KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

S.P.G.Chidambara Nadar - C.Nagammal Campus

S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. Electronics and Instrumentation Engineering

Regulation - 2020

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABI

(V TO VI)

Vision of the Department:

To develop competent Electronics and Instrumentation Engineers with Societal, Environmental and Human Values through Quality Education, Training and Research

Mission of the Department:

Department of Electronics and Instrumentation Engineering is committed to

1. Impart technical knowledge and skills to meet the industry needs .
2. Build self-learning capability among the students to update the recent technology.
3. Tie up with the industries and research institution.
4. Create passion for serving the society with moral and ethical values.

Program Educational Objectives (PEOs):

Graduates of the programme will be able to

1. Work in the Design, Automation, Testing and Software Industries.
2. Pursue higher studies and research in the field of Process Control, Biomedical, Robotics & Automation and Renewable Energy Resources.
3. Be an Entrepreneur by building leadership quality and teamwork.

PROGRAM OUTCOMES:

After going through the four years of study, the Electronics and Instrumentation Engineering graduates will have theability to

	Graduate Attribute	**Programme Outcome**
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities

		relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes (PSOs):

PSO 1: Design and develop mathematical model for transducer, process control system.

PSO 2: Select and use appropriate hardware circuit and software tools to control industrial and automation process

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B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

Regulation - 2020

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABI

(V TO VI)

SEMESTER V

S.No	Course Code	Course Title	Category	Periods / Week			Contact Period	Credit
				L	T	P		
THEORY								
1	EE1571	Control Systems	PC	3	1	0	4	4
2	EE1572	Microprocessors and Microcontrollers	PC	3	0	0	3	3
3	EI1501	Process Control	PC	3	0	0	3	3
4		Professional Elective-I	PE	3	0	0	3	3
5		Professional Elective-II	PE	3	0	0	3	3
6		Open Elective I*	OE	3	0	0	3	3
PRACTICALS								
7	EE1581	Microprocessors and Microcontrollers Laboratory	PC	0	0	4	4	2
8	EI1511	Process Control Laboratory	PC	0	0	4	4	2
9	HS1521	Professional Communication	EEC	0	0	2	2	1
			TOTAL	18	1	10	29	24

SEMESTER VI

S.No	Course Code	Course Title	Category	Periods / Week			Contact Period	Credit
				L	T	P		
THEORY								
1	EE1671	Digital Signal Processing	PC	3	0	0	3	3
2	EI1601	Instrumentation System Design	PC	3	0	0	3	3
3	EI1602	Internet of Things: Sensing and Architecture	PC	3	0	0	3	3
4	EI1603	Medical Instrumentation	PC	3	0	0	3	3
5		Professional Elective III	PE	3	0	0	3	3
6		Professional Elective IV	PE	3	0	0	3	3
7		Online Courses	OL	-	-	-	-	2
PRACTICALS								
8	EI1611	Control Engineering Laboratory	PC	0	0	4	4	2
9	EI1612	Virtual Instrumentation and System Design Laboratory	PC	0	0	4	4	2
			TOTAL	18	0	10	28	24

Professional Elective Courses (PE)

S. No.	Course Code	Course Name	Category	Contact Periods	Credits			
					L	T	P	C
Professional Elective I (5th Semester)								
1.	EI1531	Applied Soft Computing	PE	3	3	0	0	3
2.	EI1532	Analytical Instrumentation and Environment Monitoring	PE	3	3	0	0	3
3.	EI1533	Industrial Data Networks	PE	3	3	0	0	3
4.	EI1534	Smart Materials and Systems	PE	3	3	0	0	3
Professional Elective II (5th Semester)								
1.	EI1535	Analog and Digital Communication	PE	3	3	0	0	3
2.	AD1371	Data Structures and Algorithms	PE	3	3	0	0	3
3.	EI1536	Micro – Electro – Mechanical Systems	PE	3	3	0	0	3
4.	EI1537	Power Electronics	PE	3	3	0	0	3
Professional Elective III (6th Semester)								
1.	EI1631	Instrumentation in Agriculture and Food Industries	PE	3	3	0	0	3
2.	EI1632	Instrumentation Standards	PE	3	3	0	0	3
3.	EI1633	Lasers and Optical Instrumentation	PE	3	3	0	0	3
4.	EE1603	Renewable Energy Systems	PE	3	3	0	0	3
Professional Elective IV (6th Semester)								
1.	EI1634	Embedded System	PE	3	3	0	0	3
2.	EI1635	Instrumentation in Petrochemical Industries	PE	3	3	0	0	3
3.	EI1636	Introduction to Machine Learning	PE	3	3	0	0	3
4.	EI1637	Non-Destructive Testing	PE	3	3	0	0	3

Open Electives offered by Department of EIE

S.No.	Course Code	Course Name	Category	Contact Periods	Credits			
					L	T	P	C
Open Elective I (5th Semester)								
1.	OEI151	Introduction to Analytical Instruments	OE	3	3	0	0	3
2.	OEI152	Introduction to Biomedical Instrumentation	OE	3	3	0	0	3
3.	OEI153	Sensors and Transducers	OE	3	3	0	0	3

SEMESTER V

EE1571 **CONTROL SYSTEMS**

(Common to EEE & EIE)

L	T	P	C
3	1	0	4

OBJECTIVES:

- To introduce the basic control system components for the analysis of physical systems.
- To provide adequate knowledge on time response analysis and steady state error analysis of linear systems.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency response analysis of linear systems.
- To introduce the concepts of stability analysis and design of various types of compensators.
- To introduce state variable representation of physical systems.

UNIT I SYSTEMS AND REPRESENTATION 12

Basic elements in control systems: Open and closed loop systems – Mathematical Models – Differential Equations - Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs- Case Study: AC and DC servomotors.

UNIT II TIME RESPONSE ANALYSIS 12

Time response: Time domain specifications – Standard Test Signals – Time domain analysis of I and II order system – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effect of addition of poles and Zeros - Effects of P, PI, PID modes of feedback control.

UNIT III FREQUENCY RESPONSE ANALYSIS 12

Frequency response: Bode plot – Polar plot – Determination of closed loop response from open loop response (M and N circles) - Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY AND COMPENSATOR DESIGN 12

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria –Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, Lead and Lag Lead compensator using bode plots**.**

UNIT V STATE VARIABLE ANALYSIS 12

Concept of state variables – State models for linear and time invariant systems (Controllable, Observable and Jordan Models) – Equivalence between transfer function and state variable representations - Solution of state and output equation – Concepts of controllability and observability

TOTAL: 60 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Develop mathematical model for various physical systems.

CO2: Determine time-domain specifications of given linear system and discuss on applications of various types of conventional controllers (P, PI and PID)

CO3: Obtain the frequency response analysis of given linear system using bode and polar plot.

CO4: Analyze the stability of control system using suitable methods and design compensators for the given specifications.

CO5: Frame various types of state space model for a system and obtains its solution.

TEXT BOOKS:

1. Nagrath, I.J., 2006. *Control systems engineering*, New Age International.
2. Kuo, B.C., 1987. Automatic control systems, Prentice Hall PTR.

REFERENCES:

1. Gopal, M., 2012. *Control systems: principles and design*, Tata McGraw-Hill Education.
2. Ogata, K. & Yang, Y., 2002. *Modern control engineering* (Vol. 4), India: Prentice hall.
3. Dorf, R.C. & Bishop, R.H., 2011. *Modern control systems*, Pearson.
4. Dutton, K., 1997. *The art of control engineering*, Addison-Wesley Longman Publishing Co., Inc..
5. Houpis, C.H. and Sheldon, S.N., 2013. *Linear Control System Analysis and Design with MATLAB*®, CRC Press.
6. NPTEL Video Lecture Notes on *Control Engineering.*

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	L	L								L	M	M
CO2	H	M	M	L								L	M	M
CO3	H	M	M	L								L	M	M
CO4	H	M	M	L								L	M	M
CO5	H	M	M	L								L	M	M

H- High M-Medium L-Low

EE1572- MICROPROCESSORS AND MICROCONTROLLERS **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the programming concepts in 8085 processor
- To understand the features of 8051
- To deliver the introduction in PIC
- To study the interfacing of different sensors with Arduino

UNIT I: MICROPROCESSOR 8085 (12 Hrs)

Pin out and Architecture of 8085-Instruction format- Classifications of Instructions- size, operations and addressing modes-Data transfer and manipulation instructions-Branching and Machine related instructions-Timing Diagram-Interfacing with 8255, 8254.

UNIT II: MICROCONTROLLER 8051 (10 Hrs)

Hardware Architecture, pin outs of 8051- -RAM addressing- Ports in 8051- SFRs- Addressing mode- Instruction set- Stepper and Servo motor control

UNIT III: PIC MICROCONTROLLER (8 Hrs)

CPU Architecture-Instruction set- Timers-UART-A/D Converter- PWM - Introduction to C

compiler

UNIT IV: ARDUINO (8 Hrs)

I/O Port Capability of Arduino UNO- Variables –Looping statement-Operators- Simple Programming

UNIT V: APPLICATIONS (7 Hrs)

Temperature Monitoring- Distance Measurement- Obstacle detection- Stepper and servo motor control- GPS

OUTCOMES:

At the end of the course, the learner will be able to:

CO1: Describe the architecture, different operations and interfacing concept of 8085

CO2: Understand the special features and programming concepts in 8051

CO3: Comprehend the architecture and functionality of PIC microcontroller

CO4: Grasp the basic knowledge in Arduino

CO5: Develop a high level programming knowledge in Arduino

TEXT BOOKS:

1. Ramesh Gaonkar 2013. *Microprocessor Architecture Programming and Applications with 8085*, Penram Intl. Publishing, 6th Edition.
2. Kenneth Ayala 2007. *The 8051 Microcontroller*, Cengage Learning Publications, 3rd Edition.

