EC7702	Broadband Access Technologies	7	3	0	0	3	Communication
3	21EC7703	IoT System Design and Applications	7	3	0	0	3	Embedded
4	21EC7704	Ad hoc and Wireless Sensor Networks	7	3	0	0	3	Networks
5	21EC7705	Deep Learning Techniques for computer vision	7	3	0	0	3	Robotics
6	21EC7706	Lowpower SOC	7	3	0	0	3	Semiconductor

21EC7701	**DESIGN AND FABRICATION OF ELECTRONIC PRODUCT**	L	T	P	C
		3	0	0	3

Preamble

- The aim of this course is to enable students to gain practical experience & nurture their creativity in electronic product design & the objective is to provide students with a clear understanding of the practical design problems of the electronic products at an introductory level. With this course, students are expected to become familiar with the concept of designing a product as per the requirements (non-technical) & given specifications (technical), component tolerances, production constraints, safety requirements & EMC standards.

Prerequisites for the course

- 21EC3601/ Analog Electronics

Objective

- The primary objective of this course is to understand the steps and process of the electronics product design. Learning the integration of electronics product design and development from the industry experts.

UNIT I	INTRODUCTION TO ELECTRONIC PRODUCT DESIGN	9

Man-machine dialog & industrial design, user-centered design, elements of successful design, cognition, ergonomics, packaging & factors; design for manufacture, assembly & disassembly wiring, temperature, vibration & shock; safety, noise, energy coupling, grounding, earthing, filtering & shielding

UNIT II	HARDWARE DESIGN & TESTING METHODS	9

Design process, identifying the requirements, formulating specifications, design specifications, system partitioning, functional design, architectural design, functional model v/s architectural model, prototyping, performance & efficiency measures, formulating a test plan, writing all the specifications, test procedures & test cases, design reviews, module debug & testing – black box testing, white box testing, grey box testing

UNIT III	SOFTWARE DESIGN & TESTING METHODS	9

Types of software, the waterfall model of software development, models, metrics & software limitations, risk abatement & failure prevention, software bugs & testing, good programming practice, user interface, embedded & real-time software

UNIT IV	PRINTED CIRCUIT BOARD (PCB) DESIGNING	9

Fundamental definitions, standards, routing topology configuration, layer stack up assignment, grounding methodologies, aspect ratio, image planes, functional partitioning, critical frequency & bypassing, decoupling; design techniques for ESD protection, guardband & guard-rings

UNIT V	PRODUCT DEBUGGING & TESTING	9

Steps of debugging, the techniques for troubleshooting, characterization, electromechanical components, passive components, active components, active devices, operational amplifier, analog-to-digital conversion, digital components, inspection & testing of components, process of simulation, prototyping & testing, integration, validation & verification, EMI & EMC issues

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the electronic products using user-centered designing processes
CO2	Express the essential design & production procedures of electronic products
CO3	Design a prototype for meeting a particular requirement / specification
CO4	Implement the problem solving & troubleshooting skills in electronic product design
CO5	Implement the relevant set of design documentation & present it as a case study

Text Books

1. LR. G. Kaduskar & V. B. Baru, Electronic Product Design, 3rd edition, Wiley India [Unit- I-V]

Reference Books

1. F Robert J. Herrick, PCB Design Techniques for EMC Compliance, 2nd edition, IEEE Press, 1999
2. G. C. Loveday, Electronic Testing & Fault Diagnosis, 4th edition, A. H. Wheeler Publishing J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.
3. James K. Peckol, Embedded Systems – A Contemporary Design Tool, 1st edition, Wiley Publication, 2008.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee90/preview [Unit- I- V]

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	3								1	3	

2	3	3	2	2									3	
3	3	2	3	2								1	3	
4	3	3	3	2								1	3	
5	3	3	3	1								1	3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:
1. Which phenomenon is not reduced by the circuit paths of lowest impedances especially provided by power and return planes for shielding purposes?
2. What are the factors that can affect the overall safety of the equipment?

COURSE OUTCOME 2:
1. Discuss the ergonomic & aesthetic design considerations with suitable example.
2. Which phase of 31/2 digit LED Panel meter (7107/7106) to the process of conversion reveals the averaging of signal input for about 1000 clock pulses?

COURSE OUTCOME 3:
1. The probability that a server-class application hosted on the cloud is up and running for six long months without crashing is 99.99 percentage. To analyze this type of a scenario, what test you will perform?
2. Explain the different software bugs & how to eliminate them.

COURSE OUTCOME 4:
1. What are the different PCB design considerations for microprocessor / microcontroller based circuits.
2. In the process of high-speed PCB design, which measures should be taken in consideration of EMC/EMI?

COURSE OUTCOME 5:
1. Which type of solder ability testing is carried out for the generation of solder sample due to immersion of wire or sheet metal specimen in a bath of molten solder?
2. Which element of IDE performs the debugging integration as well as tracking of code execution?

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21EC7702	**BROADBAND ACCESS TECHNOLOGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

Broadband technology refers to a high-speed, higher bandwidth connection to the Internet than is offered by a standard telephone line. The greater bandwidth of a broadband connection allows for more data to be transmitted at higher speeds than a conventional telephone line.

Prerequisites for the course:
- 21EC5602/Wireless Communication Systems

Objective
- To gain insight and understand current and emerging wired and wireless Internet access technologies.
- Learn the current technology trends and system standards as well as

emerging technologies for next generation broadband access networks.

UNIT I	BROADBAND NETWORKING	9

Introduction to Broadband Networking: Services and Technology – BroadbandAccess Technologies: Digital Subscriber Line (ADSL, HDSL, RADSL, and VDSL)

UNIT II	NETWORK ARCHITECTURE	9

Access network architecture (DSLAM, ATM) - Modulation technologies (DMT) Cable Modem Service - Headend and regional network architecture (Cable Modem Termination System – CMTS, Hybrid Fiber Coax networks – HFC).

UNIT III	BROADBAND ACCESS	9

Optical Fiber-based Networks - Passive Optical Network (PON) architecture (Optical line termination, optical network terminals) - Standards (BPON, GPON, and EPON) Fixed and Mobile WiMAX: Architecture - Standards (IEEE 802.15, 802.16) Services - Comparison of broadband access techniques

UNIT IV	INTERNET PROTOCOL	9

Broadband Network Technologies - IP QoS Control Mechanisms - Resource Reservation Protocol (RSVP) - Differentiated Services - Multi-Protocol Label Switching (MPLS) - IP Multicast - IP Multimedia Sub-system (IMS) – SIP - Network and Services Convergence - Network and Services Management - Unified Communications Services - SIMPLE Presence Architecture.

UNIT V	BROADBAND SERVICES	9

Broadband Services - Services Enabled by Broadband: VoIP, IPTV, Streaming Video, VoD - VoIP - Network Architecture - Protocol Architecture for VoIP - SIP H.323 – SGCP – IPDC.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Understand the importance of broadband networking services and technologies.
CO2	Describe and compare the different broadband network access techniques of Digital Subscriber Line (DSL), cable modem service, optical fiber-based access, and broadband wireless access techniques of WiFi and WiMAX networks.
CO3	List and provide a high-level discussion on the important broadband core network technologies of MPLS and IP multicast and discuss IP QoS control mechanisms including RSVP and DiffServe.
CO4	Identify the relationship between broadband networking and the IP Multimedia Sub-system (IMS) and discuss the operation of IMS.
CO5	Discuss the important broadband services of VoIP, IPTV, streaming video, and VoD.

Text Books

5. Broadband Last Mile: Access Technologies for Multimedia Communications, edited by NikilJayant, 2005, Publisher: Taylor and Francis
6. Broadband Access Technologies by Albert A. Azzam, Niel Ransom, 1999, Publisher: McGraw-Hill Professional Publishing; 1 edition.
7. Walter j Woralski, "ADSL and DSL Technologies", McGraw Hill computer Communication series, 1998.

Reference Books

6. Broadband Optical Access Networks ByLeonid G. Kazovsky; Ning Cheng; Wei-Tao Shaw; David Gutierrez; Shing-Wa Wong, 2011, Publisher: Wiley-Interscience
7. Martin P. Clarke, "Wireless Access Network: Fixed Wireless Access and WLL network Design and operation", John Wiley & Sons 2000.

Web Resources

1. https://nptel.ac.in/courses/117101050 [Unit- I- V]

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	2							1	1	1	
2	1	2	2	2							1	1	1	
3	2	1	2	2	1							1	1	
4	2	2	2	2								1	1	
5	2	2	1	2							1	1	1	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Understand the importance of broadband networking services and technologies.

COURSE OUTCOME 2: Describe and compare the different broadband network access techniques of Digital Subscriber Line (DSL), cable modem service.

COURSE OUTCOME 3: List and provide a high-level discussion on the important broadband core network technologies of MPLS and IP multicast and discuss IP QoS control mechanisms including RSVP.

COURSE OUTCOME 4: Identify the relationship between broadband networking and the IP Multimedia Sub-system (IMS).

COURSE OUTCOME 5: Discuss the important broadband services of VoIP, IPTV, streaming video, and VoD.

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21EC7703	IOT SYSTEM DESIGN AND APPLICATIONS	L	T	P	C
		3	0	0	3

Preamble

- This Course leverages a three-part approach for teaching the fundamentals of IoT. Part I provides a high-level overview of IoT and what you need to know from a design perspective. Part II takes you through the technical building blocks of IoT, including the pertinent technologies and protocols. Finally, Part III steps you through common industry use cases so you can see how IoT is applied in the real world.

