Puducherry Technological University, Puducherry –605014

(A Technological University of Government of Puducherry)

Curriculum and Syllabi for B.Tech.(Electronics and Instrumentation Engineering)

(Effective from Academic year 2024-25)

(Subject to the Approval of the Fifth Academic Council meeting of Puducherry Technological University)

CURRICULUM AND SYLLABUS

The Curriculum of B.Tech. (Electronics and Instrumentation Engineering) is designed to fulfil the Vision, Mission, Program Educational Objectives (PEO) and the Program Outcomes (PO) listed below.

Vision

To produce world class industry ready Instrumentation Engineers and to establish state of art Instrumentation facilities to cater to the needs of the society

Mission Statements

M1 To provide a high-quality teaching and learning experience through a state-of-the-art curriculum.

M2 To engage in collaborative research and industrial projects, thereby creating Centre's of Research in Instrumentation that foster long-term interactions between academia and industry.

M3 To maximize human potential by nurturing intellectually capable and imaginative leaders across diverse professions through the development of Centers of Excellence

M4 To foster ongoing engagement with alumni, students, parents, faculty, and other stakeholders to ensure relevance and adaptability in a globalized Environment.

M5 To enhance the global visibility of academic programs and attract talent at all levels.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	Our graduates acquire a strong foundation in mathematics, science, and engineering fundamentals, enabling them to analyze and develop technically sound solutions to complex engineering problems.
PEO2	Our graduates possess specialized technical knowledge in Electronics, Instrumentation, and Control, empowering them to address contemporary challenges, engage in cutting-edge research, and development.
PE03	Our graduates demonstrate expertise in designing and developing solutions using modern methodologies, equipping them to pursue higher education, research, and global career opportunities in academia, industry, and entrepreneurship.
PE04	Our graduates uphold high ethical standards, exhibit strong communication and leadership skills, and work collaboratively in diverse teams, making meaningful contributions to society and professional communities.

PROGRAM OUTCOMES (PO)

PO1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	Graduates will be able to apply their knowledge of Electronics and Instrumentation to optimize measurement systems for diverse applications. They will achieve proficiency in Electronics, Instrumentation, and Control-related fields, enabling them to address contemporary technical challenges and explore opportunities in innovation-driven entrepreneurship.
PSO2	Graduates will leverage modern tools and methodologies for the design and analysis of advanced control systems. They will uphold high ethical standards, demonstrate effective communication skills, and collaborate efficiently in teams, contributing significantly to societal and technological advancements.

Distribution of credits among the subjects grouped under various categories:

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Basic science courses	20	BSC
2	Engineering science courses	6	ESC
3	Professional core courses	94	PCC
4	Professional elective courses	12	PEC
5	Ancillary Stream Courses	12	ANC
6	Ability enhancement courses	10	AEC
7	Skill enhancement courses	6	SEC
8	Value added courses	4	VAC
	Total	**164**	

Semester-wise Courses and Credits

Semester I

Group-II (CS1, CS2, IT1, EE1, EI1, CE1, CE2)

Course Code	Course	CCC	Periods			Credits
			L	T	P	
	3 weeks compulsory Induction Program					
MAUC101	Mathematics I	BSC	3	1		4
EIUC101	Fundamentals of Instrumentation	PCC	3	1		4
CYUC101	Chemistry	BSC	3			3
CSUC101	Programming for Problem Solving	ESC	2			2
HSUA101	English for Communication	AEC	2			2
GEUS102	Basic Engineering Skills Laboratory - II	SEC	1		4	3
GEUV102	Essence of Indian Traditional Knowledge	VAC	1			1
CYUC102	Chemistry Laboratory	BSC			2	1
CSUC102	Computer Programming Laboratory	ESC			2	1
Total			15	2	8	
			25			21

CCC - Course Category Code, L-Lecture, T – Tutorial, P – Practical
XX – Department Code
xx- serial number

Group-II (CS1, CS2, IT1, EE1, EI1, CE1, CE2)