REFERENCE BOOKS:

1. Muhammad Ali Mazidi, Janice GillispieMazidi&RolinMcKinlay 2012. *The 8051 Microcontroller and Embedded Systems using Assembly and C*, Prentice Hall Publications, 2nd Edition.
2. Ray,A.K., &Bhurchandi , K.M., 2013. *Advanced Microprocessor and Peripherals*, Tata McGraw-Hill Publications, 3 rd Edition.
3. SencerYeralan& Helen Emery 2000. *Programming and interfacing the 8051 Microcontroller*, Addison-Wesley Publications, 1st Edition.

4. Danny Causey, Muhammad Ali Mazid&RolinMcKlinlay 2008. *PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC 18, Pearson*, 2nd Edition.
5. Massimo Banzi, 2014. *Getting Started with Arduino: The Open Source*, Shroff Publishers and Distributors pvt.ltd.
6. Simon monk, 2016. Programming Arduino: Getting Started with Sketches, Mc-Graw Hill Educations, second edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L									L	M	M
CO2	H	H	M	L	L							L	H	H
CO3	H	M	L									L	M	M
CO4	H	H	M	L								L	H	H
CO5	H	H	M	L	L							L	H	H

H- High M-Medium L-Low

EI1501 PROCESS CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce technical terms and nomenclature associated with process control domain.
- To provide an overview of various types of controllers.
- To make the students understand the various controller tuning methods.
- To elaborate different types of control schemes such as cascade control, feed forward control , ratio control, split range control along with suitable case studies.
- To familiarize the students with characteristics, selection, sizing of control valves.

UNIT I INTRODUCTION TO PROCESS CONTROL 9

Need for process control – Process with dead time, Process with inverse response – Continuous and Batch process – Degree of freedom – Self regulating and non self regulating processes - Servo and Regulator operation - Mathematical model of first order liquid level and thermal processes – Higher order process – Interacting and non-interacting systems – P and ID symbols.

UNIT II PERFORMANCE OF CONTROLLERS 9

Control System parameter - Basic control action – Characteristics of Discontinuous controller modes – Two position mode – Multi position mode – Floating controller mode - Characteristics of continuous controller - Proportional, Integral and Derivative control modes – Composite control modes – PI, PD and PID control modes.

UNIT III ANALOG CONTROLLER AND TUNING 9

Electronic controllers to realize various control actions – Pneumatic Controllers – Performance criteria – IAE, ISE, ITAE and ¼ decay ratio – Selection of controllers – Tuning of controllers – Ziegler-Nichol‘s method and Cohen Coon method.

UNIT IV FINAL CONTROL ELEMENT 9

Final control operation – Signal conversion - I/P converter – Pneumatic and electric actuators – Classification of control valves – Valve positioner – Control valves characteristics – Control valve sizing – Cavitations and flashing – Selection of control valves.

UNITV CONTROL SYSTEMS WITH MULTIPLE LOOPS 9

Introduction to multivariable control - Cascade control – Feed forward control – Ratio control – Selective control systems – Split range control – Adaptive and inferential control - Case study of control schemes of distillation column, Boiler, CSTR, and Heat Exchanger.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Understand technical terms and nomenclature associated with process control domain.

CO2: Build models using first principles approach as well as analyze models.

CO3: Design, tune and implement PID Controllers to achieve desired performance for various processes.

CO4: Analyze systems and implement the control schemes for various processes.

CO5: Identify, formulate and solve problems in the process control domain.

TEXT BOOKS:

1. Bela.G.Liptak 2018. *Process Control and Optimization, Instrument Engineer's Handbook*., volume 2, CRC press, London, Fourth Edition
2. Curtis.D.Johnson 2015. *Process Control Instrumentation Technology*, Pearson Education, 8th Edition.
3. G.Stephanopoulis 2018. *Chemical Process Control-An Introduction to Theory and Practice,* Prentice Hall of India, New Delhi, 4th Edition

REFERENCE BOOKS:

1. Bequette, B.W., 2020.*Process Control Modeling, Design and Simulation*, Prentice Hall of India, Ninth Edition .
2. Coughanowr, D.R., 2013.*Process Systems Analysis and Control*, McGraw - Hill International Third Edition.
3. Bhagade, S. S &Nageshwar, G. D., 2011. Process dynamics and control, PHI publications, New Delhi.
4. Considine,D.M., 1999.*Process Instruments and Controls Handbook*, Second Edition, McGraw hill.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes	Program Specific

													Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L	L								M	H	L
CO2	H	H	L	L								M	H	L
CO3	H	H	M	L								M	H	H
CO4	H	H	M	L								M	H	H
CO5	H	H	M	L								M	H	H

H- High M-Medium L-Low

EE1581 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY
(Common to EEE & EIE)

L	T	P	C
0	0	4	2

OBJECTIVES:

- To develop the programming skills in 8085 microprocessor and 8051 microcontroller
- To interface sensors with Arduino

LIST OF EXPERIMENTS

8085 – Based Experiments

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
3. Input and Output mode operations using 8255
4. To Generate Square wave using 8254

8051-Based Experiments

5. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Arithmetic instructions
   (ii) Conditional jumps & looping
6. Stepper motor control

ARDUINO Based Experiments:

7. Display letters in Arduino IDE environment
8. Interfacing Ultrasonic Sensor to measure the distance of an object
9. Interfacing IR sensor to detect the obstacles
10. Closed loop control of stepper and servo motor
11. Mini project using microcontroller

TOTAL: 60 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Develop and Execute simple programming in 8085

CO2: Demonstrate the interface concepts in 8085

CO3: Implement the control program using 8051

CO4: Write simple programs for Arduino.

CO5: Interface different sensors with Arduino

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M						L	L		M	H	H
CO2	H	H	M						L	L		M	H	H
CO3	H	H	M	L					L	L		M	H	H
CO4	H	H	M						L	L		M	H	H

CO5	H	H	M	L	L				L	L		M	H	H

H- High M-Medium L-Low

EI1511 PROCESS CONTROL LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To verify the process control concepts on the selected process control loops.
- To interpret the closed loop response of real time process.
- To make the students aware of basic and advanced control schemes.
- To impart theoretical and practical skills in process identification and controller tuning.

LIST OF EXPERIMENTS:

1. Piping and Instrumentation Diagram – case study.
2. Simulation of different order processes with and without transportation lag.
3. Design and implementation of Interacting and non-interacting system.
4. Characteristics of various transmitters.
5. Design of multirange DP transmitter.
6. Design and implementation of ON/OFF Controller for the flow ,level, temperature and pressure Process.
7. Realization of on/off controller with neutral zone using operational amplifier.
8. Closed loop response of flow, level, temperature and pressure control loop.
9. Realization of PID controller using operational amplifier.
10. Tuning of controller using suitable algorithms for flow, level, temperature and pressure process.
11. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process
12. Study of complex control system (ratio / cascade / feed forward)
13. Characteristics of control valve with and without positioner.
14. Mathematical model of a typical industrial process using nonparametric

identification methods.

15. Design of a multi-channel data acquisition system.

TOTAL: 60PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Understand and analyze process control engineering problems.

CO2: Build dynamic models using input – output data of a process.

CO3: Work with real time control loops (flow/level/temperature/pressure).

CO4: Implement control algorithms for tuning of controllers.

CO5: Utilize simulation tools such as MATLAB and /LABVIEW.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M						M	L		L	H	H
CO2	H	H	M	L					M	L		L	H	H
CO3	H	H	M	L					M	L		L	H	H
CO4	H	H	M	L					M	L		L	H	H
CO5	H	H	M						M	L		L	H	H

H- High M-Medium L-Low

HS1521 PROFESSIONAL COMMUNICATION

L	T	P	C
0	0	2	1

OBJECTIVES:

The course aims to:

- Enhance the Employability and Career Skills of students

- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions with clarity and appropriate pharases – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic -– questioning and clarifying –GD strategies-activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress-networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course Learners will be able to:

• Make effective presentations

• Participate confidently in Group Discussions.

• Attend job interviews and be successful in them.

• Develop adequate Soft Skills required for the workplace

Available Software:

1. Odyll

REFERENCES:

1. Butterfield, 2015, *Jeff Soft Skills for Everyone*., Cengage Learning: New Delhi.

2. E. Suresh Kumar et al. 2015, *Communication for Professional Success*, Orient Blackswan: Hyderabad.

3. *Interact English Lab Manual for Undergraduate Students*,.OrientBalckSwan: 2016, Hyderabad.

4. Raman, 2014, Meenakshi and Sangeeta Sharma. *Professional Communication*.Oxford University Press: Oxford.

5. S. Hariharanet al. 2010, *Soft Skills*. MJP Publishers: Chennai.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										M				
CO2										M				
CO3										M				
CO4										M				

H- High M-Medium L-Low

SEMESTER VI

EE1671 DIGITAL SIGNAL PROCESSING

(Common to EEE/EIE)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concept of analyzing discrete time signals & systems in the time and frequency domain through mathematical representation.
- To study various time to frequency domain transformation techniques
- To understand the computation algorithmic steps for Fourier Transform
- To study about filters and their design for digital implementation.
- To introduce the programmable digital signal processor & its application.

UNIT I INTRODUCTION 9

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Linear and circular Convolution.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation - Warping, prewarping - Gibbs Phenomenon

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction – Architecture of TMSC5X DSP processor– Features – Addressing Formats – Functional modes - Introduction to Commercial Processors

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Classify the given signal or system based on its mathematical representation and explains the various sampling and quantization techniques in digital signal representation.

CO2: Solve the given discrete time system using Z-transform and analyze its stability using frequency response and determine the DTFT of a given discrete sequence. Compute DFT and Inverse DFT using Radix-2 FFT algorithm.

CO4: Design FIR filter using Windowing Technique and IIR filter using Bilinear Transformation and Impulse Invariant Techniques and also to design Analog filters for Butterworth and Chebyshev approximations.