Prerequisites for the course

- 21EC5601 / Microprocessor and Microcontroller

Objective

- To express the concept of IoT.
- To explain the communication models and various protocols for IoT.

- To Design portable IoT using Arduino/Raspberry Pi /open platform.
- To apply data analytics and use cloud offerings related to IoT.
- To design the applications of IoT in real time scenario.

UNIT I	INTRODUCTION TO INTERNET OF THINGS	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

UNIT II	COMPONENTS IN INTERNET OF THINGS	9

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee,Wifi, GPS, GSM Modules)

UNIT III	PROTOCOLS AND TECHNOLOGIES BEHIND IOT	9

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT IV	OPEN PLATFORMS AND PROGRAMMING	9

IOT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT V	IOT APPLICATIONS	9

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Express the concept of IoT.
CO2	Explain the communication models and various protocols for IoT.
CO3	Design portable IoT using Arduino/Raspberry Pi /open platform.
CO4	Apply data analytics and use cloud offerings related to IoT.
CO5	Design the applications of IoT in real time scenario.

Text Books

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017. [Unit- I-V]

Reference Books

1. Perry Lea, "Internet of things for architects", Packt, 2018
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Web Resources

1. https://archive.nptel.ac.in/courses/106/105/106105166/ [Unit- I- V]

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										3	
2	3	3	3										3	
3	3	3	3										3	
4	3	3	3		3								3	
5	3	3	3	2	2	2							3	

COURSE LEVEL ASSESSMENT QUESTIONS
 COURSE OUTCOME 1:
  1. Formulate the logical design of IoT with explanation.
  2. Summarize the various IoT enabled technologies
 COURSE OUTCOME 2:
  1. Explain the various functional blocks of IoT eco systems.
  2. Discuss about the following in detail a) Sensors and Actuators. b) Connecting Smart Objects.
 COURSE OUTCOME 3:
 1. Design an RFID-based inventory management system for a warehouse. The system should track and monitor the movement of products using RFID tags and readers. Explain the components required for the system, including RFID tags, readers, and a central database. Discuss the challenges and considerations involved in implementing RFID technology, such as tag selection, tag-reader communication protocols, and data security. Describe how the system would handle real-time updates of inventory levels and provide insights on stock availability. Additionally, discuss the potential benefits of using RFID technology in warehouse operations, including improved accuracy, efficiency, and inventory visibility.
 2. Compare and contrast the characteristics, advantages, and use cases of popular IoT protocols such as MQTT, CoAP, and HTTP. Discuss the key differences in terms of data transmission, messaging patterns, bandwidth utilization, and support for constrained devices. Explain how each protocol addresses the requirements of different IoT scenarios, including low-power sensor networks, real-time telemetry, and remote device management. Additionally, discuss the challenges and considerations in selecting the appropriate IoT protocol for a specific application, considering factors such as scalability, interoperability, and security.
 COURSE OUTCOME 4:
  1. Design an IoT system using Raspberry Pi or Arduino that monitors and controls the temperature and humidity levels in a greenhouse. The system should consist of sensor nodes placed inside the greenhouse, a central control unit, and cloud connectivity for remote monitoring and control. The control unit should read sensor data, regulate the greenhouse environment by controlling fans and heaters, and provide real-time data visualization on a cloud-based dashboard accessible from any device. Explain the architectural design of the system, the programming languages and frameworks you would use, how you would interface with sensors and actuators, the process of accessing GPIO pins, and how you would establish connectivity with the cloud for data transmission and remote access.
  2. Design a weather monitoring system using Raspberry Pi or Arduino that collects data from multiple sensors (such as temperature, humidity, and rainfall) and provides real-time

weather updates. The system should have a modular architecture, allowing for easy expansion of sensor types in the future. Explain the overall architecture of the system, including the choice of microcontroller, sensor integration, data storage, and how the system will provide real-time updates. Additionally, describe the programming languages and frameworks you would use to develop the system, and outline the steps involved in retrieving sensor data, processing it, and displaying the weather information to users.

COURSE OUTCOME 5:
1. Develop a design for an IoT-based health monitoring system in a smart city. How would you integrate wearable devices, data analytics, and connectivity to enable remote health monitoring and early detection of health issues?.
2. Design an IoT solution to optimize water management in a smart city. How would you monitor water usage, detect leakages, and implement smart irrigation systems for parks and gardens?

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21EC7704	ADHOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Preamble

- The Course covers the fundamentals of Adhoc networks and routing protocols .The course also deals with Node hardware and software architecture of wireless sensor networks, Routing Protocols, Localization, security and applications of wireless sensor networks.

Prerequisites for the course

- 21EC4604-Prinicples of Communication Networks.

Objective

- Learn fundamentals of Adhoc network and routing protocols
- Understand the Node hardware and software architecture of Wireless Sensor Networks.
- Have an in-depth knowledge on routing protocols for WSN's
- Understand the Localization and security issues possible in WSN's.
- Have an exposure to different applications of WSN's⍰

UNIT I	AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS	9

Issues in Ad hoc wireless networks, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequence Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV), Routing Protocols With Efficient Flooding Mechanisms, Hierarchical Routing Protocols - Fisheye State Routing Protocol.

UNIT II	NODE HARDWARE AND SOFTWARE ARCHITECTURE – WSN's	9

Architecture of Wireless Sensor Nodes - Components of Wireless Sensor Node Architecture-Common Wireless Sensor Node Architecture - Wireless Sensor Network Characteristics- Software Architecture Components- Software Development For Sensor Nodes – Tiny OS.

UNIT III	ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS	9

Topology Control Protocols - Sensor Protocol for Information via Negotiation (SPIN), LEACH Routing Protocol, Connectivity-Guaranteed and Energy Efficient Protocol - Connectivity-Guaranteed Protocol, Density-Aware Clustering Protocol.

UNIT IV	LOCALIZATION AND SECURITY IN WIRELESS SENSOR NETWORKS	9

Hop-Count-Based Expectation of Distance Localization, Voronoi-Based Localization in MSNs, Security in WSN's-Node Constraints , Network Constraints, Security Goals, Attacks on sensor networks, The Secure Triple-Key Management Scheme

UNIT V	WIRELESS SENSOR NETWORKS - APPLICATIONS	9

Wireless Body Sensor Networks- Architecture of BSN- Differences between Wide Scale WSNs and BSNs, Ubiquitous Sensor Networks- WSNs on Regional Environmental Protection, Underwater wireless Sensor networks, Internet Of Things WSN's- Integrating WSNs with the Internet, Architecture of the IoT for WSNs.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Q&A

Outcomes

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

CO1	Understand fundamentals of Adhoc network and routing protocols
CO2	Explain the node hardware and software Architecture
CO3	Analyze the various routing protocols for WSN's
CO4	Investigate Localization and Security in WSN's
CO5	Examine the applications of WSN's

Text Books

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2006. [Unit- I]
2. S. R. Vijayalakshmi & S. Muruganand, Wireless Sensor Networks, Architecture, Applications, Advancements, Mercury Learning and Information,2018[Unit- II,V]
3. Senchun Chai • Zhaoyang Wang • Baihai Zhang • Lingguo Cui • Runqi Chai ,Wireless Sensor Networks, Springer ,2020 [Unit- III,IV]

Reference Books

1. Holger Karl, Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006
2. Parag Verma, Ankur Dumka, Anuj Bhardwaj, Navneet Kaur, Alaknanda Ashok, Anil Kumar Bisht, and Raksh Pal Singh Gangwar, Security Issues For Wireless Sensor Networks ,Taylor and Francis ,2022.
3. Ankur Dumka, Sandip K. Chaurasiya, Arindam Biswas, and Hardwari Lal Mandoria, A Complete Guide to Wireless Sensor Networks From Inception to Current Trends, CRC Press,2019

Web Resources

1. https://onlinecourses-archive.nptel.ac.in/noc18_cs09/preview [Unit- I- V]

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									3		3
2	3	3	3									3		3
3	3	3	3									3		3
4	3	3	3	1								2		3
5	3	1	1	1				2	2			2		3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1: Understand fundamentals of Adhoc network and routing protocols
1. Explain Routing Protocols With Efficient Flooding Mechanisms and Hierarchical Routing Protocols
2. Illustrate with necessary diagrams Ad hoc On–Demand Distance Vector Routing
   COURSE OUTCOME 2: Explain the node hardware and software Architecture
1. With necessary illustrations explain in detail node hardware architecture of WSN's
2. Summarize the Software Architecture Components- Software Development For Sensor Nodes
   COURSE OUTCOME 3: Analyze the various routing protocols for WSN's
1. Elaborate Topology control routing protocols
2. Compare and contrast Guaranteed and Energy Efficient Protocol with Density-Aware Clustering Protocol
   COURSE OUTCOME 4: Investigate Localization and Security in WSN's
1. Explain Voronoi-Based Localization in MSNs
2. Compare active attacks with passive attacks and describe Triple-Key Management Scheme
   COURSE OUTCOME 5: Examine the applications of WSN's
1. Illustrate the architecture of IOT with WSN's
2. Explain Ubiquitous wireless sensor networks

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21EC7705	**DEEP LEARNING TECHNIQUES FOR COMPUTER VISION**	**L**	**T**	**P**	**C**
		3	0	0	3

Preamble

Deep Learning for Computer Visionis the area of study dedicatedto helping computers see and understand the meaning in digital images such as photographsand videos.

