Francis Xavier Engineering College

(An Autonomous Institution)
Tirunelveli 627 003
Tamil Nadu India

Department of Electrical and Electronics Engineering

Minor/Specialization Honour Degree Courses

Robotics in Industrial Automation

R 2021-UG

Vision of the Department

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

Mission of the Department

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

List of Minor/Specialization Honour Degree Courses
Robotics in Industrial Automation

S.No	Course Code	Course Name	Sem	L	T	P	C
1	21EH401	Industry 4.0	4	3	0	0	3
	21EH501	Sensors and Actuators	5	3	0	0	3
2	21EH601	Artificial Intelligence for Robotics (Practical cum Theory)	6	2	0	4	4
4	21EH701	Digital Image Processing of Machine Vision (Practical cum Theory)	7	2	0	4	4
5	21EH801	Project	8	0	6	4	4

21EH401	Industry 4.0	L	T	P	C
		3	0	0	3

Preamble

The essential goal of Industry 4.0 is **to make manufacturing – and related industries such as logistics – faster, more efficient and more customer-centric**, while at the same time going beyond automation and optimization and detect new business opportunities and models.

Prerequisites for the course

1. Basic Engineering Knowledge

Objectives

1. Describe and show understanding of the characteristics of the 4th Industrial Revolution and digitalization.
2. Describe the impact of digitalization on the industry.
3. Describe the major technology areas within Industry 4.0 and be able to evaluate challenges and possibilities related to these.
4. Describe possible future scenarios in production based on new technologies within Industry 4.0.
5. Demonstrate the ability to carry out a practical work to theories and design of an Industry 4.0 system.

UNIT I	INTRODUCTION TO INDUSTRY 4.0	9

Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT II	INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM	9

Introduction to Cyber Physical Systems (CPS), Architecture of CPS- Components, Data science and technology for CPS, Emerging applications in CPS in different fields. Case study: Application of CPS in health care domain.

UNIT III	SMART ENERGY SOURCES	9

Energy Storage for Mitigating the Variability of Renewable Electricity Sources-Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation.

UNIT IV	SMART GRID	9

Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0.

UNIT V	SMART APPLICATIONS	9

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study-Smart Cars, Self-Driving Cars, Introducing Google‘s Self-Driving Car, Intellectual Property Rights.

Total Periods	**45**

Suggestive Assessment Methods

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

Outcomes

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

1	Understand the basic concepts of Industry 4.0 and the other related fields.
2	Understand cyber physical system and the emerging applications.
3	Analyse the different energy storage systems
4	Analyse a smart grid system.
5	Implement the industry 4.0 to solve engineering problems.

Text Books

1. Jean-Claude André, ―Industry 4.0, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, ―Handbook of Industry 4.0 and SMART Systems‖ Taylor and Francis,2020
3. Miller M, ―The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world‖, Pearson Education, 2015, ISBN: 9780134021300.

Reference Books

1. Pengwei Du and Ning Lu, ―Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs, Academic Press, 2018, Reprint edition , ISBN-13:978-0128100714
2. Hossam A. Gabbar, ―Smart Energy Grid Engineering, Academic Press, 2017, ISBN 978-0-12-805343-0.
3. Mini S. Thomas, John Douglas McDonald, ―Power System SCADA and Smart Grids‖, CRC Press, 2017

Web Recourses

1. http://www.nptel.ac.in/
2. https://link.springer.com/chapter/10.1007/978-3-319-57870-5_11
3. https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/manufacturing/ch-en-manufacturing-industry-4-0-24102014.pdf

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

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

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

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1. Discuss the general frame work of Industry 4.0
2. List any four-application area of Industry 4.0

COURSE OUTCOME 2:

1. Describe the Cyber physical system pertaining to health care application.
2. With suitable example explain CPS in health care domain.

COURSE OUTCOME 3:

1. Describe the different types of electric energy storage.
2. Discuss the potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind

COURSE OUTCOME 4:

1. Write a note on smart grid solutions.
2. List the design challenges in smart grid and Industry 4.0 integration.

COURSE OUTCOME 5:

1. Describe smart applications will illustratively examples.
2. Explain how Industry 4.0 helps in Intellectual Property Rights.

Compiled By A RAVI Verified By

21EH301	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

Preamble

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 and actuators. The main purpose of offering this course is to elaborate the theoretical aspects of sensors, their classifications, static and dynamic characteristics, recent trends and their applications in automation.