Course Code	Course	CCC *	Periods			Credits
			L	T	P	
MAUC102	Mathematics II	BSC	3	1		4
EIUC102	Basics of Industrial Automation and Control	PCC	3	1		4
PHUC101	Physics	BSC	3			3
MEUC101	Engineering Graphics	ESC	1		4	3
HSUA102	Professional English	AEC	2			2
GEUS102	Basic Engineering Skills Laboratory - I	SEC	1		4	3
GEUV101	NSS, Yoga and Health	VAC			2	1
PHUC102	Physics Laboratory	BSC			2	1
Total			13	2	12	
			27			21

Exit Option for the students who opt to exit after completion of first year of B.Tech Programme and have secured a minimum of 42 credits will be awarded a UG certificate in a discipline if, in addition they complete one vocational course of 4 credits during the summer vacation of the first year

Semester III

Course Code	Course	CCC	Periods			Credits
			L	T	P	
MAUC104	Transforms and Partial Differential Equations	PCC	3	1		4
EIUC103	Electric Circuits and Network Analysis	PCC	3	1		4
EIUC104	Analog circuit Design	PCC	3			3
EIUC105	Transducers and Measurement systems	PCC	3			3
HSUA103	Entrepreneurship	AEC	2			2
GEUV103	Environmental Education	VAC	1			1
EIUC106	Analog Circuits Laboratory	PCC			3	1.5
EIUC107	Transducers and Measurement systems Laboratory	PCC			3	1.5
Total			15	2	6	-
			23			20

Semester IV

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUC108	Electrical and Electronics instruments	PCC	3	1		3
EIUC109	Signal processing	PCC	3	1		4
CSUC137	Data Structure and Object-Oriented Programming	PCC	3			3
EIUC110	Control systems	PCC	3	1		4
EIUC111	Digital system Design	PCC	3			3
HSUA104	Design Thinking	AEC	2			2
GEUC104	Universal Human values	VAC	1			1
EIUC112	Simulation Laboratory	PCC			3	1.5
CSUC138	Data Structure and Object-Oriented Programming Laboratory	PCC			3	1.5
Total			18	2	6	
			26			23

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUN1XX	Ancillary stream course 1	ANC	3			3
EIUH101	Design of Sensors and Transducers	HNC	3	1		4

Exit Option for the students who opt to exit after completion of second year of B.Tech Programme and have secured a minimum of 87 credits will be awarded a UG Diploma in a discipline if, in addition they complete one vocational course of 4 credits during the summer vacation of the second year.

Semester V

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUC113	Industrial instrumentation	PCC	3			3
EIUC114	VLSI Design	PCC	3			3
EIUC115	System Design using 8051 Microcontroller	PCC	3			3
HSUA105	Industrial Economics and Management	AEC	2			2
EIUE1xx	Professional Elective 1	PEC	3	1		4
EIUC116	System Design using 8051 Microcontroller Laboratory	PCC			3	1.5
EIUC117	VLSI Design Laboratory	PCC			3	1.5
EIUC118	Instrumentation system design Laboratory	PCC			3	1.5
Total			14	3	9	
			26			19.5

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUN1XX	Ancillary stream course 2	ANC	3			3
EIUH102	Measurement Data Analysis	HNC	3	1		4

Semester VI

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUC119	Analytical Instruments	PCC	3			3
EIUC120	Embedded System Design	PCC	3			3
EIUC121	Process Control	PCC	3			3
EIUE1xx	Professional Elective 2	PEC	3	1		4
EIUC122	Process Control Laboratory	PCC			3	1.5
EIUC123	Embedded System Design Laboratory	PCC			3	1.5
EIUC124	Virtual Instruments Laboratory	PCC			3	1.5
EIUC125	Internship	PCC				2
Total			12	2	9	
			23			19.5

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUN1XX	Ancillary stream course 3	ANC	3			3
EIUH103	Field Instruments for Process Control	HNC	3	1		4

Exit Option for the students who opt to exit after completion of third year of B.Tech Programme and have secured a minimum of 133 credits will be awarded a B.Sc. (Engg.) in a discipline.