Prerequisites for the course

- Basics Python Programming
- Basics of Image Processing.

Objective

- To understand the fundamentals of computer vision
- To learn about Image Preparation

- To explore Convolutional Neural Networks
- To Characterize Image Classification & Object Detection
- To apply the techniques learned on various Applications

UNIT I	INTRODUCTION TO COMPUTER VISION	9

Introduction, Challenge of Computer Vision, Tasks in Computer Vision, Promises of Deep Learning, Types of Deep Learning Network Models, Types of Computer Vision Problems, Keras Model Life-Cycle, Keras Functional Models, Standard Network Models.

UNIT II	IMAGE DATA PREPARATION	9

Loading and Manipulating Images, Manually Scaling Image Pixel Data, Loading and Manipulating Images with keras, Scaling Image Pixel Data with keras, Loading Large Datasets From Directories with Keras, Image Data Augmentation in Keras.

UNIT III	CONVOLUTIONAL NEURAL NETWORKS	9

Different Color Channel Ordering Formats, Working of Convolutional Layers, Incorporating Filter Size, Padding, and Stride, Working of Pooling Layers, CNN Milestone Architecture and its working, 1x1 Convolutions, Implementing Model Architecture, Pre-Trained Models and Transfer Learning

UNIT IV	IMAGE CLASSIFICATION & OBJECT DETECTION	9

Classification of Black and White Photos, Small Photos of Objects, Classify Dogs and Cats, Labelling Satellite Photographs, Deep Learning for Object Recognition, Object Detection With YOLOv3 and Mask R-CNN.

UNIT V	APPLICATIONS	9

Self-Driven cars, Handwritten digit recognition, Road Signs detection, Generative Models, Applications of generative models, Neural artistic style transfer, Generative Adversarial Networks, Visual dialogue model.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
- Descriptive Answers- CAT-1, CAT-2	- Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	- Descriptive Answers

Outcomes

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

CO1	Understand how deep learning and computer vision are Interconnected
CO2	Perform various operations to prepare the image for Classification
CO3	Implement Convolutional Neural Networks for performing image Classification
CO4	Detect and Classify images using Computer vision
CO5	Apply Computer Vision Techniques for Real Time Applications.

Text Books

1. Jason Brownlee, "Deep Learning for Computer Vision Image Classification, Object Detection, and Face Recognition in Python", Machine Learning Mastery, (2019)[Unit- I-IV]
2. RajalingappaaShanmugamani, "Deep Learning for Computer VisionExpert Techniques to Train Advanced Neural Networks Using TensorFlow and Keras" Packt Publishing, 2018[Unit- V]

Reference Books

1. Mohamed Elgendy, "Deep Learning for Vision Systems" Manning publisher, 2020
2. VaibhavVerdhan, "Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras", Apress, (2021)

Web Resources
1. https://onlinecourses.nptel.ac.in/noc20_cs88/preview[Unit- I- V]

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	2	2		2				3	3	
2	3	3	3	3	3	2		2				3	3	
3	3	3	3	3	3	2		2				3	3	
4	3	3	3	3	3	2		2				3	3	
5	3	3	3	3	3	2		2				3	3	

COURSE LEVEL ASSESSMENT QUESTIONS
  COURSE OUTCOME 1:
Students will be able toUnderstand how deep learning and computer vision are Interconnected **(Understand)**
1. Compare Deep Learning with Machine learning.
2. Give the Venn diagram for Deep Learning.
  COURSE OUTCOME 2: (Apply)
Students will be able toperform various operations to prepare the image for Classification
1. How is the pixel valuesnormalized to a range between zero and one?
2. What is the need of Image Data Generator in image preparation?
  COURSE OUTCOME 3: (Apply)
Students will be able toImplement Convolutional Neural Networks for performing image Classification
1. Illustrate pooling stage in convolutional network.
2. Explain feature map.
  COURSE OUTCOME 4: (Apply)
Students will be able toDetect and Classify images using Computer vision
1. What Are the Softmax and ReLU Functions?
2. What Will Happen If the Learning Rate Is Set Too Low or Too High?
  COURSE OUTCOME 5: (Apply)
Students will be able toApply Computer Vision Techniques for Real Time Applications.
1. What are the applications of GAN in computer vision?
2. What is generative art using GAN?

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21EC7706	**LOW POWER SOC DESIGN**	**L**	**T**	**P**	**C**

		3	**0**	**0**	**3**

Preamble

This course covers all major aspects of low-power design of SoCs, and addresses emerging topics related to future design. It explores the many different domains and disciplines that impact power consumption from system-level to device level.

Prerequisites for the course

- 21EC6601/ VLSI Design

Objective

This course aims to:

- Know the sources of power dissipation and need for low power designs for emerging technologies.
- Understand the concepts of Low power design techniques for digital circuits
- Analyze the power dissipations of memory and processor systems and able to adopt suitable methods for power reduction.
- Learn optimization of power in combinational and sequential logic machines for SoC Design
- Identify suitable techniques to reduce the power dissipation and design circuits with low power dissipation.

UNIT I	POWER DISSIPATION IN CMOS	9

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design, Logic level power optimization – Dynamic dissipation in CMOS

UNIT II	SOC DESIGN&LOW POWER CIRCUIT TECHNIQUES	9

System trade offs and evolution of ASIC Technology - System on chip concepts and methodology - SoC challenges and components - SoC Design Flow - On-chip buses, Power consumption in circuits, flip-flops and latches

UNIT III	DESIGN METHODOLOGY FOR MEMORY AND CORES	9

Design process for hard cores - Soft and firm cores - Designing with hard cores and soft cores - Core and SoC design examples - Embedded memories - Specification of analog circuits - A/Dconverter – Phase located loops - High I/O.Low Power Memory Design: Sources and reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM.

UNIT IV	DESIGN VALIDATION	9

Core level validation -Test benches - SoC design validation - hardware/ Software Coverification. Case Study: Validation and test of systems on chip, PAD Design.

UNIT V	SOC TESTING	9

SoC Test Issues - Testing of digital logic cores - Cores with boundary scan - Testing of microprocessor cores - r, comparison of microprocessors for power & performance, Built in self test method - testing of embedded memories. CaseStudy: Integrating BIST techniques for on-line SoC testing.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model,	• Descriptive Answers

	Assignment	

Outcomes

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

CO1	Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability
CO2	Characterize and model power consumption & understand the basic analysis methods.
CO3	Express memory sources and reduction techniques.
CO4	Interpreting Logic validation for low power
CO5	Adopt memory and software design Testing for low power.

Text Books

1. J.Rabaey, "Low Power Design Essentials (Integrated Circuits and Systems)", Springer, 2009 [Unit- I-IV]
2. Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.[Unit- V]

Reference Books

1. J.B.Kuo&J.H.Lou, "Low-voltage CMOS VLSI Circuits", Wiley, 1999.
2. Rochit Rajsunah, "System-on-a-chip: Design and Test", Artech House, 2007.
3. Prakash Raslinkar, Peter Paterson & Leena Singh, "System-on-a-chip verification: Methodology and Techniques", Kluwer Academic Publishers, 2000.
4. M.Keating, D.Flynn, R.Aitken, A, GibbonsShi, "Low Power Methodology Manual for System-on- Chip Design Series: Integrated Circuits and Systems", Springer, 2007.
5. A.Manzone, P.Bernardi, M.Grosso, M. Rebaudengo, E. Sanchez, M.S.Reorda, Centro Ricerche Fiat, "Integrating BIST techniques for on-line SoC testing, IEEE Symposium on On-Line Testing, 2005.
6. Ricardo Rels, "Design of System on Chip: Devices and Components" Springer, July 2004.

Web Resources

1.https://archive.nptel.ac.in/courses/106/105/106105034/[Unit- I- V]

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		3
2	2	1	3	3								3		3
3	3	3	3	3								3		3
4	2	2	2	3								3		3
5	2	3	3	3								3		3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Discuss about Power desipation modes in SOC?
COURSE OUTCOME 2:
1. Discuss about various low power design Techniques?
COURSE OUTCOME 3:

1. Explain various low power memory in low power VLSI?
   COURSE OUTCOME 4:
1. Illustrate about Power contribution of memory arrays in SOC?
   COURSE OUTCOME 5:
1. Discuss about Built in self test method with necessary diagram?

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List of Professional Electives Courses

S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective V								
1	21EC7707	Micro- and Nano-Fabrication Technologies	7	3	0	0	3	Electronics
2	21EC7708	Mobile Communications	7	3	0	0	3	Communication
3	21EC7709	Embedded C and Linux	7	3	0	0	3	Embedded
4	21EC7710	Cognitive Radio Networks	7	3	0	0	3	Networks
5	21EC7711	Unmanned Aerial Vehicles	7	3	0	0	3	Robotics
6	21EC7712	FPGA for Embedded System Applications	7	3	0	0	3	Semiconductor

21EC7707	MICRO- AND NANO-FABRICATION TECHNOLOGIES	L	T	P	C
		3	0	0	3

Preamble

- Microfabrication and nanofabrication are the basis of manufacturing for nearly all modern miniaturized systems that are ubiquitously used in our daily life. Examples include; computer chips and integrated sensors for monitoring our environment, cars, mobile phones, medical devices and more. Micro- and nanofabrication can be taught to students and professionals by textbooks and ex-cathedra lectures, but the real learning comes from seeing the manufacturing steps as they happen. In this engineering course, we will go a step beyond classroom teaching to not only explain the basics of each fabrication step but also show you how it's done through video sequences and zooming into the equipment.