CO5: Discuss the architecture and functional modes of commercial digital signal processors

TEXT BOOKS:

1. Proakis, J.G., & Manolakis, D.G., 2009. *Digital Signal Processing Principles, Algorithms and Applications*, Pearson Education.
2. Robert, J, Schilling & Sandra, L, Harris., 2014. *Introduction to Digital Signal Processing using MATLAB*, Cengage Learning.

REFERENCES:

1. Emmanuel , C , Ifeachor &Barrie,W ,Jervis, 2009. *Digital Signal Processing – A Practical approach*, Pearson Education.
2. Alan, V, Oppenheim, Ronald, W, Schafer &John , R, Buck., 2010. *Discrete – Time Signal Processing*, Pearson Education.
3. Sen, M, kuo&Woon-sengs.gan, 2013. *Digital Signal Processors, Architecture, Implementations & Applications*, Pearson.
4. Mitra, S. K., 2011. *Digital Signal Processing – A Computer Based Approach*, Tata McGraw Hill.
5. Venkataramani, B., & Bhaskar, M., 2010. *Digital Signal Processors, Architecture,*

Programming and Applications, Tata McGraw Hill.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L									L	H	M
CO2	H	M	L									L	H	M
CO3	H	M	L									L	H	M
CO4	H	M	L									L	H	M
CO5	H	M	L									L	H	M

H- High M-Medium L-Low

EI1601 INSTRUMENTATION SYSTEM DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart knowledge in the design of signal conditioning circuit for different process variables.
- To introduce about control valve sizing and section of pumps for practical applications.
- To familiarize with the concepts of micro controller-based design for process applications.

UNIT I DESIGN OF FLOW AND TEMPERATURE MEASUREMENT 9

Orifice meter - design of orifice for given flow condition - design of Rota meter -design of

RTD measuring circuit - design of cold junction compensation circuit for thermocouple using RTD - Transmitters – zero and span adjustment in D/P transmitters and temperature transmitters.

UNIT II DESIGN OF PRESSURE AND LEVEL MEASUREMENT 9

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube -design of Air purge system for level measurement.

UNIT III DESIGN OF CONTROL VALVES 9

Control valves - design of actuators and positioners - types of valve bodies -valve characteristics - materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications.

UNIT IV DESIGN OF PUMPS 9

Types of pumps - pump performance - pipe work calculation - characteristics of different pumps - pump operation - maintenance - instruments used in pumping practice - pump noise and vibration - selection of pumps. Electronic P+I+D controllers - design - adjustment of setpoint, bias and controller settings.

UNITV MICROCONTROLLER BASED DESIGN 9

Design of logic circuits for alarm and annunciator circuits, interlocks - design of microcontroller based system for data acquisition - design of microprocessor based P+I+D controller.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the learner will be able to:

CO1: Design temperature and flow measurement system for process application.

CO2: Design level and pressure measurement system for process application.

CO3: Analyze the requirement of control valve and suggest an appropriate design procedure.

CO4: Analyze the requirement of control system components such as pumps and suggest an appropriate design procedure.

CO5: Design microcontroller based measurement and control system.

TEXT BOOKS:

1. Anderson, N.A., 1998.*Instrumentation for Process Measurment and Control*, Routledge, 3rd Edition.
2. Considine, D.M., 2009. *Process Instruments and Controls Handbook*, McGraw-Hill., 5th Edition.
3. Earnest Doebelin, 2006.*Measurement Systems*, Tata McGraw Hill, 5th edition.

REFERENCE BOOKS:

1. Bela Liptak , 1995.*Instrument engineers Hand Book* (Process measurement),CRC Press.
2. Johnson, C.D., 2009.*Process Control Instrumentation Technology*, Prentice Hall of India, 8th Edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M									M	H	H
CO2	H	H	M									M	H	H
CO3	H	H	M	L								M	H	H
CO4	H	H	M	L								M	H	H
CO5	H	H	M									M	H	H

H- High M-Medium L-Low

EI1602 **INTERNET OF THINGS: SENSING AND ARCHITECTURE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To learn about the basics of IOT protocols.
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates – Sensor Basics – Active , Passive sensors, Industrial , Environmental Advanced sensor Like GPS, Range Sensor (LIDAR), Biosensor.

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoTreference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.

UNIT IV BUILDING IoT WITH RASPBERRY PI 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the learner will be able to:

CO1: Explain the concept of IoT and Sensor fundamentals

CO2: Understand the design architecture of IoT

CO3: Analyze various protocols for IoT

CO4: Design a portable IoT using Raspberry Pi.

CO5: Deploy an IoT application and connect to the cloud in real time scenario.

TEXT BOOKS:

1. ArshdeepBahga, Vijay Madisetti 2015, *Internet of Things – A hands-on approach*, Universities Press.
2. Raj Kamal., 2018. *Internet of Things: Architecture and Design Principles*, McGraw-Hill Education Pvt. Ltd.

REFERENCE BOOKS:

1. Dieter Uckelmann, Mark Harrison, Michahelles&Florian (Eds) 2011. *Architecting the Internet of Things*, Springer.
2. Honbo Zhou, 2012. *The Internet of Things in the Cloud: A Middleware Perspective*, CRC Press.
3. Jan Holler, Vlasios Tsiatsis , Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand&David Boyle, 2014.*From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence*, Elsevier.
4. Olivier Hersent, David Boswarthick&Omar Elloumi 2012. *The Internet of Things – Key applications and Protocols*, Wiley.
5. Lucas Darnell, 2016. *The Internet of Things (A Look at Real World Use Cases and Concerns)*, Kindle Edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	Program Outcomes	**Program Specifi**

CO													c Outcomes	
	PO1	PO2	PO3	PO 4	PO 5	PO6	PO 7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PS O2
CO1	M	M	M										L	L
CO2	M	L	L										L	L
CO3	M	M	L										H	M
CO4	H	M	M		M							M	H	M
CO5	H	M	L									M	H	M

H- High M-Medium L-Low

EI1603 MEDICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an overview about physiology and various physiological signal measurements.
- To make students understand various biomedical instruments used for non-electrical parameter measurement.
- To provide an overview about electrical parameter acquisition and recording.
- To provide knowledge on electrical safety.
- To make students familiarized with various medical imaging systems and IoT in health care.
- To provide knowledge on the fundamental concept of life assisting, therapeutic and robotic devices.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems-

Respiratory systems -Kidney and blood flow -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers -Temperature measurements - Fiber optic temperature sensors.

UNIT II **NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES** **9**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III **ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS** **9**

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV **MEDICAL IMAGING SYSTEMS** **9**

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Retinal Imaging - Positron emission tomography- IoT protocols in health care.

UNITV **LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES** **9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart –Lung machine – Audio meters – Dialyzers – Lithotripsy - ICCU patient monitoring system – NanoRobots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Understand the functions of the physiological systems with its anatomy and gain knowledge on various sensing and measurement devices.

CO2: Select the appropriate non-electrical physiological measurement systems to measure the different physiological parameters

CO3: Comprehend the operation of electro physiological measurement systems to measure bio signals and electrical safety of biomedical equipments.

CO4: Illustrate the principles of different imaging techniques for diagnosis and IoT protocols

CO5: Select the appropriate medical devices for diagnosis, therapeutic applications

TEXT BOOKS:

1. Khandpur R.S., 2019.*Handbook of Biomedical Instrumentation*, Tata McGraw-Hill, New Delhi, 3rd Edition.
2. Leslie Cromwell, 2007.Biomedical Instrumentation and Measurement, Prentice Hall of India, New Delhi.
3. John, G, Webster, 2015.*Medical Instrumentation Application and Design*, John Wiley and sons, New York, 4th Edition.

REFERENCE BOOKS:

1. James, E, Moore Jr& Duncan, J, Maitland, 2013.*Biomedical Technology and Devices*, CRC press, 2nd Edition.
2. Joseph, J, Carr & John, M, Brown 2012.*Introduction to Biomedical Equipment Technology*, John Wiley and sons, New York, 4th edition.
3. Sang, C,Suh, VaradrajGurupur& Murat, M,Tanik 2011.*Health Care Systems, Technology and Techniques*, Springer, 1st Edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	**Program Outcomes**												**Program Specific Outcomes**	
	PO1	**PO2**	**PO3**	**PO**	**PO**	**PO6**	**PO**	**PO8**	**PO9**	**PO1**	**PO1**	**PO1**	**PSO**	**PS**

				4	**5**		**7**			**0**	**1**	**2**	**1**	**O2**
CO1	H	M	L									M		
CO2	H	M	L									M	M	
CO3	H	M	L			L						M	M	
CO4	H	M	L									M	M	M
CO5	H	M	L	L								M	M	M

H- High M-Medium L-Low

EI1611 **CONTROL ENGINEERING LABORATORY**

(Common to EEE & EIE)

L	**T**	**P**	**C**
0	**0**	**4**	**2**

OBJECTIVES:

- To impart knowledge on analysis and design of control system in time and frequency domain.
- To impart knowledge in classical control and state space-based control system design.
- To familiarize the students with LabVIEW and MATLAB - Real-time programming to collect and process data.

LIST OF EXPERIMENTS

1. Time response characteristics of a second order system.
2. Frequency response characteristics of a second order system.
3. Constant gain compensation in time and frequency domain.
4. Stability Analysis of Linear Systems using Bode, Root locus & Nyquist plots method using MATLAB software
5. Compensating Networks - Characteristics
6. Design of compensation networks - Lead, Lag, Lead-lag
7. Design of state feedback controller.
8. Observer design - full order and reduced order.
9. Real time control of AC / DC servo system
10. Study of AC Synchro- Transmitter – Receiver characteristics

11. Real time control of Inverted Pendulum
12. Real time control system design using LabVIEW

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, students will be able to

CO1: Understand and analyze process control engineering problems.

CO2: Design control systems in both classical and modern techniques.