Semester VII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUC126	PLC & DCS	PCC	3			3
EIUC127	System Design Using Single Board Computer	PCC	3	1		4
EIUE1xx	Professional Elective 3	PEC	3	1		4
EIUC128	Robotics and Automation	PCC				3
EIUC129	Industrial Automation Laboratory	PCC			3	1.5
EIUC130	System Design Using Single Board Computer Laboratory	PCC			3	1.5
EIUC131	Mini project	PCC			4	2
EIUC132	Comprehensive viva	PCC				1
Total			12	2	4	
			18			20

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUN1XX	Ancillary stream course 4	ANC	3			3
EIUH104	Advanced Control Systems	HNC	3	1		4

Semester VIII

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUC133	Main Project	PCC			16	8
Total					16	
			16			8

Course Code	Course	CCC	Periods			Credits
			L	T	P	
EIUH105	Seminar	HNC				2

List of Professional Elective Courses

Professional Elective	Course code	Course	**Semester**
Professional Elective I	EIUE101	Digital Image Processing	**V**
	EIUE102	Power Plant Instrumentation	
	EIUE103	Industrial Electronics	
	EIUE104	Virtual Instrumentation	
	EIUE105	Instrumentation System Design	
Professional Elective II	EIUE106	Biomedical Instrumentation	**VI**
	EIUE107	Cyber Security in Industrial Automation	
	EIUE108	Design of Process Control System Components	
	EIUE109	Applied Soft Computing	
	EIUE110	Sustainable Instrumentation Design	
Professional Elective III	EIUE111	Fiber Optics and Laser Instrumentation	**VII**
	EIUE112	MEMS	
	EIUE113	Computer Control of Process	
	EIUE114	Instrumentation in Petrochemical Industry	
	EIUE115	Basic Troubleshooting for Instrumentation Engineers	

Courses offered under various categories:

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MAUC101	Mathematics – I	I	4	20
	PHUC101	Physics	II	3	
	CYUC101	Chemistry	I	3	
	PHUC102	Physics laboratory	II	1	
	CYUC102	Chemistry Laboratory	I	1	
	MAUC102	Mathematics –II	II	4	
	MAUC104	Transforms, Partial Differential Equations and Statistics	III	4	
ESC	MEUC101	Engineering Graphics	II	3	6
	CSUC101	Programming for Problem Solving	I	2	
	CSUC102	Computer Programming Laboratory	I	1	
PCC	EIUC101	Fundamentals of Instrumentation	I	4	94
	EIUC102	Basics of Industrial Automation and Control	II	4	
	EIUC103	Electric Circuits and Network Analysis	III	4	
	EIUC104	Analog Circuit Design	III	3	
	EIUC105	Transducers and Measurement systems	III	3	
	EIUC106	Analog Circuits Laboratory	III	1.5	
	EIUC107	Transducers and Measurement systems Laboratory	III	1.5	
	EIUC108	Electrical and Electronics Instruments	IV	3	
	EIUC109	Signal processing	IV	4	
	CSUC137	Data Structure and Object-Oriented Programming	IV	3	
	EIUC110	Control systems	IV	4	
	EIUC111	Digital System Design	IV	3	
	EIUC112	Simulation Laboratory	IV	1.5	
	CSUC138	Data Structure and Object-Oriented Programming Laboratory	IV	1.5	
	EIUC113	Industrial instrumentation	V	3	
	EIUC114	VLSI Design	V	3	
	EIUC115	System Design using 8051 Microcontroller	V	3	
	EIUC116	System Design using 8051 Microcontroller Laboratory	V	1.5	
	EIUC117	VLSI Design Laboratory	V	1.5	
	EIUC118	Instrumentation System Design Laboratory	V	1.5	
	EIUC119	Analytical Instruments	VI	3	
	EIUC120	Embedded System Design	VI	3	
	EIUC121	Process Control	VI	3	
	EIUC122	Process Control Laboratory	VI	1.5	
	EIUC123	Embedded System Design Laboratory	VI	1.5	
	EIUC124	Virtual Instruments Laboratory	VI	1.5	