Prerequisites for the course

- Knowledge in electronics, physics, chemistry and materials science with mathematical background

Objective

- Able to define the concepts involved in IC chip manufacturing.
- Gain knowledge on various Nano deposition technologies.
- To learn the etching technologies used in semiconductor industry.
- Emphasize on the importance of doping and surface modification.
- To define the concept of self-assembled monolayers for Nano device fabrication.

UNIT I	CRYSTAL GROWTH, WAFER PREPARATION AND EPITAXY	9

Basic steps in IC fabrication - Electronic grade silicon – crystal plane and orientation – Defects in the lattice – Czochralski crystal growing – Silicon shaping – Processing consideration – Vapour phase epitaxy – Liquid phase epitaxy - selective epitaxy - Epitaxial Evaluation.

UNIT II	DEPOSITION TECHNOLOGIES	9

Deposition processes- Thermal, Plasma and Arc physical vapour deposition, Chemical vapour deposition process- Atomic layer deposition process-Liquid phase deposition by spin coating, Spray coating, Dip coating, Sol-gel Technology.

UNIT III	ETCHING TECHNOLOGIES	9

Etching Technology basics, Wet chemical etching – process, etching of single crystal silicon, etching of insulators, semiconductors and conductors – Dry etching – physical etching, Chemical dry etching, Chemical etching – powder blasting, gas cluster ion beam etching (GCIB) technology

UNIT IV	DOPING AND SURFACE MODIFICATION	9

Importance of doping and surface modification-Introduction into doping-Doping by diffusion-Doping by implantation-Doping applications-MEMS applications, Wafer Technology applications-Thermal oxidation of silicon- oxidation mechanisms, oxidation equipment and process.

UNIT V	NANOFABRICATION BY SELF-ASSEMBLY	9

Self-Assembly process- Introduction to self-assembly, Chemical, Physical and Colloidal Self-Assembly, Static and dynamic Self-assembly, Directed self-assembly-Basics, Mechanisms-Surface topography and surface wetting, Role of defects in self-assembly. Self-assembled monolayers (SAMs).

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the wafer preparation techniques in IC industry.
CO2	Explaining the fabricate thin films for the fabrication of micro and nanodevices.
CO3	Classify the etching techniques in any prepared substrates for nanofabrication.
CO4	Express the wafer technology applications and surface modification techniques.
CO5	Design the self-assembled monolayers for nanofabrication.

Text Books

1. Hans H. Gatzen, Volker Saile, JurgLeuthold, "Micro and Nano Fabrication: Tools and Processes", Springer, 2015[Unit- I-IV]
2. Sami Franssila, "Introduction to Microfabrication", Wiley Publications, 2010.[Unit- V]

Reference Books

1. Mark J. Jackson, "Microfabrication and Nano manufacturing", Taylor andFrancis Group, 2006.
2. 2. Bo Cui, "Recent advances in Nanofabrication Techniques and Applications",InTech Publisher, 2011.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_bt37/preview[Unit- I- V]

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	2											3

3	3	2	2												3
4	3	2	2												3
5	3	2	2												3

COURSE-LEVEL ASSESSMENT QUESTIONS
  COURSE OUTCOME 1:
    1. Detail explanation about the step by step procedure of IC fabrication.
    2. Explain the types and techniques used in Epitaxial growth ?
  COURSE OUTCOME 2:
    1. Demonstrate about the working process of Deposition.
    2. List the types of Deposition and explain the process one by one.
  COURSE OUTCOME 3:
    1. Explain about etching and also the working principle of Etching.
    2. Describe in detail about the physical and chemical etching
  COURSE OUTCOME 4:
    1. Explain in detail about doping and surface modification.
    2. List the real time application of doping application
  COURSE OUTCOME 5:
    1. Explain self-assembly and types of the self-assembly.
    2. Demonstrate Self-assembled monolayers.

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21EC7708	**MOBILE COMMUNICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

Mobile Communication is the use of technology that allows us to communicate with others in different locations without the use of any physical connection (wires or cables). This course provides knowledge about mobile radio propagation and wireless channel & networks. To understand the features like Scalability, Network access control, Mobile device management, Switching. Application of IoT are studied with related protocols and their performance

Prerequisites for the course

- 21EC4601 /Analog and Digital Communication

Objective

- Learn basic propagation of radio waves.
- Learn the parameters of wireless channels.
- Study the cellular architecture & wireless network.
- Study the Multiple Access & modulation schemes.
- Know the Applications in IOT & GSM system.

UNIT I	**MOBILE RADIO PROPAGATION**	**9**

Free space propagation model, Three basic propagation mechanisms, Reflection-Two-Ray model, Diffraction – Knife-edge diffraction model, Scattering, Log-normal shadowing, Okumara model, Hata model, Log-distance path loss model.

UNIT II	**WIRELESS CHANNELS**	**9**

Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters- Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading

UNIT III	CELLULAR ARCHITECTURE & WIRELESS NETWORK	9

Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity trunking & grade of service – Coverage and capacity improvement, overview of Wi-Fi, WiMAX and bluetooth technology

UNIT IV	MODULATION AND MULTIPLE ACCESS SCHEMES	9

OFDM, Spread Spectrum Systems-DSSS, FHSS, RAKE receiver, Access methods - FDMA, TDMA - CDMA -SDMA and CSMA, Diversity Techniques

UNIT V	GSM SYSTEM & APPLICATIONS IN IOT	9

GSM- architecture, GPRS, IoT System for weather monitoring-IoT System for home automation-Wi-Fi-controlled Mobile Robot - Remote Energy Monitoring and Control Device

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Understand the basic propagation mechanism of Radio Waves
CO2	Be aware of the various channel parameters of wireless
CO3	Comprehend the Cellular Architecture & wireless network
CO4	Realize the Modulation and Multiple Access schemes in Cellular Communication
CO5	Identify with the Applications in IOT & GSM.

Text Books

1. Rappaport,T.S., "Wireless communications", Pearson Education, Second Edition, 2010. [Unit-1 to 4]
2. Adrain Mc Ewen, Hakim Cassimally, "Designing the Internet of Things", Wiley, 2014. [Unit-5]

Reference Books

1. Samuel Y. Lee, "Mobile Communication Engineering", McGraw Hill, 1998. [Unit-1 to 4]
2. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014. [Unit-5]

Web Resources

1. https://nptel.ac.in/courses/117106108/
2. https://nptel.ac.in/courses/117/102/117102062/
3. https://nptel.ac.in/courses/106/106/106106167/
4. https://nptel.ac.in/courses/108/105/108105134/

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		3
2	3	3	3	2										3
3	3	2	3	2	2									3
4	3	2	2	3	3									3
5	3		3	2	2							3		3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Design of Okumara model & Hata model.
2. Explain in details about Knife-edge diffraction model.
COURSE OUTCOME 2:
1. Give explanation in details about Fading due to Doppler spread.
2. Analyse the demerits of fading due to Multipath time delay spread.
COURSE OUTCOME 3:
1. Explain about interference & system capacity trunking
2. Discuss about bluetooth technology
COURSE OUTCOME 4:
1. Compare the features of FDMA, TDMA - CDMA -SDMA and CSMA
2. Analyze the Diversity Techniques
COURSE OUTCOME 5:
1. Brief explanation about GSM- architecture
2. Explain any one IoT System for home automation

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21EC7709	EMBEDDED C AND LINUX	L	T	P	C
		3	0	0	3

Preamble

- This course deals with using Linux OS for embedded systems. Fundamentals of Linux and porting Linux to independent processor platforms are taught.

Prerequisites for the course

- 21CS1501/ Problem Solving and Logical Thinking using C

Objective

- Acquire skill to use and know Linux operating system
- Acquire skill to write programs in C and Scripting languages; interface with Git repository
- Get knowledge on embedded Linux; software development process for embedded Linux.
- Know the methods of software design for Embedded Linux
- Acquire skill of writing embedded applications, in Linux platform

UNIT I	LINUX ESSENTIAL	9

Introduction to Linux - Linux file system architecture - Linux commands : User level - System level (Superuser specific) - "vi" text editor; its commands - "gedit" text editor; its Commands - Introduction to "bash"; the Borne shell - Shell programming - Important system commands & its use - Demo: Linux shell programming.