Prerequisites for the course

2. Measurements and Instrumentation
3. Electronic Devices and Integrated Circuits Design

Objectives

1. To learn the construction details, operation and characteristics of sensors.
2. To impart knowledge on inductive and capacitive transducer.
3. To familiarize on the Mechanical and Electrical actuating systems.
4. To study the construction details and operation of micro sensors and actuators
5. To impose the concept of sensor processing techniques.

UNIT I	SENSORS	9

Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal.

Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.

UNIT II	INDUCTIVE & CAPACITIVE TRANSDUCER	9

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn.

Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT III	ACTUATORS	9

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

UNIT IV	MICRO SENSORS AND MICRO ACTUATORS	9

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT V	SENSOR MATERIALS AND PROCESSING TECHNIQUES	9

Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials

Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

Total Periods	**45**

Suggestive Assessment Methods

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

Outcomes

Upon completion of the course, the students will be able to:	
1	Apply the basic concepts related to sensor, transmitter and transducer
2	Examine the characteristics and applications of inductive and capacitive transducer.
3	Illustrate various premises, approaches, procedures and selection related to actuating system.
4	Create analytical design and development solutions for micro sensors and actuators.
5	Analyse various micro fabrication and processing techniques for designing and developing sensors.

Text Books

1. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 2005.
2. Sergej Fatikow and Ulrich Rembold, "Microsystem Technology and Microbotics", First edition, Springer –Verlag NEwyork, Inc, 1997.
3. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010.

Reference Books

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2018.
2. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 2013.
3. Manfred Kohl, "Shape Memory Actuators", first edition, Springer,2013.

Web Recourses

4. https://www.es.ele.tue.nl/education/SensorsActuators/files/sensors/01-data-acquisition.pdf
5. https://github.com/agmarrugo/sensors-actuators
6. http://pages.hmc.edu/harris/class/e11/lect11.pdf

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	3	2					1				1		3	1
2	2	2					1				2		3	1
3	3	2					0				2		3	1
4	2	2					1				2		3	1
5	3	2					1				1		3	1

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	FAT 1	FAT 2	END SEM EXAM
REMEMBER	10	10	05	0	10
UNDETSTAND	30	20	05	05	30
APPLY	60	50	15	05	40
ANALYZE	0	20	0	15	20
EVALUATE	0	0	0	0	0
CREATE	0	0	0	0	0
	100	100	25	25	100

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1:

1.Examine the following static characteristics: Accuracy, Precision, Resolution, Sensitivity, backlash and Response time

2. Illustrate about construction and working of Strain gauge .

COURSE OUTCOME 2:

1.Describe the construction of LVDT and explain its principle of operation with the aid of diagram.

2.Discuss the working principle, operation and applications of Capacitor pressure sensor.

COURSE OUTCOME 3:

1.Discuss the construction and characteristics of control valves used in Hydraulic actuators.

2.Compare Mechanical and Electrical actuating systems

COURSE OUTCOME 4:

1.Describe the Motion Principle of Electrostatic Micro actuators

2.Explain in detail about the working of micro pressure sensor.

COURSE OUTCOME 5:

1. Illustrate about the chemical vapour deposition with appropriate diagrams.

2.Describe sputtering technique for deposition of thin and thick films on sensing surface

21EH401	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

Prerequisites for the course

NA

Objectives

To impart knowledge about the following topics:
The basic concepts of Artificial Intelligence.

Methods of solving problems using Artificial Intelligence.
Planning a given problem in the language/framework of different AI methods.
Learn the methods adopted in Artificial Intelligence.
Applications of AI in Robotic Applications.

Syllabus

UNIT I	INTRODUCTION	9

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

UNIT II	PROBLEM SOLVING	9

Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning–knowledge representation – first order logic.

UNIT III	PLANNING	9

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT IV	REASONING AND LEARNING	9

Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions-Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.