	EIUC125	Internship	VI	2	
	EIUC126	PLC & DCS	VII	3	
	EIUC127	System Design Using Single Board Computer	VII	4	
	EIUC128	Robotics and Automation	VII	3	
	EIUC129	Industrial Automation Laboratory	VII	1.5	
	EIUC130	System Design Using Single Board Computer Laboratory	VII	1.5	
	EIUC131	Mini project	VII	2	
	EIUC132	Comprehensive viva	VII	1	
	EIUC133	Main Project	VIII	8	
PEC	EEUE1xx	Professional Elective – I	V	4	**12**
	EEUE1xx	Professional Elective – II	VI	4	
	EEUE1xx	Professional Elective – III	VII	4	
AEC	HSUA101	English for Communication	I	2	**10**
	HSUA102	Professional English	II	2	
	HSUA103	Entrepreneurship	III	2	
	HSUA104	Design Thinking	IV	2	
	HSUA105	Industrial Economics and Management	VI	2	
SEC	GEUS101	Basic Engineering Skills Laboratory - I	I/II	3	6
	GEUS102	Basic Engineering Skills Laboratory - II	I/II	3	
VAC	GEUV101	NSS, Yoga and Health	II	1	**4**
	GEUV102	Essence of Indian Traditional Knowledge	I	1	
	GEUV103	Environmental Education	III	1	
	GEUC104	Universal Human values	IV	1	
ANC		Ancillary Stream Elective course	**IV-VII**	12	**12**
Total					**164**

<table>
<tr><td colspan="2">Department : Mathematics</td><td colspan="4">Programme : B.Tech.- EIE.</td><td colspan="3">Semester Exam Type : TY</td></tr>
<tr><td colspan="2">Semester : Three</td><td colspan="4">Subject Category: BSC</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>MAUC104</td><td>Transforms and Partial Differential Equations</td><td>3</td><td>1</td><td>-</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Basic Integration and Probability</td></tr>
<tr><td rowspan="5">Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Explain the concept of Laplace Transform and its inverse.</td></tr>
<tr><td>CO2</td><td colspan="7">Utilize Laplace Transform to solve the ODEs.</td></tr>
<tr><td>CO3</td><td colspan="7">Analyze various methods of solving first order PDE.</td></tr>
<tr><td>CO4</td><td colspan="7">Determine the solution of higher order PDE and applying the method of variable separation to solve wave equation.</td></tr>
<tr><td>CO5</td><td colspan="7">Make use of Fourier series method to solve heat equations.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">LAPLACE TRANSFORMS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Definition of Laplace Transform, Inverse Laplace Transform, Linearity property, Laplace transform of unit step function, Unit impulse function and some elementary functions, Change of scale and first shifting property, Laplace transform of Periodic functions</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">APPLICATIONS OF LAPLACE TRANSFORMS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Derivatives and integrals of Laplace transform, Transform of derivatives and integrals, Application: Solution of single ordinary linear differential equation with constant coefficients, Initial and Final value theorem.</td><td>CO1, CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">PARTIAL DIFFERENTIAL EQUATIONS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">General and Singular solution of PDE, Complete Solution of First order linear and Non-linear PDE, First order linear PDE - method of grouping and Lagrange's multipliers method.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">HIGHER ORDER PDE AND BOUNDARY VALUE PROBLEMS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Homogeneous linear PDE of higher order with constant coefficients. Solution of partial differential equation by the method of separation of variables. Application of PDE: Variable separable solutions of the one dimensional wave equation, Transverse vibration of a stretched string.</td><td>CO3, CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">ONE DIMENSIONAL AND TWO DIMENSIONAL HEAT FLOW EQUATION</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Heat Equation, Solution of one-dimensional heat equation by the method of separation of variables, Temperature distribution with zero and non-zero boundary values, Two dimensional heat flow under steady state conditions (Cartesian).</td><td>CO3, CO4, CO5</td></tr>
<tr><td colspan="2">Total contact Periods: 48</td><td colspan="2">Total Tutorials: 12</td><td colspan="3">Total Practical Classes: 00</td><td colspan="2">Total Periods: 60</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. Veerarajan T, Engineering Mathematics I & II, McGraw-Hill Education(India) Private Limited, 2019
2. Veerarajan T, Transforms and Partial Differential Equations, Third Edition, McGraw-Hill Education(India) Private Limited, 2016.
3. Venkataraman M.K., Engineering Mathematics, Third Year, Part-B, The National Publishing Company, Chennai, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics (9 th Ed), John Wiley & Sons, New Delhi, 2011.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
6. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2011.
7. B.S. Grewal "Higher Engineering Mathematics" (44th Ed), Khanna Publishers, 2018.</td></tr>
</table>