UNIT II	LINUX PROGRAMMING FUNDAMENTALS	9

Introduction to "C" w.r.t GNU C compiler - GNU Tool chain: introduction & installation - Editing source code in C with "gedit" or IDE - Compiling and building executable - Introduction to "gdb" -

Running the program; on terminal; using gdb - Introduction to Git repository - Cloning files from Git Hub - Git essentials - Advanced Git features - Demo: Programming using Git hub

UNIT III	ELEMENTS OF EMBEDDED LINUX	9

Introduction to embedded Linux; cross platform tools - Sample programs for cross platform use - Booting process and boot loader - Linux kernel; introduction - Porting and configuring the kernel - Simple typical kernel programming - Building root file system - Selecting a build system; build process - Demo: Simple kernel programs

UNIT IV	SYSTEM ARCHITECTURES AND DESIGN CHOICES	9

Embedded system storage; choosing the parameters - Flash memory and system memory operation - Access time considerations - Introduction to device drivers; identifying and using them - Internals and architecture of device drivers - Writing sample device driver; char device - block device - Debugging the device driver - Making the "init" - Demo: Kernel programming; device driver programming

UNIT V	WRITING EMBEDDED APPLICATIONS	9

Process and threads - POSIX thread commands; syntax and use - Memory allocation and management; leak detection - GDB debugging revisited - FT- Trace utility and its use in debugging - Use of graphics plotting tools; - Installing and using FT trace utilities - Debug/test data collection and profiling - Real time Linux

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Understand the Linux OS and work with the command line.
CO2	Write C programs and Interfacing with Git repository
CO3	Understand the GNU development tool chain and some basic C programming and shell programming.
CO4	Build flash based embedded Linux system to work with typical micro controller board
CO5	Develop, test, debug and profile embedded application programs

Text Books

1. Karim Yaghmour, Jon Masters, Gillad Ben Yossef, Philippe Gerum, "Building embedded Linux systems", O'Reilly, 2008 [Unit- I-V]
2. Chris Simonds, "Mastering Embedded Linux Programming", Packt Publishing, Open source, 2015 [Unit- I-V]

Reference Books

1. Richard Stones, Neil Mathew, "Begining Linux Programming", Wiley Publications, 4th edition, 2008.
2. Willam Rothwell, "Jump start your Linux programming skills", Addison Wesley, 2017

Web Resources

1. https://www.youtube.com/watch?v=9vsu67uMcko
2. https://www.youtube.com/watch?v=akU1Ji8Vzdk [Unit- I- V]

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									3
2	3	2	2		3									3
3	1		3	3	3									3
4		2	3	3	3									3
5		2	3	3	3									3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. A Linux computer has no access to the internet. Which command displays information about the network gateway for the system?
2. What is the purpose of conditional expressions in shell scripts?.
COURSE OUTCOME 2:
1. If a software release is in a state in that it has many new features that have not been rigorously tested, it is typically referred to as beta software. True or False?
2. Applications make requests to the kernel and receive resources, such as memory, CPU, and disk in return. True or False?
COURSE OUTCOME 3:
1. What are the main components of the Linux kernel?
2. How does the Linux kernel handle memory management?
COURSE OUTCOME 4:
1. Mention what are the essential components of embedded system?
2. Describe the process of creating a character device driver in Linux.
COURSE OUTCOME 5:
1. How do you write a basic kernel module in Linux?
2. Describe the Linux kernel's virtual memory management system.

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21EC7710	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

Prerequisites for the course
- 21EC5704/Wireless Networks

Preamble
- Cognitive Radio is a concept introduced to attack the upcoming spectrum crunch issue and make opportunistic use of spectrum. It is an emerging field. It is useful for students to understand basic concepts about technology. There are various research opportunities and challenges in Cognitive Radio. The resource allocation & its optimization under various constraints is required to improve system performance.

UNIT I	INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO	9

Introduction – Software Defined Radio - Evolution of Software Defined Radio. Cognitive radio-Evolution of Cognitive radio. Key application- Interoperability, Dynamic Spectrum Access. Radio Frequency Spectrum- Regulatory History and Successes, Emerging Regulatory Challenges and Actions, Spectrum Measurements and Usage, Applications for Spectrum Occupancy Data.

UNIT II	COGNITIVE RADIO ARCHITECTURE	9

Functions, Components and Design Rules-Cognition cycle – orient, plan, decide and act phases, Building the CRA on SDR Architectures, Software Defined Radio Architectures for Cognitive Radios-SDR Architectures, Software Tunable Analog Radio Components.

UNIT III	SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS	9

Introduction – Primary Signal detection – energy detector, Cyclostationary Feature Detector, matched filtering, cooperative Sensing and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing.

UNIT IV	MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO	9

MAC for cognitive radios –Multichannel MAC, Slotted ALOHA, CSMA with AMC. Network layer design – Routing in cognitive radios, flow control and error control techniques.

UNIT V	ADVANCED TOPICS IN COGNITIVE RADIO	9

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, GNU radio for cognitive radio experimentation.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers-CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Express the principles of software defined radio and cognitive radio.
CO2	Explain the principles of cognitive radio architecture
CO3	Express the algorithms for cognitive radio spectrum sensing and dynamic spectrum access
CO4	Design of MAC and Network Layer Error Control
CO5	Explain the advanced features of cognitive radio for real world applications.

Text Books

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, "Cognitive Radio Communications and Networks", Academic Press, Elsevier, 2010. (Unit I, III and V)

2. Huseyin Arslan (Ed.), "Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007. (Unit II)

Reference Books

1. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley and Sons, 2009. (Unit –IV)
2. Bruce Fette, "Cognitive Radio Technology", Newnes, 2006

Web Resources
1. https://nptel.ac.in/courses/108/107/108107107/

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											3
2	3	2	3											3
3	3	2	3											3
4	3	3	3											3
5	3	2	3											3

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:
1. Experiment the regulatory issues of cognitive access in details. (Analyze)
2. Discuss the future of CR as a technology for the development of new applications. (Understand)

COURSE OUTCOME 2:
1. Demonstrate how the SDR Architectures used to Build the Cognitive Radio (Apply)
2. Conclude the need of Software Tunable Analog Radio Components in the Cognitive Radio Structure. (Analyze)

COURSE OUTCOME 3:
1. Infer the Primary User Detection and Feature Detection Methods in Spectrum Sensing.. (Understand)
2. Demonstrate Fundamental Limits of Cognitive Radios with suitable examples. (Apply)

COURSE OUTCOME 4:
1. In a CSMA/CA network with a data rate of 10 Mbps, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What should be the minimum frame size if we increase the data rate to
   A) 100 Mbps? B) 1 Gbps? C) 10 Gbps?. (Analyze)
2. Compose the method used for Network layer design and routing in cognitive radios (Apply)

COURSE OUTCOME 5:
1. Experiment the Public Safety in cognitive radio networks. (Analyze)
2. Demonstrate the real time need for Highly Securable Cognitive Radio Networks. (Apply)

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21EC7711	UNMANNED AERIAL VEHICLES	L	T	P	C
		3	0	0	3

Preamble

- This course introduces students to the control of unmanned aerial vehicles (UAVs). The course will cover modeling and dynamics of aerial vehicles, and common control strategies. Laboratory exercises allow students to apply knowledge on a real system, by programming a microcontroller to control a UAV.

Prerequisites for the course

- 21EC5601/M icroprocessor and Microcontroller

Objective

- The objective of this Course is to understand the features of UAV, elements, navigation and guidance of UAV and to design and simulate UAV

UNIT I	INTRODUCTION TO UAV	9

Definition, History; Difference between aircraft and UAV; DGCA Classification of UAVs; Types and Characteristics of Drones: Fixed, Multi-rotor, and Flapping Wing; Applications: Defense, Civil, Environmental monitoring.

UNIT II	BASICS OF FLIGHT	9

Different types of flight vehicles; Components and functions of an airplane; Forces acting on Airplane; Physical properties and structure of the atmosphere; Aerodynamics – aerofoil nomenclature, aerofoil characteristics, Angle of attack, Mach number, Lift and Drag, Propulsion and airplane structures.

UNIT III	UAV ELEMENTS, NAVIGATION AND GUIDANCE	9

Components: Arms, motors, propellers, electronic speed controller (ESC), flight controller; Propulsion; Data Link; Sensors and Payloads: GPS, IMU, Light Detection and Ranging (LiDAR), Imaging cameras, Classification of payload based on applications; Hyper-spectral sensors; Laser Detection and Range (LADAR); Synthetic Aperture Radar (SAR); Thermal cameras; ultra-sonic detectors; Case study on payloads.

UNIT IV	DESIGN & SIMULATION OF UAV	9

Introduction to CAD; Design of UAV components; Structural Analysis using CAE; Aerodynamic Analysis using CFD; Manufacturing of the components of UAVs: 3D printing; Case studies

UNIT V	MISSION PLANNING AND CONTROL:	9

Mission Planning and Control: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Tradeoffs

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the types and characteristics of UAVs and their applications
CO2	Illustrate the concepts of aerodynamics of flight vehicle.

CO3	Identify and explain the components, sensors and payload of UAVs, their navigation and guidance.	
CO4	Design and perform structural, aerodynamic analysis of UAV components	
CO5	Explain the stages and control of aerial vehicles	

Text Books

1. Andey Lennon, "Basics of R/C Model Aircraft Design" Model Airplane News Publication" Motorbooks Intl Publications 1996
2. John Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publications 2015

Reference Books

1. K Valavanis, George J Vachtsevanos, Handbook of Unmanned Aerial Vehicles, New York, Springer, Boston, Massachusetts: Credo Reference, 2016.
2. DGCA RPAS Guidance Manual, Revision 3 - 2020

Web Resources

1. https://www.digimat.in/nptel/courses/video/101104073/L01.html
2. http://www.digimat.in/nptel/courses/video/101104073/L06.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	1									3	3	
2	3	2	1									3	3	
3	3	1	2									3	3	
4	3	2	1									3	3	
5	3	2	1									3	3	

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. State and explain the different types of Drones with respect to physical appearance
2. Discuss about the ' Air vehicle' in UAV system functional structure (system composition)

COURSE OUTCOME 2:

1. Discuss 'Coaxial Rotor' airframe with necessary diagram
2. Explain 'Ducted Fan Aircraft' and 'Jet-life Aircraft' airframe configurations

COURSE OUTCOME 3:

1. How communication range and height of operating UAV are related, discuss with the help of necessary diagram?
2. Discuss the most usual types of antenna to be adopted for UAS, discuss them briefly with necessary diagrams.