CO3: Design full order and reduced order state observer

CO4: Design and implement controllers to regulate and control various systems

CO5: Utilize simulation tools such as MATLAB and /LABVIEW

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	M	L	L				M	L		L	M	M
CO2	H	H	M	L	L				M	L		L	M	M
CO3	H	H	M	L	L				M	L		L	M	M
CO4	H	H	M	L	L				M	L		L	M	M
CO5	H	H	M	L	L				M	L		L	M	M

H- High M-Medium L-Low

EI1612 **VIRTUAL INSTRUMENTATION AND SYSTEM DESIGN LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

- Create Simple Virtual Instruments.
- Program using for loops, charts, graphs, case structures
- Handle file Input / Output Operations.
- Acquire signals and implement the real time control systems.
- To impart knowledge on the design of signal conditioning circuits for the measurement of industrial parameter
- To develop the skills needed to design, fabricate and test PID controller
- To develop various modules for final year project as per industrial standards and practices.
- To impart knowledge on the industrial documentation preparation.

LIST OF EXPERIMENTS:

1. Implementation of simple LabVIEW programs using different data types.
2. Programming exercises for loops, charts, graphs, case structures.
3. Programming exercises on file Input /Output operations.
4. Data acquisition through DAQ cards.
5. Programming exercises on sensors and actuators module.
6. Real time applications control using myRIO.
7. Design of Instrumentation amplifier.
8. Design of active filters – LPF, HPF and BPF.
9. Design of regulated power supply.
10. Design of V/I and I/V converters.
11. Design of PID controller using ELVIS kit
12. Design of signal conditioning circuit for strain gauge and RTD.
13. Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

    (Implement any of two experiments listed from 7 to 12 using ELVIS kit)

TOTAL: 60 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Develop VI programs for simple applications.

CO2: Develop real time control system of industrial process.

CO3: Create communication with the field instruments by developing data acquisition systems.

CO4: Understand design of signal conditioning circuits and instrumentation systems.

CO5: Prepare documentation for instrumentation projects.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L		M				M	L		M	H	H
CO2	H	H	M	L	M				M	L		M	H	H
CO3	H	H	M	L	M				M	L		M	H	H
CO4	H	H	M						M	L		M	H	H
CO5	H	M	M	L					M	L		M	H	L

H- High M-Medium L-Low

Professional Elective Courses (PE)

Professional Elective I

EI1531 **APPLIED SOFT COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application

UNIT I ARCHITECTURES – ANN **9**

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network

UNIT II NEURAL NETWORKS FOR CONTROL **9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum-Familiarization with neural network toolbox

UNIT III FUZZY SYSTEMS **9**

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- ANFIS - Adaptive fuzzy system

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEM **9**

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control - Familiarization with fuzzy logic toolbox

UNITV GENETIC ALGORITHMS **9**

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems- Familiarization with GA toolbox

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Explain the architecture and learning methodologies of perceptron, and back propagation neural networks

CO2: Apply neural network concepts on modelling and control of the given engineering problem

CO3: Explain fuzzy logic operations, relations and inference system and neuro fuzzy system

CO4: Apply fuzzy logic control techniques for the given engineering problem

CO5: Apply genetic algorithm to solve the given optimization problem

TEXT BOOKS:

1. George, J.Klir. and Bo Yuan., 2006, *Fuzzy sets and Fuzzy Logic*, Second Edition, PHI
2. Zurada, J.M., 2006, *Introduction to artificial neural systems*, Jaico Publishing House
3. Goldberg, D.E., 1989, *Genetic algorithms in search, optimization, and machine learning*, Addison-Wesley.
4. Timothy, J. Ross., 2010, *Fuzzy Logic with Engineering Applications*, Tata McGraw Hill, 3rd Edition.
5. LauranceFausett, and Englewood Cliffs, N.J., 1992, *Fundamentals of Neural Networks*, Pearson Education.

REFERENCES:

1. Simon Haykin, 2003, *Neural Networks*, Pearson Education.
2. John Yen and Reza Langari., 2003, *Fuzzy Logic – Intelligence Control & Information*, Pearson Education, New Delhi.
3. Gen, M. and Cheng, R., 2000, '*Genetic algorithms and optimization*', Wiley Series in Engineering Design and Automation.
4. Padhy,N.P., 2013, *Artificial Intelligence and Intelligent Systems*, Oxford.
5. William S.Levine., 2011, *Control System Advanced Methods*, The Control Handbook CRC Press.

6. Sivanandam, S.N. and Deepa, S.N., 2013, *Principles of Soft computing*, Wiley India Edition, 2nd Edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L	L								L	M	M
CO2	H	M	L	L	L							L	M	M
CO3	H	M	L	L	L							L	M	M
CO4	H	M	L	L	L							L	M	M
CO5	H	M	L	L	L							L	M	M

H- High M-Medium L-Low

EI1532 **ANALYTICAL INSTRUMENTATION AND ENVIRONMENT MONITORING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of

physics as they related to specific instrumentation used for environmental monitoring instruments.

- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY 9

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy, Single and double beam instruments – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources, detectors and applications.

UNIT II CHROMATOGRAPHY 9

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – Applications, Paper chromatography, Thin layer chromatography, High pressure liquid chromatography – Applications.

UNIT III ENVIRONMENTAL MONITORING INSTRUMENTS 9

Sources of Pollution, Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements. Environmental gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.

UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer-Calibration of instruments.

UNITV NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass Spectrometry-Nuclear radiations detectors.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Comprehend the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.

CO2: Assess the suitable analytical method of chromatography for a specific purpose, and also suggest alternative analytical methods for quality assurance.

CO3: Distinguish the strengths and limitations of the various environmental monitoring instrumental methods.

CO4: Illustrate the latest ideas on ion-selective electrodes and analyzers which have potential applications in medical field, food and beverage industries.

CO5:Understand the working principle, types and applications of NMR and Mass spectroscopy

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J.A., & Settle, F.A., 2012. *Instrumental methods of analysis*, CBS publishing & distribution, 7th Edition.
2. Braun, R.D., 2012. *Introduction to Instrumental Analysis*, Pharma Book Syndicate, Singapore, 2nd edition.
3. Robert E. Sherman 1996. *Analytical Instrumentation*, Instruments Society of America.

REFERENCE BOOKS:

1. Khandpur, R.S., 2018. *Handbook of Analytical Instruments*, Tata McGraw-Hill publishing Co. Ltd., 5th edition.
2. Ewing, G.W., 1992 (Digitized in 2007). *Instrumental Methods of Chemical Analysis*, McGraw-Hill, 5th Edition.
3. Liptak, B.G.,2016. *Process Measurement and Analysis,* CRC Press, 5th Edition.
4. Mudakavi,J.R., *NPTEL lecture notes on Modern Instrumental methods of Analysis,* IISC, Bangalore.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	Program Outcomes	**Program**

CO													Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	L									L	H	
CO2	H	M	L									L	H	M
CO3	H	M	L			L						L	H	M
CO4	H	M	L									L	H	M
CO5	H	M	L									L	H	

H- High M-Medium L-Low

EI1533 INDUSTRIAL DATA NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

UNIT I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing - CSMA/CD,TCP/IP.

UNIT II INTERNET WORKING and RS 232, RS485 9

Bridges - Routers - Gateways - ARCNET configuration- special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor(AS)–

interface, Device Net.

UNIT III HART AND FIELD BUS 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks HART commands- HART applications - Fieldbus - Introduction - General Fieldbus architecture- Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability Interchangeability- Introduction to OLE for process control (OPC).

UNIT IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibusprotocol stack, Profibus communication model - communication objects - system operation troubleshooting- review of foundation fieldbus - Data Highway.

UNITV INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wirelesscommunication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs- Wireless sensor networks: Hardware components – energy consumption of sensor nodes -Introduction to wireless HART and ISA100.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To interpret basic concepts of data communication and its importance.

CO2: To comprehend the various internetworking devices involved in industrial networks

CO3: To illustrate, compare & explain the working of HART and Field bus used in process digital communication.

CO4: To summarize the operation of MODBUS, PROFIBUS protocol & its applications.

CO5: To understand the different Industrial Ethernet protocol and usage of wireless communication in process applications

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders and John Park, 2004, *Practical Industrial Data Networks Design, Installation and Troubleshooting'*Newnes Publication, Elsevier.

2. William Buchanan, 2000, *Computer Buses*, CRC Press.
3. BehrouzForouzan , 2007, *Data Communications & Networking*, Tata McGraw hill,4th edition.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum and David J. Wetherall, 2011, *Computer Networks*, Prentice Hall of IndiaPvt. Ltd, 5th Edition.
2. Theodore S Rappaport, 2001, *Wireless Communication: Principles and Practice*, PrenticeHall of India, 2ndEdition.
3. William Stallings, 2005, *Wireless Communication & Networks*, Prentice Hall of India, 2**nd**Edition.
4. Feng Zhao and LeonidesGuibas, 2004, *Wireless sensor networks*, Elsevier publication.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M										L	H	M
CO2	H	M										L	H	M
CO3	H	M										L	H	M
CO4	H	M										L	H	M
CO5	H	M										L	H	M

H- High M-Medium L-Low

EI1534 **SMART MATERIALS & SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To familiarize the students with the different smart materials and their characteristics
- To expose the students to understand the functionalities through the mathematical equations
- To teach the students about the significant features of smart materials in sensing, actuation and control.
- To design and develop smart structures using smart material based actuators and sensors

UNIT I INTRODUCTION TO SMART MATERIALS & STRUCTURES 9

Smart materials for sensing and actuation, the role of Smart Materials in developing Intelligent Systems and Adaptive Structures. Piezoelectric Materials: constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezo ceramic materials, variation of coupling coefficients in hard and soft piezo ceramics, polycrystalline vs single crystal piezoelectric materials, poly vinyldene fluoride, piezoelectric composites

UNIT II ACTUATORS & SENSORS BASED ON PIEZOELECTRIC MATERIAL 9

Induced Strain actuation model, Unimorph and Bimorph Actuators, Actuators embedded in composite laminate, Impedance matching in actuator design, Feedback Control, Pulse Drive, Resonance Drive, Piezoelectric as a Sensor and its applications

UNIT III MAGNETOSTRICTIVE MATERIAL 9

Magnetostrictive Materials – constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials. Magnetostrictive Mini Actuators, Thermal instabilities, Discretely distributed actuation, Magnetostrictive Composites. Magnetostrictive Sensors

UNIT IV SMA AND EAP 9

Shape Memory Alloys (SMA) – Phase Transformations, Basic Material Behaviour and Modelling Issues, A Comprehensive Model for Uniaxial Stress, Properties of SMAs for Biomedical Applications Shape Memory Alloy based actuators for Shape Control. Electro-active Polymers (EAP): Electro-active Polymers for Work-Volume Generation, EAP as actuator and sensor. Electro-Rheological (ER) fluids, Magneto-Rheological (MR) fluids

UNIT V **INTEGRATION OF SMART SENSORS AND ACTUATORS TO SMART STRUCTURES** **9**

Optimal Placement of Sensors and Actuators, Design of Controller for Smart Structure, Techniques of Self-Sensing using piezoelectric and SMA, SMA based encoders, micro robotics, micro devices. Case Studies to Advanced Smart Materials: Active Fibre Composites (AFC), Energy Harvesting Actuators and Energy Scavenging Sensors, Self-healing Smart Materials

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To acquire knowledge about the smart materials, their characteristics and design aspects

CO2. To illustrate the use of piezoelectric material in designing various sensors & actuators.