UNIT V	AI IN ROBOTICS	9

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

S.No	List of Experiments	CO
1	Determination of maximum and minimum position of links	1
2	Verification of transformation (Position and orientation) with	1

		respect to gripper and world coordinate system	
3		Estimation of accuracy, repeatability and resolution	**2**
4		Robot programming and simulation for pick and place	**2**
5		Robot programming and simulation for Colour identification	**3**
6		Robot programming and simulation for Shape identification	**3**
7		Robot programming and simulation for machining (cutting, welding)	**4**
8		Robot programming and simulation for writing practice	**4**
9		Robot programming and simulation for any industrial process (Packaging, Assembly)	**5**
10		Robot programming and simulation for multi process.	**5**
		Total Periods	**45 Theory +30 Lab**

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

Outcomes

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

Understand the concepts of Artificial Intelligence.
Identify appropriate AI methods to solve a given problem.
Formalize a given problem in the language/framework of different AI methods.
Summarize the learning methods adopted in AI.
Design and perform an empirical evaluation of different algorithms on a problem formalization and illustrate the applications of AI in Robotic Applications.

Text Books

Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approach", Pearson Education, India, 2021

Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: AddisonWesley, 2011.

Reference Books

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1999.

2. Robin Murphy, Robin R. Murphy, Ronald C. Arkin, "Introduction to AI Robotics", MIT Press, 2001.

Francis.X.Govers, "Artificial Intelligence for Robotics", Packt Publishing, 2018.
Huimin Lu, Xing Lu, "Artificial Intelligence and Robotics", Springer, 2017.

Web Recourses
1. **https://onlinecourses.nptel.ac.in/noc21_cs42/preview**
2. https://onlinecourses.nptel.ac.in/noc19_me71/preview

CO Vs PO Mapping and CO Vs PSO Mapping

CO		PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1		3	3	3		2				3			2	3	
CO 2		3	3	3		2				3			2	3	
CO 3		3	3	3		2				3			2	3	
CO 4		3	3	3		2				3			2	3	
CO 5		3	3	3		2				3			2	3	

1-Low, 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOM'S CATEGORY	ASSESSMENT TESTS				END SEMESTER EXAMINATION
	CAT – 1	CAT -2	FAT -1	FAT - 2	
EMEMBER	10	10	5	5	10
NDERSTAND	30	30	10	10	30
PPLY	60	60	10	10	60
NALYZE	0	0	0	0	0
VALUATE	0	0	0	0	0
REATE	0	0	0	0	0

COURSE LEVEL ASSESSMENT QUESTIONS

COURSE OUTCOME 1 (CO 1) :
What is Artificial Intelligence? (Remember) List down the characteristics of intelligent agent. (Understand)
COURSE OUTCOME 2 (CO 2) :
What are the advantages of Breadth First Search? (Remember) What is Heuristic Search? (Remember)
COURSE OUTCOME 3 (CO 3) :
Explain the components of a planning system for a simple Blocks World example. (Analyse)

State and Explain Partial order planning. (Understand)

COURSE OUTCOME 4 (CO 4) :

Explain about Adaptive learning with example? (Analyse)

Describe the Learning with macro-operators. (Understand)

COURSE OUTCOME 5 (CO 5) :

How AI is used in robotics?

What is the role of semantic analysis in NLP?

COURSE CONTENT AND LECTURE SCHEDULE

S.NO	TOPIC	NO OF HOURS REQUIRED
1	History	1
2	state of the art	1
3	Need for AI in Robotics.	2
4	Thinking and acting humanly	2
5	intelligent agents	1
6	structure of agents	2
7	Solving problems by searching	1
8	Informed search and exploration	1
9	Constraint satisfaction problems	2
10	Adversarial search, knowledge and reasoning	2
11	knowledge representation	1
12	First order logic.	2
13	Planning with forward and backward State space search	2

14	Partial order planning	2
15	Planning graphs	2
16	Planning with propositional logic	2
17	Planning and acting in real world.	1
18	Probabilistic reasoning	1
19	Filtering and prediction	1
20	Hidden Markov models–	1
21	Kalman filters	1
22	Dynamic Bayesian Networks, Speech recognition, making decisions	1
23	Forms of learning	1
24	Knowledge in learning	1
25	Statistical learning methods	1
26	Reinforcement learning, communication, perceiving and acting, Probabilistic language processing, and perception.	1
27	Robotic perception	1
28	localization, mapping	1
29	configuring space	1
30	planning uncertain movements	2
31	dynamics and control of movement	2
32	Ethics and risks of artificial intelligence in robotics.	2
33	Determination of maximum and minimum position of links	3
34	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system	3
35	Estimation of accuracy, repeatability and resolution	3
36	Robot programming and simulation for pick and place	3
37	Robot programming and simulation for Colour identification	3
38	Robot programming and simulation for Shape identification	3
39	Robot programming and simulation for machining (cutting, welding)	3
40	Robot programming and simulation for writing practice	3
41	Robot programming and simulation for any industrial process (Packaging, Assembly)	3