COURSE OUTCOME 4:

1. Write the Design procedure of UAV components
2. Using the case studies of 3 D printing how the manufacturing of the components of UAVs are done.

COURSE OUTCOME 5:

1. Enumerate the mission planning and control of Air control mechanism

2. Explain the operational behavior of Data-Link Functions and its Attributes in Air control mechanism.

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21EC7712	**FPGA FOR EMBEDDED SYSTEM APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Preamble

- FPGA stands for field-programmable gate array. It is an integrated circuit that implements code in hardware to execute a thousand times faster than in a processor. These circuits, or arrays, consist of configurable logic blocks (CLBs), memory, or other elements. In fact, Microcontrollers, FPGA and CPLD (Complex Programmable Logic Devices) are independent embedded systems with their own pros and cons within the embedded engineering discipline. Multi-Threading – FPGA can process multiple instructions at the same time.

Prerequisites for the course

- 21EC3603 - Digital Logic Design, 21EC6601 - VLSI DESIGN

Objective

- Understand and critically compare state-of-the-art design automation methodologies.
- Use computer aided design tools to synthesize a design written in VHDL and generate a bitstream for execution on an FPGA.
- Verify hardware designs at several levels in the design flow.
- Understand the need for and application of different optimization techniques, and their relative interaction within computer aided design tools.
- Take advantage of pre-existing intellectual property to reduce design time and produce more optimal results.

UNIT I	**INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN**	**9**

Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.

UNIT II	**SILICON ON CHIP DESIGN**	**9**

Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design-FPGA to ASIC conversion – Design for integration-SOC verification-Set top box SOC.

UNIT III	**PHYSICAL AND LOW POWER DESIGN**	**9**

Over view of physical design flow- tips and guideline for physical design- modern physical design techniques- power dissipation-low power design techniques and methodologies-low power design tools- tips and guideline for low power design.

UNIT IV	**FPGA Programming**	**9**

VHDL essentials: Entity: model interface, Architecture, Process, Variable types and operators, Decisions and Loops - Hierarchical design – Debugging models: Assertions – Basic data types, Simulation and Test benches - Libraries – Synthesis – Place and route – VHDL issues for FPGA design.

UNIT V	**FPGA Interfacing methods**	**9**

Serial Communication: RS232 – Camera Link Interface - ADC interface – High-speed Data Converter Using Parallel and Serial Interface - PS/2 Mouse Interface – PS/2 Keyboard Interface, VGA Interface.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the need for programmable devices.
CO2	Express the IC fabrication techniques vis-à-vis CMOS switch.
CO3	Explain the low power design techniques and methodologies.
CO4	Write VHDL programs for optimised system design using FPGA
CO5	Interface basic devices to FPGA in designing digital systems.

Text Books

1. M.J.S. Smith, "Application Specific Integrated Circuits", Pearson Education, 2020 [Unit- I-III]
2. Peter Wilson, "Design Recipes for FPGAs: Using Verilog and VHDL", Elsevier (Newnes), 2015 (Second Edition). [Unit- IV- V]

Reference Books

1. Wayne Wolf, —FPGA-Based System Design, Prentice Hall PTR, 2019.
2. Farzad Nekoogar and Faranak Nekoogar, —From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003

Web Resources

1. www.vhdl.org/rassp/vhdl/guidelines/DesignReq.pdf [Unit- I- V]
2. https://nptel.ac.in/courses/117/108/117108040/# [Unit- I- V]

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	2						1	1	3	
2	3	2	2	2							1	1	3	
3	3	2	2		3						1	1	3	
4	3	3	3	2							1	1	3	
5	3	3	3	2							1	1	3	

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:

1. Explain the different types of ASIC.
2. With block diagram explain architecture of PAK and PLA implement a 4:1 MUX with these device and compare the performances.

COURSE OUTCOME 2:
1. 1 With neat sketches explain Soc testing techniques in detail.
2. 2. Write short notes on Bluetooth radio/modem.

COURSE OUTCOME 3:
1. Explain about modern physical design techniques.
2. Describe the low power design techniques and methodologies.

COURSE OUTCOME 4:
1. Are Verilog/vhdl Concurrent Or Sequential Language In Nature?
2. What Is An Alias And Write Its Syntax?

COURSE OUTCOME 5:
1. With neat sketches explain Soc testing techniques in detail.
2. Write short notes on Bluetooth radio/modem

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List of Professional Electives Courses

S.No	Course Code	Course Name	Sem.	L	T	P	C	Stream/Domain
Professional Elective VI								
1	21EC7713	Digital Image Processing	7	3	0	0	3	Electronics
2	21EC7714	Millimeter wave Communication	7	3	0	0	3	Communication
3	21EC7715	Design using RaspBerry Pi	7	3	0	0	3	Embedded
4	21EC7716	4G & 5G Networks	7	3	0	0	3	Networks
5	21EC7717	Machine Learning Fundamentals	7	3	0	0	3	Robotics
6	21EC7718	TCAD for VLSI Circuits	7	3	0	0	3	Semiconductor

21EC7713	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Preamble

Digital image processing deals with developing a digital system that performs operations on an digital image. This course provides knowledge about digital image fundamentals & image representation. To understand the process of highlighting certain information of an image. To explain the concept of a process in which regions or features sharing similar characteristics are identified and grouped together and Image segmentation may use statistical classification, thresholding, edge detection, region detection, or any combination of these techniques

Prerequisites for the course

- 21EC5603 / Discrete Time Signal Processing

Objective

- Learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with segmentation techniques.
- Be familiar with image compression.
- Learn to represent image in form of features.

UNIT I	DIGITAL IMAGE FUNDAMENTALS	8

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color image fundamentals-RGB, HSI models

UNIT II	IMAGE ENHANCEMENT	10

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Color image Enhancement.

UNIT III	IMAGE RESTORATION AND SEGMENTATION	9

Restoration: Noise models – Mean Filters – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.
Segmentation: Region based segmentation- Morphological processing- erosion and dilation-watershed segmentation algorithm

UNIT IV	WAVELETS AND IMAGE COMPRESSION	9

Wavelets – Sub band coding - Multi resolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.

UNIT V	IMAGE REPRESENTATION AND RECOGNITION	9

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

	Total Periods	**45**

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	In depth knowledge on the basics of digital signal and system.
CO2	Detail idea on digital image fundamentals
CO3	Knowledge to use various image transform techniques.
CO4	Ability to apply various image enhancement techniques.
CO5	Potential to use image restoration and segmentation Techniques.

Text Books

1. 1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Fourth Edition, Pearson Education, 2018.

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc19_ee55/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee23/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	3	3	2										3
2	3	3	3	3	2									3
3	3	3	3	2	2									3
4	3	3	2	3	2									3
5	3	3	3	2	2									3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Provide concise narrative about Image Sampling and Quantization.
2. Illustrate about RGB, HSI models
COURSE OUTCOME 2:
1. Explain in details about Smoothing and Sharpening Spatial Filtering
2. Analyse the Butterworth and Gaussian filters
COURSE OUTCOME 3:
1. Compare Mean Filters – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters
2. Discuss about Region based segmentation**.**
COURSE OUTCOME 4:
1. Analyses the features – Image Compression models
2.Write about the Lossy Compression
COURSE OUTCOME 5:
1. Brief explanation about Topological feature, Texture and Pattern classes
2. Design any Recognition based on matching

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21EC7714	MILLIMETER WAVE COMMUNICATION	L	T	P	C
		3	0	0	3

Preamble

Future communication networks require significantly increased bandwidths in order to cope up with the ever increasing number of wireless devices and high data throughput. Today's millimeter wave technology is mature enough to handle this requirement. Millimeter wave components are usually realized by frequency scaling the microwave components. However, an engineer has to deal with several design challenges in terms of higher loss, high signal-to-noise ratio, signal distortions etc. while implementing a millimeter wave system. Primary focus of this course is to discuss the design issues at millimeter wave frequencies.

Prerequisites for the course

- 21EC5602/ Wireless Communication Systems

Objective

1. To develop a brief theoretical foundation of Mm Wave technology, its potential use in Wireless Communications and its standards.
2. To learn various channel effects in Mm Wave scenario and exposing the students to baseband techniques, antenna requirements, and Physical layer design and algorithms.
3. To get exposed to the goals and challenges of new emerging applications of Mm Wave in Wireless Communications.
4. To apply the acquired knowledge in the field of Mm Wave Wireless Communication in the future communication technologies.
5. To review the literature related to Mm wave for Wireless Communication and to report it ethically.

UNIT I	INTRODUCTION TO MILLIMETER WAVE COMMUNICATION	9

A Preview of MmWave Implementation Challenges, Emerging Applications of MmWave Communications, MmWave Standardization.

UNIT II	RADIO WAVE PROPAGATION FOR MILLIMETER WAVE	9

Large-Scale Propagation Channel Effects, SmallScale Channel Effects, Spatial Characterization of Multipath and Beam Combining, Angle Spread and Multipath Angle of Arrival, Antenna Polarization, Outdoor and Indoor Channel Models.

UNIT III	ANTENNAS AND ARRAY FOR MILLIMETER WAVE APPLICATIONS	9

Fundamentals of On-Chip and In-Package MmWave Antennas, Fundamentals of On-Chip and In-Package Milli meter Wave Antennas, InPackage Antennas, Antenna Topologies for Milli meter Wave Communications, Techniques to Improve Gain of On-Chip Antennas, Adaptive Antenna Arrays — Implementations for Milli meter Wave Communications, Characterization of On-Chip Antenna Performance.