CO3: To explain the use of magnetostrictive material in sensors & actuators

CO4: To infer the different properties and use of SMA & EAP materials in material design.

CO5: To analyze and design techniques, to offer solutions to industrial problems using smart materials.

TEXT BOOKS:

1. Mukesh,V, Gandhi &Brian,S, Thompson, 1992. *Smart Materials and Structures,* Chapman & Hall Publishers, 1st Edition.
2. Mel Schwartz, 2002. *Encyclopedia of smart materials,* John Wiley and Sons, 1st Edition.
3. Srinivasan,A.V. & Michael McFarland D, 2010. *Smart Structures Analysis and Design,* Cambridge University Press, 1st Edition.

REFERENCE BOOKS:

1. Culshaw B., 2004. *Smart structures and Materials,* Artech house, 1st Edition.
2. Leo, D.J. 2008. *Engineering Analysis of Smart Material Systems,* John Wiley & sons, 1stEditon.
3. Smith,R.C. 2005. *Smart material systems: model development, frontiers in applied mathematics, SIAM.*
4. Janocha,H, 2007. *Adaptronics and smart structures: Basics, Materials, Design, and Applications,* springer, 2nd Edition.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											H	
CO2	H	M											H	
CO3	H	M											H	
CO4	H	M	M									M	H	H
CO5	H	H	M	M								M	H	H

H- High M-Medium L-Low

Professional Elective II

EI1535 **ANALOG AND DIGITAL COMMUNICATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the students to the principles of analog and digital communication.
- To impart knowledge on the waveform encoding techniques.
- To facilitate the students in analyzing the performance of transmitters and receivers.
- To familiarize the students with the principles of multi-user communication systems.

UNIT I ANALOG MODULATION SCHEMES 9

Modulation - Amplitude modulation:-DSB-FC, DSB-SC and SSB-SC - Frequency modulation and Phase Modulation – Time domain representation – Spectral characteristics – Block diagram of AM Transmitters and Receivers – Concept of Superheterodyning.

UNIT II WAVEFORM ENCODING TECHNIQUES 9

Sampling theorem, Types of Sampling, Quantization – Principles of PAM, PPM, PWM – Pulsecode modulation, DPCM, Quantization noise in PCM – Delta Modulation, ADM.

UNIT III LINE CODING TECHNIQUES AND ERROR CORRECTION 9

Properties of line codes, UniPolar / Bipolar, RZ/NRZ and Manchester – Time domain representation - M-ary schemes, Error detection and correction- Hamming code and Linear block codes - Matched filter and Correlator.

UNIT IV PASSBAND DIGITAL MODULATION 9

BASK, BFSK, BPSK, QPSK and QAM – Signal space representation – Probability of error forASK, FSK, PSK – Comparison of the schemes – Coherent/Non-Coherent reception.

UNITV MULTIPLEXING AND MULTIPLE ACCESS SCHEMES 9

Concept of multiplexing: FDM and TDM. Multiple Access: FDMA, TDMA and CDMA – Application to Mobile communication and Satellite communication.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Gain knowledge about the principles of communication techniques.

CO2:Understand the importance of each type of modulation system for specific applications.

CO3: Capable of configuring Source coding schemes.

CO4: Analyze various Band pass signaling schemes and compare their performance.

CO5: Gain knowledge on multiple access schemes.

TEXT BOOKS:

1. Simon Haykin2010.*Communication Systems*, 4th Edition, Wiley India.
2. Herbert Taub, Donald Schilling &GoutamSaha2011.*Principles of Communication System*, 3rd Edition, McGraw-Hill.

REFERENCE BOOKS:

1. Dennis Roddy& John Coolen2008. *Electronic Communications*, 4th Edition, PearsonEducation.
2. Lathi, B.P.,&Zhi Ding, 2010. *Modern Digital and Analog Communication Systems*, 4th Edition, Oxford University Press.
3. John G. Proakis&MasoudSalehi 2008. *Digital Communication*, 4th Edition, McGraw Hill.
4. Singh, R.P. &Sapre, S.D., 2007. *Analog and Digital Communication Systems*, McGraw-Hill Publishing Company Ltd.
5. Kennedy, G., 2008. *Electronic Communication Systems*, McGraw-Hill, 4thEdition, 35th reprint.
6. Bruce Carlson, A., &Paul B. Crilly 2010. *Communication System*, 5th Edition, Tata McGrawHill.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											M	M
CO2	H	M											M	M
CO3	H	M											M	M
CO4	H	M											M	M
CO5	H	M											M	M

H- High M-Medium L-Low

AD1371	DATA STRUCTURES AND ALGORITHMS (Common to ECE & ADS)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the fundamentals of algorithms and the concepts of List ADTs
- Learn Linear Data structures- Stacks and Queues
- Understand the concepts of non-linear data structures , Trees
- Learn the concepts of non-linear data structures, Graphs
- Understand sorting, searching and hashing algorithm

UNIT I INTRODUCTION: ALGORITHMS AND ADTs 9

Time and space complexity-Big O,Omega,Theta notation Abstract Data Types-– List ADT – array based implementation, linked list implementation, singly linked lists, circularly linked lists, doubly linked lists, applications of lists.

UNIT II STACK AND QUEUE 9

Stack ADT – Operations, Applications, Evaluating arithmetic expressions, Conversion of Infix to postfix expression - Queue ADT – Operations, Circular Queue, Priority Queue, dequeue, applications of queues.

UNIT III TREES 9

Tree ADT - Tree traversals - Binary Tree ADT - expression trees, applications of trees - Binary search tree ADT – AVL Tree - B-Tree - Heap- Binary heap - Applications of heap.

UNIT IV GRAPHS 9

Definition, Representation of Graph, Types of graph, Breadth-first traversal, Depth-first traversal - Topological Sort - Bi-connectivity - Cut vertex - Euler circuits - Applications of graphs.

UNITV SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching - Linear Search, Binary Search - Sorting - Bubble sort, Selection sort, Insertion sort, Shell sort, Radix sort - Hashing - Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Illustrate the basic concepts of List ADT.

CO2: Explain Stack and Queue ADTs.

CO3: Summarize the concepts of non-linear data structures, Trees.

CO4: Outline the concepts of non-linear data structures, Graphs.

CO5: Apply appropriate sorting and searching techniques for problem solving.

TEXT BOOK:

1. Weiss, M.A., 1997. *Data Structures and Algorithm Analysis in C*, 2/e. Pearson Education India.
2. ReemaThareja, 2011. *Data Structures Using C*, Second Edition, Oxford University Press..

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest& Clifford Stein, 2002. *Introduction to Algorithms*, Second Edition, Mcgraw Hill.
2. Aho, Hopcroft& Ullman, 1983. *Data Structures and Algorithms*, Pearson Education.
3. Kochan, S.G., 2015. *Programming in C*. Pearson education.
4. Ellis Horowitz, SartajSahni, Susan & Anderson-Freed, 2008. *Fundamentals of Data Structures in C*, Second Edition, University Press

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO	PO	PO6	PO	PO8	PO9	PO1	PO1	PO1	PSO	PS

				4	**5**		**7**			**0**	**1**	**2**	**1**	**O2**
CO1	L								L	L				
CO2	L	L	L						L		L		L	
CO3	M	M	L	L					L		L		L	L
CO4	M	M	L	L					L		L		L	L
CO5	L								L		L			

H- High M-Medium L-Low

EI1536 MICRO – ELECTRO – MECHANICAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To educate basic knowledge about MEMS & its applications.
- To Study about the MEMS materials.
- To introduce various MEMS fabrication techniques.
- To study about various mechanical sensors and actuators.

UNIT I INTRODUCTION TO MEMS 9

Introduction to MEMS and Microsystems-emergence- scaling issues -Materials and Substrates for MEMS- MEMS devices-Engineering Mechanics for Micro System Design -Application of MEMS.

UNIT II MATERIAL PROPERTIES 9

MEMS materials- structural and sacrificial materials- silicon, mechanical, electrical and thermal properties of materials-Basic modeling of elements in electrical and mechanical systems.

UNIT III MEMS FABRICATION 9

MEMS Fabrication Technologies-single crystal growth- micro matching-photolithography-micro stereolithography- thin film deposition- impurities doping-diffusion- etching- bulk and surface micro machining-etch stop technique and microstructure- LIGA.

UNIT IV MICRO DEVICES -I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation– Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications –Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators-Actuation using Shape Memory Alloys.

UNITV MICRO DEVICES -II 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators– piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flowsensors.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Differentiate the characteristics of simple MEMS and its applications.

CO2: Understand the properties of various MEMS materials.