42	Robot programming and simulation for multi process.	3
Total		**60 Hrs**

COURSE DESIGNERS:

Faculty 1 Mrs.S.Chithra Mail ID : chithras@francisxavier.ac.in

21EH701	**Digital Image Processing of Machine Vision**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**4**

Preamble

It is an introductory course which emphasize the knowledge on Image Processing and Machine Vision

Prerequisites for the course

Digital Signal Processing

Objectives

To cover the fundamentals in digital image processing and Machine Vision

To educate the mathematical models in digital image processing and Machine Vision

To develop time and frequency domain techniques for image enhancement.

To expose the students to classification techniques in Machine Vision

To develop Applications using image processing and Machine Vision

UNIT I	**DIGITAL IMAGE FUNDAMENTALS**	**6**

Introduction – Origin – Steps in Digital Image Processing , Components, Elements of Visual Perception – Image Sensing and Acquisition, Image Sampling and Quantization – Relationships between pixels, Transformation: Orthogonal, Euclidean, Affine Color Image Processing: Color Fundamentals Color models.

UNIT II	**IMAGE ENHANCEMENT**	**6**

Image Negative, Log Transform, Power Law transform, Histogram equalization and Histogram Specification Spatial Domain: Basics of Spatial Filtering, The Mechanics of Spatial Filtering, Generating Spatial Filter Masks-Smoothing and Sharpening Spatial Filtering Frequency Domain:, The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Laplacian, Unsharp Masking and Homomorphic filters.

UNIT III	**MORPHOLOGICAL & IMAGE RESTORATION**	**6**

Morphology: Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation.Restoration :Noise models – Mean Filters – Order Statistics -Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters.		
UNIT IV	**IMAGE SEGMENTATION**	**6**
Point, Line, and Edge Detection: Detection of Isolated Points, Line detection, edge models, basic and advance edge detection, Edge linking and boundary detection , Canny's edge detection algorithm.Thresholding : Foundation, Role of illumination, Basic Global thresholding		
UNIT V	**BOUNDARY REPRESENTATION**	**6**
Region Based segmentation: Region Growing, Region Splitting and merging. Region Identification, chain code, simple geometric border representation, Fourier Transform of boundaries, Boundary description using segment sequences, B-spline representation.		
	Total Periods	**30**

Experiments

S.NO	Experiments	CO
1	Installation Python/Numpy/Matplotlib + OpenCV	1
2	Histogram Equalization	2
3	Warping	3
4	Convolution	4
5	Histogram of Oriented Gradients	4
6	Image Mosaic / Stitching	5
7	Motion Tracking	5

Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
WRITTEN TEST	1.Lab Practicals	WRITTEN TEST

Outcomes

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

1	Understand theory and models in image processing.
2	Interpret and analyze 2D signals in Spatial and frequency domain through image transforms.

3	Find shape using various representation techniques and classify the object using different classification methods.
4	Apply quantitative models of image processing for segmentation applications.
5	Apply quantitative models of image processing for restoration applications.

Text Books

Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision Cengage Engineering, 3rd Edition, 2013
Gonzales and Woods, Digital Image Processing, Pearson Education, India, Third Edition,

Reference Books

Anil K.Jain, Fundamentals of Image Processing, Prentice Hall of India, First Edition, 1989.
W Pratt, Digital Image Processing, Wiley Publication, 3rd Edition, 2002

Web Recourses

1.https://staff.fnwi.uva.nl/r.vandenboomgaard/IPCV20162017/20162017/LabExercises/Lab_ImageMosaic.html

2.https://staff.fnwi.uva.nl/r.vandenboomgaard/IPCV20162017/20162017/LabExercises/Motion.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	2				2						3		2	
2	2				2						3		2	
3	2				2						3		2	
4	2				2						3		2	
5	2				2						3		2	

1-Low , 2- Medium, 3- High

BLOOMS LEVEL ASSESSMENT PATTERN

BLOOMS CATEGORY	CAT 1	CAT 2	Lab Components	Model Exam	END SEM EXAM

REMEMBER	20	10			10
UNDERSTAND	40	20			20
APPLY	40	50	50	50	50
ANALYZE		20	50	50	20
EVALUATE					
CREATE					

Complied by: Mrs. R. Aandal