UNIT IV	MULTI-GBPS DIGITAL BASEBAND CIRCUITS	9

Review of Sampling and Conversion for ADCs and DACs, Device Mismatches: An Inhibitor to ADCs and DACs, Goals and Challenges in ADC Design, Encoders, Trends and Architectures for MmWave Wireless ADCs, Digital to Analog Converters.

UNIT V	MILLIMETER WAVE PHYSICAL LAYER DESIGN	9

Practical Transceivers, High-Throughput PHYs, PHYs for Low Complexity, High Efficiency, Future PHY Considerations, Challenges when Networking Milli meter Wave Devices.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers-CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the fundamental concepts of Mm Wave Wireless Communication.
CO2	Analyze various channel effects in Mm Wave communication scenario and understand various design considerations.
CO3	Exposed to the goals and challenges of new emerging applications of Mm Wave in Wireless Communications
CO4	Analyze challenges and various emerging applications of Mm Waves in Wireless Communications research field.
CO5	Review the literature related to Mm wave for Wireless Communication and to report it ethically

Text Books

1. Theodore S. Rappaport, Robert W. Heath Jr., Robert C. Daniels, James N. Murdock, Millimeter Wave Wireless Communications, Prentice Hall, 2014. [Unit I-V]
2. Kao-Cheng Huang, Zhoacheng Wang, "Millimeter Wave Communication Systems", Wiley IEEE press, 2011. [Unit I-V]

Reference Books

1. Prakash Bhartia, and Inder Bahl, MmWave Engineering and Applications, Wiley Interscience

Web Resources
> 1. https://onlinecourses.nptel.ac.in/noc21_ee76

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	2	2	2	1								3
2	2	2	2	1	2	1								3
3	2	2	2	2	2	1								3
4	2	2	2	1	2	1								3
5	1	3	2	2	2	1								3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Explain about the Characteristics of Millimeter wave and their Implementation challenges.
2. Explain the applications of Millimeter wave communication
COURSE OUTCOME 2:
1. Analyze the difference between Indoor Channel models and Outdoor channel Models
2. Compare and contrast the Spatial Characterization of Multipath and Beam combining
COURSE OUTCOME 3:
1. Interpret various antenna topologies employed in Millimeter wave communication.
 2. Explain the Techniques used to Improve Gain of On-Chip Antennas.
COURSE OUTCOME 4:
1. Analyze the trends and Architectures for Milli meter Wave Wireless Analog to Digital Converters.
2. Brief out the Goals and Challenges in ADC Design, Encoders
COURSE OUTCOME 5:
   1. Explain the Challenges faced when Networking Milli meter Wave Devices and how to overcome it.
2. Discuss the physical transceivers used in physical layer design of Millimeter wave.

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		L	T	P	C
21EC7715	**DESIGN USING RASPBERRY PI**	**3**	**0**	**0**	**3**

Preamble

The aim of this course is to impart knowledge about Raspberry Pi . This course helps tounderstand the working of Raspberry Pi, its features and how various components can be used with Raspberry Pi.

Prerequisites for the course

- 21CS2501-Introduction to Computing using Python

Objective

- To explore the concepts of Raspberry Pi.
- To impart the knowledge on usage of Raspberry Pi.

- To familiarize with the networking concept of Raspberry Pi.
- To explore the working procedures of Raspberry Pi with Python..
- To learn the IOT based applications using Raspberry Pi.

UNIT I	INTRODUCTION TO RASPBERRY PI	9

Introduction–Raspberry Pi's components -Raspberry Pi's ports, Raspberry Pi 400 -Assembling -Connecting the microSD card, keyboard and mouse- Connecting to a network cable and power supply-Setting up Raspberry Pi 400

UNIT II	USING RASPBERRY PI	9

Welcome Wizard- Navigating the desktop-Chromium Web Browser-File Manager-Raspberry Pi Configuration Tool-Libre Office Productivity suite

UNIT III	GETTING STARTED WITH A RASPBERRY PI COMPUTER	9

NOOBS to set up Rasperry Pi SD card- Networking through LAN Connector- Networking via a USB Wi-Fi dongle-Connecting to the Internet through a proxy server-Connecting remotely to the Raspberry Pi over the network using VNC-Connecting to the Raspberry Pi over the network using SSH

UNIT IV	WORKING WITH RASPBERRY PI USING PYTHON	9

Python Basics –IDLE-Strings-Lists-Dictionaries-Exceptions-Modules- Classes- Methods-Inheritance-File Handling-Pickling- Internet- Design of RasPi Robot- Basic Rover- Adding a Range Finder and Screen-Assembling- Display Writing.

UNIT V	IOT APPLICATIONS USING RASPBERRY PI	9

Linux on Raspberry Pi- Raspberry Pi Interfaces- Programming Raspberry Pi with Python -Controlling LED with Raspberry Pi-Interfacing an LED and Switch with Raspberry Pi-Interfacing a Light Sensor (LDR) with Raspberry Pi.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers-CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Comprehend the fundamental concepts of Raspberry Pi.
CO2	Familiarize with the Raspberry Pi usage.
CO3	Explore the networking and user interfaces of Raspberry Pi.
CO4	Apprehend with basic foundations of Python Programming and libraries.
CO5	Model the IOT based applications using Raspberry Pi.

Text Books

1. Gareth Halfacree "The Official Raspberry Pi Beginner's Guide"–4th Edition ,Raspberry Pi Press, 2020. [Unit- I-III]
2. Simon Monk, "Programming the Raspberry Pi Getting started with python" Tata McGraw Hill, 2013. [Unit- IV]
3. Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2016.[Unit-V]

Reference Books
1.Eben Upton and Gareth Halfacree, "Raspberry Pi User Guide", 4th edition, John Wiley & Sons, August 2016.
2. Alex Bradbury and Ben Everard, "Learning Python with Raspberry Pi", JohnWiley & SonsRobert, 2014.
3. Simon Monk. "Raspberry Pi Cookbook",First edition ,Orielly, 2013.

Web Resources
1. http://www.digimat.in/nptel/courses/video/106105166/L28.html
2. https://www.digimat.in/nptel/courses/video/106105166/L29.html
3. https://www.youtube.com/watch?v=3_JWl3zbIPo
4. https://www.youtube.com/watch?v=KqNrHOXP6r0

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		1	1				1	3	
2	3	2	1	1	1		1	1				1	3	
3	3	2	1	1	1		1	1				2	3	
4	3	2	1	2	2		1	1				2	3	
5	3	2	3	2	3		1	1				1	3	

 COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. Every time you reboot your Raspberry Pi, you have to log in and then start the desktop manually. Is it possible to make this automatic? If so then brief the technique to do the same.

COURSE OUTCOME 2:
1. Comment on: If your TV or monitor doesn't have an HDMI connector, that doesn't mean you can't use Raspberry Pi.

 COURSE OUTCOME 3:
1. When an operating system is written to a Raspberry Pi's SD card, the partition size is fixed by the image installed and it cannot use the whole of the SD card. This leaves little room for user files. Fix this issue.

 COURSE OUTCOME 4:
1. Sometimes when you press the button on a switch, the expected action happens more than once, because the switch contacts bounce. Consider this case andwrite code to de-bounce the switch using python.

COURSE OUTCOME 5:
1. Construct the facial recognition system using Raspberry pi.This system will be set on your door lock so that a person who tries to enter your home and office must need to pass a facial recognition check and you may control this.

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21EC7716	4G & 5G NETWORKS	L	T	P	C
		3	0	0	3

Preamble

- This course aims to introduce students about basic theory and principles of wireless communication systems in general and cellular systems in particular.

Prerequisites for the course

- 21EC5602/Wireless Communication Systems

Objective

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks

UNIT I	EVOLUTION OF WIRELESS NETWORKS	9

Networks evolution: 2G, 3G, 4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core (NG-core), visualized Evolved Packet core (vEPC).

UNIT II	5G CONCEPTS AND CHALLENGES	9

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio andcloud technologies, Radio Access Technologies (RATs), EPC for 5G. .

UNIT III	NETWORK ARCHITECTURE AND THE PROCESSES	9

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS, NGAP, GTP-U, IPSec and GRE.

UNIT IV	DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES	9

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V	SECURITY IN 5G NETWORKS	9

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers-CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Summarize the evolution of wireless networks.
CO2	Illustrate the concepts and challenges of 5G networks.

CO3	Comprehend the 5G architecture and protocols.
CO4	Exemplify the dynamic spectrum management
CO5	Describe the security aspects in 5G networks

Text Books

1. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020. [Unit I- III]
2. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press, 2019. [Unit IV- V]

Reference Books

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material.
2. 5G system Design: An end to end Perspective, Wan Lee Anthony, Springer Publications, 2019.

Web Resources

1. https://nptel.ac.in/courses/108105134[Unit I- III]
2. https://onlinecourses.nptel.ac.in/noc21_ee102/preview[Unit IV- V]

CO Vs PO Mapping and CO Vs PSO Mapping

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

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1.   What security measures are implemented in the Evolved Packet Core for both 4G and 5G networks?
2.   What are the key differences between 4G and 5G networks?
COURSE OUTCOME 2:
1.   What are the key features and advantages of LTE (Long-Term Evolution) as a radio access technology?
2.   How does the Session Management Function (SMF) contribute to the establishment and management of sessions in the 5G core network?
COURSE OUTCOME 3:
1.   What are some real-world applications and use cases that can benefit from network slicing in the 5G architecture?
2.   How does edge computing enable real-time data processing and analytics at the network edge?
COURSE OUTCOME 4:
1.   What are the challenges and limitations associated with spectrum trading?
COURSE OUTCOME 5:

1.   What are the challenges and considerations in managing user domain security in a remote or mobile work environment?
2.   How does 5G network security differ from the security measures implemented in previous generations, such as 4G?