CO3: Summarize the concept of MEMS fabrication techniques.

CO4: Interpret the construction and working of Electrostatic, thermal sensors and actuators.

CO5: Comprehend the characteristics of pressure, tactile and flow sensors and understand the effects of piezoelectric sensors & actuators.

TEXT BOOKS:

1. MinhangBao 2005. *Analysis and Design Principles of MEMS Devices*,Elsevier,1st Edition.
2. Mahalik, N.P.,2008.*MEMS*, Tata McGraw Hill.
3. Chang Liu 2010.*Foundations of MEMS*, Pearson Education Inc.

REFERENCE BOOKS:

1. Vijay Varadan,K., Vinoy,K.J.,&Gopalakrishnan,S., 2006.*Smart Material Systems and MEMS: Design and Development Methodologies*: John Wiley & Sons Ltd.

2. Mohamed Gad-el-Hak 2006.*The MEMS Handbook*, CRC Press.
3. James J.Allen 2010. *Micro Electro Mechanical System Design*, CRC Press.
4. Maluf, N 2004.*An Introduction to Micro electromechanical Systems Engineering*, Artech House,2nd Edition.
5. Ananthasuresh, *G.K.,* Vinoy,K.J., Gopalakrishnan,S ,Bhat K.N &Aatre V.K., 2010. *Micro and Smart Systems,* K.J. Wiley publication.
6. Stephen D Senturia 2002.*Microsystem Design*, Kluwer Academic Publishers.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M											H	
CO2	H	M											H	
CO3	H	M											H	
CO4	H	H											H	H
CO5	H	H											H	H

H- High M-Medium L-Low

EI1537 **POWER ELECTRONICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers.
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWERSEMI-CONDUCTOR DEVICES AND CHARACTERISTICS 9

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation – Simulation tools.

UNIT II PHASE-CONTROLLED CONVERTERS 9

Single phase – Three phase – Half controlled – Fully controlled rectifiers – performance parameters -Effect of source and load inductance –– Gate Circuit Schemes for Phase Control–Dual converters.

UNIT III DC TO DC CONVERTER 9

Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost and Cuk Regulators- Soft-switching DC - DC Converters: zero-voltage-switching converters, zero-current switching converters, Multi-resonant converters and Load resonant converters-operating principles.

UNIT IV INVERTERS 9

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNITV AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control –Multistage sequence control -single phase and three phase cyclo converters –

Introduction to Matrix converters.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Analyze power electronic devices and circuits using simulation software.

CO2: Classify various types of phase-controlled converters and Gate control methods.

CO3: Design suitable dc to dc converter for specific applications.

CO4: Categorize various types of inverters and PWM Techniques.

CO5: Choose appropriate ac to ac converters for control of popular applications.

TEXT BOOKS:

1. Rashid, M.H., 2014.*Power Electronics – Circuits, Devices and Applications*, PHI, Fourth edition.
2. Dubey, G. K., Doradla, S.R., Joshi. &Sinha, R.M., 2010.*Thyristorised Power Controllers*, New Age International Publishers, New Delhi.
3. Umanand, L., 2010.*Power Electronics Essentials and Applications*, Wiley.

REFERENCE BOOKS:

1. Singh, M.D. &Khanchandani, K.B., 2017. *Power Electronics,* Tata McGraw Hill, 2nd Edition.
2. VedamSubramanyam, K., 2012.*Power Electronics,* New Age International Publishers, 2nd Edition, New Delhi.
3. Mohan, Undeland. and Robbins 2007.*Power Electronics: Converters, Applications and Design*, John Wiley and Sons, 3rd Edition, New York.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	H	H	M		L							M	H	H
CO2	H	H	M									M	H	H
CO3	H	H	M									M	H	H
CO4	H	H	M									M	H	H
CO5	H	H	M									M	H	H

H- High M-Medium L-Low

Professional Elective III

EI1631 **INSTRUMENTATION IN AGRICULTURE AND FOOD INDUSTRIES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an understanding on the need of instrumentation in agriculture and food processing sector.
- To know about food quality assessment and instruments used for the same.
- To familiar with agricultural process and its related measurements
- To get exposure to various process in agriculture and food industries with its controlling methods.
- To acquire knowledge about various food processing equipment.

UNIT I INTRODUCTION 7

Necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.

UNIT II INSTRUMENTATION FOR FOOD QUALITY ASSURANCE 10

Inline measurement for the control of food processing operations: color measurements of food, food composition analysis using infrared, microwave measurements of product variables, pressure and temperature measurement in food process control, level and flow measurement in food process control, ultrasonic instrumentation in food industry. Instrumental techniques in the quality control, Major Processes: Flow diagram of sugar plant, sensors and instrumentation set-up for it, Oil extraction plant and instrumentation set-up, Juice extraction control set-up.

UNIT III INSTRUMENTATION FOR AGRICULTURE 10

Irrigation systems: necessity, irrigation methods: overhead, center pivot, lateral move, micro irrigation systems &it's performance, comparison of different irrigation systems, soil moisture measurement methods. Major Processes: Application of SCADA for DAM parameters and control, Water distribution and management control, Auto-Drip irrigation systems, Irrigation Canal management, upstream and downstream control concepts, supervisory control.

UNIT IV GREEN HOUSES AND INSTRUMENTATION 9

Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.: Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.

UNITV DESIGN CONSIDERATIONS OF AGRICULTURAL AND FOOD PROCESSING EQUIPMENTS 9

Design of Food Processing equipments, dryers, design of dryers PHTC, RPEC, LSU and Drum Dryer, determination of heat and air requirement for drying grains.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: To understand the necessity of instrumentation in agriculture and food processing.

CO2: To Select the appropriate instruments for food quality assessment

CO3: Explain about major process involved in agriculture and drip irrigation process

CO4: To demonstrate process flow diagram and its associated control methods.

CO5: To Choose a Food Processing equipment based on its application.

TEXT BOOKS:

1. Semioh Otles, 2012. *Methods of analysis of food components and additives*, CRC Press, Taylor and Francis group, 2nd Edition.
2. Fellows, P.J., 2009. *Food Processing Technology Principles and Practice*, Woodhead Publishing, 3rd Edition.
3. Mcmillan, G. K., and Considine, D. M., 1999. *Process/Industrial Instruments and Controls Handbook*, McGraw Hill International, 5th edition.

REFERENCE BOOKS:

1. Liptak, B. G., 2005. *Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II*, CRC press, 4th Edition.
2. Hall, C. W., and Olsen, W. C., 1992. *The literature of Agriculture Engineering*, Cornell University Press.
3. Sahu, J. K., 2016. *Fundamentals of Food Process Engineering*, Alpha Science Intl Ltd.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	L									M	H	M
CO2	H	H	M									M	H	M
CO3	H	H	L									M	H	M
CO4	H	H	M									M	H	M
CO5	H	H	M									M	H	M

H- High M-Medium L-Low

EI1632 INSTRUMENTATION STANDARDS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart basic knowledge on Instrumentation standards, principles and its behaviour.
- To make the students understand the general requirements for electrical equipment in hazardous location.
- To impart basic knowledge on control valve standards.
- To impart basic knowledge on fossil power plant and nuclear power plant standards.
- To impart basic knowledge on temperature sensor standards.

UNIT I STANDARDS ORGANIZATION 9

Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. **API:** Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems.

UNIT II ISA STANDARDS 9

Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37).

UNIT III ISA STANDARDS-CONTROL VALVE AND ACTUATOR 9

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24, 75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

UNIT IV ISA STANDARDS-FOSSIL AND NUCLEAR POWER PLANTS 9

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

UNIT V BS , ISO, IEC, & ANSI 9

Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple

Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the learner will be able to:

CO1: Understand the role of standards organization.

CO2: Implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms.

CO3: Utilize the different standards related to control valve and actuators.

CO4: Implement standards related to power plant and nuclear power plant.

CO5: Select different standards related to orifice sizing, RTD and thermocouples.

TEXT BOOKS:

1. API Recommended Practice 551, 2001. *Process Measurement Instrumentation*, American Petroleum Institute, Washington, D.C, Second Edition.
2. API Recommended Practice 554, 2008. *Process Instrumentation and Control – 3 parts*, American Petroleum Institute, Washington, D.C., First Edition.
3. ISA standard 5, *Documentation of Measurement and Control Instruments and Systems*, ISA, North Carolina, USA.
4. ISA standard 12, *Electrical Equipment for Hazardous Locations*, ISA, North Carolina, USA.
5. ISA standard 20, *Instrument Specification Forms*, ISA, North Carolina, USA.
6. ISA standard 37, *Measurement Transducers*, ISA, North Carolina, USA.
7. ISA standard 75, *Control Valve Standards*, ISA, North Carolina, USA.
8. ISA standard 96, *Valve Actuator*, ISA, North Carolina, USA.
9. ISA standard 77, *Fossil Power Plant Standards*, ISA, North Carolina, USA.
10. ISA standard 67, *Nuclear Power Plant Standards*, ISA, North Carolina, USA.
11. BS EN 60584-1, 2013. *Thermocouples - EMF specifications and tolerances*, British Standard.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	L	L										M	M
CO2	H	M	M	L									H	H
CO3	H	M	M	L									H	H
CO4	H	M	M	L									H	H
CO5	H	M	M	L									H	H

H- High M-Medium L-Low

EI1633 LASERS AND OPTICAL INSTRUMENTATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge on the principles of laser generation, laser systems and its types.
- To emphasize how lasers have been used for industrial applications and knowledge on the fundamentals of holography
- To provide knowledge on the theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics, and losses associated with optical fibers.
- To provide an overview of recent advances in fiber optic sensor technology.
- To provide knowledge on the medical applications of lasers.

UNIT I FUNDAMENTALS OF LASERS 9

Lasers -I: Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions. Lasers -II: Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs

UNIT II LASER APPLICATIONS 9

Generation of Lasers: Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold. Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its Applications.

UNIT III OPTICAL FIBERS AND ITS PROPERTIES 9

Introduction, optical fibers-fundamentals, light transmission in optical fibers principles, optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles, modified fiber ends and tips principles, optical sources and detectors.

UNIT IV OPTICAL FIBER SENSORS 9

Phase and polarization fiber sensors, ring interferometer with multiturn fiber coil, optical fluid level detector, optical fiber flow sensors, optical displacement sensors, optical displacement Moire fringe modulation sensors, micro bend optical fiber sensors, intrinsic fiber sensors measurement, current measurement by single-mode optical fiber sensors, Fluro-optic temperature sensors, photo elastic pressure sensors, laser Doppler velocimeter using optical fiber

UNIT V APPLICATIONS OF FIBER OPTIC LASER SYSTEMS IN MEDICINE 9

Introduction, Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiber-optic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laparoscopic laser surgery, photodynamic therapy in oncology, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopedics, laser lithotripsy, flowchart diagrams for clinical applications of laser-fiber systems-advances

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To explain about the basic principle and working of Laser systems.

CO2: To comprehend the engineering applications of laser systems.

CO3: To explain the fundamentals of optical fiber communications

CO4: To understand the concept of optical fibers in sensor design.

CO5: To apply fiber optic laser systems in medical field.

TEXT BOOKS:

1. Wilson and Hawkes, 2010. *Opto Electronics-An Introduction*, Pearson Education,3rd Edition.
2. John Ready, 1997. *Industrial Applications of Lasers*, Academic Press,2nd Edition.
3. Keiser, G., 2017. *Optical Fiber Communications*, McGraw Hill International Edition.
4. John, M,Senior., 2014.*Optical Fiber Communications: Principles and Practice*, Pearson Education.

REFERENCE BOOKS:

1. Liu, MMK., 2010.*Principles and Applications of Optical Communications*, Tata McGraw Hill.
2. Agrawal, G.P., 2010.*Fiber Optic Communication Systems*, Wiley,4th Edition.
3. Gowar, J., 2018.*Optical Communication Systems*,Prentice Hall of India Pvt. Limited,5th Edition.
4. Bhattacharya, P., 1998.*Semiconductor Optoelectronics*, Pearson Education, 2nd Edition.
5. Djafar, K, Mynbaev and Lowell, L,Scheiner, 2001.*Fiber-Optic CommunicationsTechnology*, Prentice Hall of India Pvt. Limited,1st Edition.
6. Khare, R.P., 2004. *Fiber Optics and Optoelectronics*, Oxford Press.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes	Program Specific Outco

													mes	
	PO1	**PO2**	**PO3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O2**
CO1	H	M	L										H	
CO2	H	M	L										H	
CO3	H	M	L										H	
CO4	H	M	L										H	
CO5	H	M	L										H	

H- High M-Medium L-Low

EE1603 RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyze topology of the stand-alone and grid connected photo-voltaic systems.
- To outline the various forms of wind energy conversion systems.
- To outline the concept of other non-conventional energy sources such as bio mass, hydro, ocean, geothermal etc.

UNIT I RENEWABLE ENERGY (RE) SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources(solar, wind, biomass, ocean and geothermal), Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 9

Basics of wind energy- Classification of wind turbine: Horizontal Axis wind turbine and

Vertical axis wind turbine-Power in the Wind – Types of Wind Power Plants(WPPs)– Components of WPPs-Working of WPPs(DFIG,PMSG & SCIG based WPPs)- Siting of WPPs-Grid Connected and Stand alone WPPs

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking (P&O and Incremental conductance algorithm), Applications.

UNIT IV BIOMASS & OTHER RE SOURCES 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes- Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Essential components of hydroelectric system, Pumped Storage in Hydro power plants.

UNIT V OCEAN & MODERN ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able

CO1: To explain the importance of various renewable energy sources and its existing scenario in world.

CO2: To Analyze the different configurations of the wind energy conversion systems.

CO3: To Develop a stand-alone photo voltaic system with MPPT algorithm.

CO4: To Discuss the basic concepts of Biomass Energy and other renewable energy sources such as hydro, geothermal etc.

CO5: To elucidate the concepts of Ocean and modern energy sources such as fuel cell, batteries etc.

REFERENCES:

1. Joshua Earnest & Tore Wizeliu, 2011. *Wind Power Plants and Project Development*, PHI Learning Pvt.Ltd, New Delhi.
2. Kothari,D.P., Singal,K.C., &RakeshRanjan, 2013. *Renewable Energy Sources and Emerging Technologies*, PHI Learning Pvt.Ltd, New Delhi.
3. Scott Grinnell, 2016. *Renewable Energy & Sustainable Design*, CENGAGE Learning, USA.
4. Bradley,A. Striebig,Adebayo, Ogundipe,A. and Maria Papadakis,2016. *Engineering Applications in Sustainable Design and Development*", Cengage Learning India Private Limited.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	M									L	L	L
CO2	H	M	M									M	L	L
CO3	H	M	M									M	L	L
CO4	H	M	M									M	L	L
CO5	H	M	M									M	L	L

H- High M-Medium L-Low

Professional Elective IV

EI1634 EMBEDDED SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basic concept of Embedded System.
- To provide the basic concepts of RTOS.
- To expose the ideas on ARM processor.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Embedded system Vs General Computing system-Structural unit in Embedded system-Design Process in Embedded system-Challenges in Embedded system-Hardware-Software Co-design-Selection of Processor and memory-Timer & Counting devices-Applications- Smart Card, Digital Camera and AVM.

UNIT II EMBEDDED NETWORKING 9

I/O Devices and Ports-Serial Communication Devices-Serial Peripheral Interface- I^2C-CAN Bus-RS232-Wireless and Mobile system protocols- Need for device driver.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- Objectives-Different phases-Modeling-Data Flow Graph Model-State Machine Model-Sequential Programing Model-Concurrent Programing Model- Object Oriented Model.

UNIT IV REAL TIME OPERATING SYSTEMS 9

Introduction to RTOS- Process, Task, Thread-Multiprocessing and Multithreading-Scheduling algorithm-Inter-process communication-Signals, pipes, Semaphores, shared data problem, Queues and Mailbox- VxWorks-Mucos-II.

UNIT V ARM PROCESSORS 9

Block diagram-Features of LPC 214x- ARM 9- ARM Cortex M3 - Simple instruction sets in LPC214x- Case study using LPC 214x.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, the students will be able to

CO1: Illustrate the basic concept of embedded systems.

CO2: Apply the suitable embedded protocol for different applications.

CO3: Explain the embedded system development.

CO4: Distinguish real time tasks and scheduling concepts.

CO5: Describe the different architecture of ARM processor.

TEXT BOOKS:

1. Rajkamal., 2013. *Embedded System-Architecture, Programming, Design*, McGraw Hill.
2. Peckol., 2010. *Embedded system Design*, John Wiley & Sons.

REFERENCE BOOKS:

1. Lyla, B, Das., 2013. *Embedded Systems-An Integrated Approach*, Pearson.
2. Shibu, K.V., 2009. *Introduction to Embedded Systems*, Tata McGraw Hill.
3. Elicia White., 2011. *Making Embedded Systems*, O' Reilly Series, SPD.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	H	H	M								M	H	H
CO2	H	H	H	M								M	H	H
CO3	H	M	M	M								M	H	H
CO4	H	H	H	M								M	H	H
CO5	H	M	M	M								M	H	H

H- High M-Medium L-Low

		L	T	P	C
EI1635	**INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the method of oil recovery and the steps involved in oil gas production process.
- To understand the process behavior of important unit operations in petrochemical industry through mathematical model.
- To apply knowledge to select the appropriate control strategy for the selective process.
- To know about the most important derivatives obtained from petroleum products.
- To realize the need of selection and maintenance of instruments in petrochemical industry.

UNIT I OIL EXTRACTION AND OIL GAS PRODUCTION 9

Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT II IMPORTANT UNIT OPERATIONS IN REFINERY 9

Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.

UNIT III DERIVATIVES FROM PETROLEUM 9

Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene —Derivatives from ethylene – Derivatives from propylene.

UNIT IV IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9

BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT V SAFETY IN INSTRUMENTATION SYSTEMS 9

Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: To explain oil gas production process and important unit operations in a refinery.

CO2: To analyze mathematical model of unit operations in petrochemical industry.

CO3: To select appropriate control strategy for unit operations in a refinery.

CO4: To estimate the chemical derivatives obtained from petroleum products.

CO5: To identity suitable methods for safety instrumentation followed in process industries.

TEXT BOOKS:

1. Balchen, J.G. and Mumme, K.I., 1988. *Process Control Structures and Applications*, Von Nostrand Reinhold Company, New York.
2. Waddams, A.L., 1973. *Chemicals from Petroleum*, Wiley, (digitized in 2007).

REFERENCE BOOKS:

1. Paul Gruhn. and Harry Cheddie., 2006. *Safety Instrumented Systems: Design, Analysis, and Justification*, 2nd Edition, ISA Press.
2. Liptak, B.G., 2005. *Instrumentation in Process Industries*, Chilton Book Company.
3. Austin, G.T. Shreeves., 1985. *Chemical Process Industries*, McGraw Hill International Student Edition, Singapore.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	**Program Outcomes**	**Program Specific Outco**

													mes	
	PO1	**PO2**	**PO3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PS O2**
CO1	H	L											M	L
CO2	H	M	L										M	M
CO3	H	H	M										M	M
CO4	H	L	L										L	L
CO5	H	M	M										M	M

H- High M-Medium L-Low

EI1636 INTRODUCTION TO MACHINE LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To have the basic knowledge in machine learning.
- To develop the models using machine learning concept.
- To analyze the data using different techniques.
- To develop the knowledge in optimization algorithm.
- To write python coding for machine learning.

UNIT I INTRODUCTION 9

Learning - Types of machine learning - Supervised learning - The brain and the neurons, Linear Discriminants -Perceptron - Linear Separability -Linear Regression - Multilayer perceptron - Examples of using MLP - Back propagation of error.