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21EC7717	**MACHINE LEARNING FUNDAMENTALS**	L	T	P	C
		3	0	0	3

Preamble

Machine learning is a subfield of artificial intelligence (AI). The goal of machine learning generally is to understand the structure of data and fit that data into models that can be understood and utilized by people. Although machine learning is a field within computer science, it differs from traditional computational approaches. In traditional computing, algorithms are sets of explicitly programmed instructions used by computers to calculate or problem solve. Machine learning algorithms instead allow for computers to train on data inputs and use statistical analysis in order to output values that fall within a specific range. Because of this, machine learning facilitates computers in building models from sample data in order to automate decision-making processes based on data inputs. This subject describes the common machine learning methods of supervised and unsupervised learning, and common algorithmic approaches in machine learning, including the k-nearest neighbour algorithm, decision tree learning, and deep learning.

Prerequisites for the course

- 21EC4604/ Principles of Computer Networks

Objective

- To understand the basic concepts of machine learning.
- To construct supervised learning models.
- To develop unsupervised learning algorithms.
- To evaluate and compare different network models.
- To design and analysis of machine learning experiments.

UNIT I	**INTRODUCTION TO MACHINE LEARNING**	9

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II	**SUPERVISED LEARNING**	9

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests

UNIT III	**ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING**	9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT IV	NEURAL NETWORKS	9

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout

UNIT V	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	9

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
• Descriptive Answers- CAT-1, CAT-2	• Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	• Descriptive Answers

Outcomes

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

CO1	Explain the basic concepts of machine learning.
CO2	Design supervised learning models.
CO3	Design unsupervised learning algorithms.
CO4	Analyse and compare different network models.
CO5	Design and analysis of machine learning experiments.

Text Books

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.(UNIT-1-3)
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014. (UNIT-4-5)

Reference Books

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.

Web Resources

1. https://nptel.ac.in/courses/106106139

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						2	2		2		3
2	3	3	3	2								2		3

3	3	3	2	3							2		3
4	3	3	2	3							2		3
5	3	3	2	3							2		3

COURSE LEVEL ASSESSMENT QUESTIONS
COURSE OUTCOME 1:
1. How Matrix factorization works in PCA. Explain in detail?
2. Explain the evaluation technology of machine learning algorithm?
COURSE OUTCOME 2:
1. Identify a supervised learning problem?
   a) Image classification
   b) Market segmentation
   c) Fraud detection
   d) Social network analysis
2. Discuss Linear Discriminate Analysis algorithm with neat sketch?
COURSE OUTCOME 3:
1. Summarize K-means algorithm and group the points (1, 0, 1), (1, 1, 0), (0,0,1) and (1, 1, 1) using K-means algorithm.
2. List the limitations of K-mean algorithm.
COURSE OUTCOME 4:
1. Which of the following is a type of neural network?
   Decision tree
   b) Random forest
   c) Convolutional neural network
   d) Linear regression
2. Describe vanishing gradient problem and discuss the methods to avoid this.
COURSE OUTCOME 5:
1. What is overfitting and underfitting? Which technique is used to reduce these effects on model?
2. Calculate precision, recall, F1 score and accuracy for the following cases in dataset true positive=30, True negative=20, False positive=10, False negative=15.

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21EC7718	TCAD FOR VLSI CIRCUITS	L	T	P	C
		3	0	0	3

Preamble

The TCAD for VLSI course provides an in-depth exploration of the pivotal role that Technology Computer-Aided Design (TCAD) plays in the design and optimization of Very Large Scale Integration (VLSI) circuits. This course equips students with a comprehensive understanding of semiconductor physics, device modeling, fabrication processes, and simulation techniques essential for modern VLSI design. By delving into the intricacies of TCAD tools, students will gain practical skills in simulating, analyzing, and optimizing semiconductor devices and processes to enhance circuit performance, reliability, and manufacturability.

Prerequisites for the course

- 21EC6601/ VLSI Design

Objective

- To gain a solid grasp of semiconductor physics and its impact on device behavior, enabling informed design decisions.
- To develop proficiency in using numerical techniques to simulate and analyze the electrical characteristics of semiconductor devices.
- To comprehend the intricate link between semiconductor fabrication processes and device performance, enhancing device optimization.
- To acquire expertise in creating and validating compact models for semiconductor devices, essential for accurate circuit simulations.
- To utilize TCAD tools to explore technology scaling, reliability challenges, and emerging device technologies, contributing to innovative VLSI design and informed decisions.

UNIT I	Introduction to TCAD and Semiconductor Basics	9

Overview of TCAD and its significance in VLSI design. Introduction to semiconductor physics: band theory, carrier concentration, doping. MOS and bipolar transistor operation principles.

UNIT II	Semiconductor Process and Device Simulation	9

Fundamentals of semiconductor fabrication processes: oxidation, diffusion, ion implantation. Process simulation techniques and tools. Device simulation methods using numerical techniques.

UNIT III	Device Modeling and Compact Modeling	9

Detailed study of MOS and bipolar transistor models. Development and implementation of compact models for circuit simulation. Extraction and verification of model parameters.

UNIT IV	Technology Scaling, Reliability, and Advanced Devices	9

Implications of technology scaling on VLSI design and performance. Analysis of device reliability issues: hot carriers, electromigration, oxide breakdown. Exploration of advanced devices: FinFETs, tunnel FETs, memristors.

UNIT V	TCAD Tools, Design Considerations, and Projects	9

Hands-on experience with TCAD software tools for process and device simulation. Exploring how TCAD insights impact VLSI design decisions. Design for manufacturability (DFM) concepts and techniques. Completion of a project or case study applying TCAD techniques.

	Total Periods	45

Suggestive Assessment Methods

Continuous Assessment Test (20 Marks)	Formative Assessment Test (20 Marks)	End Semester Exams (60 Marks)
- Descriptive Answers- CAT-1, CAT-2	- Quiz, MCQ, Open Book Test, Seminar, Debate, Working Model, Assignment	- Descriptive Answers

Outcomes

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

CO1	Understand the role of TCAD in VLSI design and gain foundational knowledge of semiconductor physics and transistor operation.
CO2	Acquire the ability to simulate semiconductor fabrication processes and understand device simulation methods.
CO3	Gain expertise in semiconductor device modeling and the creation of compact models for circuit simulations.
CO4	Understand the impact of technology scaling, device reliability challenges, and emerging

	advanced devices on VLSI design.
CO5	Gain practical experience with TCAD tools, understand design considerations, and apply TCAD techniques to real-world problems.

Text Books

1. Robert F. Pierret, Semiconductor Device Fundamentals, Pearson, 1996 [Unit- I- V]
2. Richard C. Jaeger, Introduction to Microelectronic Fabrication, Pearson, 2001
3. Simon Li, TCAD for Semiconductor Engineers, Springer, 2011

Reference Books

1. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer., Analysis and Design of Analog Integrated Circuits, Wiley, 2009
2. Yuan Taur and Tak H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press; 2nd edition, 2013

Web Resources

1. https://www.youtube.com/playlist?list=PL6R2tD4rOcKtPA5pqhT0hqC_n9EthrdjZ

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	3	3									3	
3	3	3	3	3									3	
4	3	3	3										3	
5	3	3	3	3									3	

COURSE LEVEL ASSESSMENT QUESTIONS

 COURSE OUTCOME 1:
1. Explain the importance of TCAD in the VLSI design process.
2. Describe the concept of energy bands in semiconductors.
3. How does doping influence the electrical behavior of semiconductors?
4. Compare and contrast the operating principles of MOS and bipolar transistors.

 COURSE OUTCOME 2:
1. Explain the steps involved in the oxidation process during semiconductor fabrication.
2. Compare and contrast diffusion and ion implantation as doping methods.
3. How are process simulation tools used to predict manufacturing outcomes?
4. Describe the numerical techniques used for device simulation and their significance.

 COURSE OUTCOME 3:
1. Explain the components of a MOSFET model and their significance.
2. Describe the process of extracting model parameters for a bipolar transistor.
3. How are compact models used in circuit simulation? Provide an example.
4. Discuss the importance of verifying model accuracy in the design process.

 COURSE OUTCOME 4:

1. How does technology scaling influence the performance and characteristics of VLSI devices?
2. Discuss the significance of hot carrier effects in MOSFETs and methods to mitigate them.
3. Explain the concept of oxide breakdown in semiconductor devices.
4. Compare FinFETs and tunnel FETs in terms of their advantages and disadvantages.

COURSE OUTCOME 5:
1. Describe the steps involved in using TCAD software for process simulation.
2. How can TCAD insights influence decisions in VLSI design? Provide examples.
3. Explain the importance of design for manufacturability (DFM) in semiconductor manufacturing.
4. Discuss the challenges and solutions faced during the completion of your TCAD project.

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SEMESTER VIII

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
Practical Courses								
1	21EC8911	Project Work – II/Startup	EEC	20	0	0	20	10
			Total	20	0	0	20	**10**