UNIT II CLASSIFICATION OF ALGORITHMS 9

Decision trees - Constructing decision trees - Classification of regression trees - Regression example - Probability and Learning: Turning data into probabilities - Some basic statistics - Gaussian mixture models - Nearest Neighbor methods.

UNIT III ANALYSIS 9

The k-Means algorithm - Vector Quantization’s - Linear Discriminant Analysis - Principal

component analysis - Factor Analysis - Independent component analysis - Locally Linear embedding – Isomap - Least squares optimization - Simulated annealing.

UNIT IV OPTIMIZATION TECHNIQUES 9

The Genetic algorithm - Genetic operators - Genetic programming - Combining sampling with genetic programming - Markov Decision Process - Markov Chain Monte Carlo methods: sampling - Monte carlo - Proposal distribution.

UNIT V PYTHON FOR MACHINE LEARNING 9

Baysean Networks - Markov Random moFields - Hidden Markov Models -Tracking methods. Python: Installation - Python for MATLAB AND R users - Code Basics - Using NumPy and MatPolitB.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the learner will be able to:

CO1: Apply multilayer perceptron using simple machine learning techniques.

CO2: Select the suitable decision trees and statistics models.

CO3: Analyze the different set of data for machine learning.

CO4: Apply optimization techniques for real time applications.

CO5: Implement the Python programming for machine learning.

TEXT BOOKS:

1. Kevin, P, Murphy., 2016. *Machine Learning – A probabilistic Perspective*, MIT Press.
2. Randal,S., 2016. *Python Machine Learning*, PACKT Publishing.

REFERENCE BOOKS:

1. EthemAlpaydin., 2016. *Machine Learning: The New AI*, MIT Press.
2. ShaiShalev-Shwartz and Shai Ben-David, 2014. *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press.
3. Sebastian Raschka., 2015. *Python Machine Learning*, PACKT Publishing Ltd.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

		Progra

CO	Program Outcomes												m Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	M									M	H	H
CO2	H	H	M									M	H	H
CO3	H	H	H	H								M	H	H
CO4	H	H	H	H								M	H	H
CO5	H	H	H									M	H	H

H- High M-Medium L-Low

EI1637 NON-DESTRUCTIVE TESTING METHODS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand principle behind various NDT techniques.
- Know about NDT equipment and accessories.
- Explain working procedures of various NDT techniques.
- Learn materials that could be inspected – codes, standards, specifications.
- Understand the principle of radiographic imaging.

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION 9

Introduction to various non-destructive methods- Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

UNIT II LIQUID PENETRANT TESTING, MAGNETIC PARTICLE TESTING 9

Physical principles, procedure for penetrant testing, Penetrant Testing materials, Penetrant testing methods – water washable, post – Emulsifiable methods, Applications, Principle of MPT, procedure used for testing a component , Equipment used for MPT, Applications

UNIT III EDDY CURRENT TESTING, ACOUSTIC EMISSION 9

Principles, Instrumentation for ECT, Absolute - differential probes, Techniques – High sensitivity Techniques, Applications - Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures

UNIT IV ULTRASONIC TESTING 9

Principle , Ultrasonic transducers, Inspection Methods, Normal Inscudent Pulse – Echo Inspection , Through – transmission Testing , angle Beam Pulse – Echo testing, Techniques for Normal Beam Inspections, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan – Applications

UNIT V RADIOGRAPHY,COMPARISON AND SELECTION OF NDT METHODS 9

Basic principle, Effect of radiation on film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

OUTCOMES:

Upon Successful Completion of this course, the students will be able to

CO1: Describe the NDT equipments and accessories.

CO2: Apply the NDT techniques in practical applications.

CO3: Explain eddy current testing and acoustic emission.

CO4: Classify the methods of ultrasonic testing.

CO5: Compare and select the various NDT techniques based on the applications.

TEXT BOOKS:

1. Baldev Raj., Jayakumar, T. and Thavasimuthu, M., 2014. *Practical Non-Destructive Testing*, Narosa Publishing House.
2. Ravi Prakash., 2010. *Non-Destructive Testing Techniques*, 1st revised edition,

New Age International Publishers.

REFERENCE BOOKS:

1. Peter, J. Shull., 2002. *Non Destructive Evaluation: Theory, Techniques and Application* Marcel Dekker, Inc., New York,
2. Paul, E. Mix., 2005. *Introduction to Non-destructive testing: a training guide*, Wiley, 2nd Edition, New Jersey.
3. Krautkramer, J., 1996. *Ultra Sonic Testing of Materials*, 1st Edition, Springer Verlag Publication, New York.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

CO	Program Outcomes												Program Specific Outcomes	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	L									M	M	M
CO2	H	M	L									M	M	M
CO3	H	M	L									M	M	M
CO4	H	L	M									M	M	M
CO5	H	M	M									M	M	M

H- High M-Medium L-Low

Open Elective I

OEI151 **INTRODUCTION TO ANALYTICAL INSTRUMENTS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.

UNIT I SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - Types of optical instruments – Applications.

UNIT II MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III NMR AND MASS SPECTROMETRY 9

Theory of NMR –– chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources. Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values –instrumentation.

UNIT IV SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance-Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNITV ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry - applications of voltametry. Study of surfaces – Scanning probe microscopes – AFM and STM.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: List out the various optical instruments which used in the various regions of the spectrum

CO2: Comprehend the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.

CO3: Understand the working principle, types and applications of NMR and Mass spectroscopy

CO4: Suggest a suitable analytical method of chromatography for a specific purpose and alternative analytical methods for quality assurance.

CO5: Illustrate the latest ideas on ion-selective electrodes and microscopes which have potential applications in medical field, food and beverage industries.

TEXT BOOKS:

1. Skoog, D.A., F. James Holler, and Stanky R.Crouch 2017. *Instrumental Methods of Analysis*, Cengage Learning , 7th edition.

2. Willard, H.H., Merritt, L.L., Dean, J.A., & Settle, F.A., 2012. *Instrumental methods of analysis*, CBS publishing & distribution, 7th Edition.

3. Braun, R.D., 2012. *Introduction to Instrumental Analysis*, Pharma Book Syndicate, Singapore, 2nd edition.

4. Ewing, G.W**.,** 2003. *Instrumental Methods of Analysis*, McGraw Hill.

REFERENCE BOOKS:

1. Khandpur, R.S., 2018. *Handbook of Analytical Instruments*, Tata McGraw-Hill publishing Co. Ltd.,5th edition.

2. Robert E. Sherman., 1996. *Analytical Instrumentation*, Instruments Society of America.

3. Mudakavi, J.R.,*NPTEL lecture notes on Modern Instrumental methods of Analysis,* IISC, Bangalore.

OEI152	**INTRODUCTION TO BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I HUMAN BODY SUBSYSTEM AND TRANSDUCERS 9

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of pCO_2 and pO_2 in blood

UNIT III ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY 9

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typicalwaveforms – Electrical safety in medical environment, shock hazards – leakage current - Instruments for - Checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES 9

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – IoT protocols in health care.

UNIT V LIFE ASSISTING AND THERAPEUTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Gain knowledge on various sensing and measurement devices of electrical origin.

CO2: Provide latest ideas on devices of non-electrical devices.

CO3: Understand the analysis of various organ types.

CO4: Bring out the important and modern methods of imaging techniques and their analysis.

CO5: Explain the medical assistance/techniques and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell., 2007.*Biomedical Instrumentation and Measurement*, Prentice hall of India, New Delhi.
2. JosephJ.carr & John M. Brown, 2012.*Introduction to Biomedical Equipment Technology,* John Wiley and sons, New York, 4th Edition.
3. Khandpur R.S., 2019.*Handbook of Biomedical Instrumentation*, Tata McGraw-Hill, New Delhi, 3rd Edition.

REFERENCE BOOKS:

1. John G. Webster., 2015.*Medical Instrumentation Application and Design*, John Wiley and sons, New York.
2. Duane Knudson., 2007. *Fundamentals of Biomechanics*, Springer, 2nd Edition.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, & Murat M., 2011.*Health Care Systems, Technology and Techniques*, Springer, 1st Edition.
4. Ed. Joseph, D, Bronzino., 2006.*The Biomedical Engineering Hand Book*, Third Edition, Boca Raton, CRC Press LLC.
5. Arumugam, M, 2003.*Bio-Medical Instrumentation*, Anuradha Agencies.

OEI153 **SENSORS AND TRANSDUCERS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magnetoresistive – Hall Effect, Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric, Temperature – Thermistor, RTD. Flow measurement-electromagnetic flow meter, ultrasonic flow meter

UNITV MISCELLANEOUS AND SMART SENSORS 9

Bio sensors, Chemical sensors, SQUID sensor, IC sensors, Remote sensors, Smart sensors, Film sensors, Acoustic sensors, Tactile sensors, MEMS & Nano sensors, Introduction to flexible sensors and sensor fusion.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Understand the basics of measurement process, calibration, error analysis and classification of transducers and its characteristics

CO2: Discuss the principle of operation, construction and applications of motion, proximity and ranging sensors

CO3: Describe the principle of operation, construction and applications of force, magnetic and heading sensors

CO4: Explain about the principle of operation, construction and applications of optical, pressure and temperature sensors

CO5: Discuss the basic principles of various smart sensors

TEXT BOOKS:

1. Ernest, O Doebelin., 2009, *Measurement Systems – Applications and Design*, Tata McGraw-Hill.

2.Sawney, A. K, and Puneet Sawney., 2013, *A Course in Mechanical Measurements and Instrumentation and Control*", 12th edition, Dhanpat Rai & Co, New Delhi.

REFERENCE BOOKS:

1. Patranabis, D., 2010, *Sensors and Transducers*, 2nd Edition, PHI, New Delhi.

2. John Turner and Martyn Hill., 1999, *Instrumentation for Engineers and Scientists*, Oxford Science Publications.

3. Richard Zurawski., 2015, *Industrial Communication Technology Handbook,* 2nd edition, CRC Press.