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department: EIE</td><td colspan="7">Programme : B.Tech.-EIE</td></tr>
<tr><td colspan="2">Semester : Three</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC103</td><td>Electric Circuits and Network Analysis</td><td>3</td><td>1</td><td>-</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Apply network theorems to analyze DC and AC electrical circuits.</td></tr>
<tr><td>CO2</td><td colspan="7">Analyze resonance circuits, coupled circuits, and transient responses using mathematical techniques.</td></tr>
<tr><td>CO3</td><td colspan="7">Evaluate network functions, two-port network parameters, and circuit responses using Laplace transforms.</td></tr>
<tr><td>CO4</td><td colspan="7">Apply graph theory in network analysis and design basic passive filters.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">NETWORK THEOREMS FOR DC AND AC CIRCUITS</td><td colspan="2">Periods12:</td></tr>
<tr><td colspan="8">Review of loop and nodal methods of analysis, star-to-delta or delta-to-star transformation, Source transformation, Superposition theorem, Thevenin’s theorem, Norton’s theorem, reciprocity theorem, compensation theorem, Maximum power transfer theorem, Millman’s theorem and Tellegen’s theorem applied to dc and ac circuits.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">RESONANCE AND COUPLED CIRCUITS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Resonance – Series and parallel resonance circuits- Concept of band width and Q factor.
Coupled Circuits: Faraday’s laws of electromagnetic induction – Concept of self and mutual inductance – dot convention – coefficient of coupling</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">TRANSIENT ANALYSIS</td><td colspan="2">Periods:12</td></tr>
<tr><td colspan="8">Initial conditions in elements, Transient response of R-L, R-C, R-L-C circuits (Series combinations only) for step and sinusoidal excitations -Solution using Laplace transform</td><td>CO2, CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">NETWORK FUNCTIONS AND NETWORK PARAMETERS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Network functions: The concept of complex frequency- concept of transformed network- driving point impedance and admittance-transfer function- Properties of driving point impedance -poles and zeros. Z, Y, ABCD, hybrid parameters and their relations– 2-port network parameters using transformed variables.</td><td>CO3</td></tr>
<tr><td>UNIT-V</td><td colspan="6">GRAPH THEORY And PASSIVE FILTERS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Graph Theory: Incidence, Tie-set, and Cut-set Matrices, Network Topology and its Application in Circuit Analysis. Classification of filters - Analysis of a proto type low pass filter and High pass filters- Analysis of a proto type Band pass and Band stop filters- BPF and BSF-Lowpass filter with RL and RC sections-High pass filter with RC and RL Sections-Band pass filter with RLC circuits</td><td>CO2, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="3">Tutorial Periods:15</td><td colspan="2">Practical Periods: 00</td><td colspan="2">Total Periods:60</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. William Hayt and Jack E. Kimmerly, Engineering circuit analysis, McGraw Hill Company, 8th edition, 2013.
2. P. Ramesh Babu, Circuit theory, Second Edition, Scitech Publications Pvt. Ltd, 2017.
3. N.C. Jagan& C.Lakshminarayana, Network Theory, B.S Publications, 2006.
4. Kuriakose, Circuit Theory, PHI Learning, 2005</td></tr>
</table>

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department: **EIE**			Programme : **B.Tech. - EIE**						
Semester : **Three**			Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC104	**Analog Circuits Design**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	Basic Electrical and Electronic Circuits								
Outcome: At the end of the course the student will be able to	**CO1**	Understand the characteristics of semiconductor devices and analyze biasing circuits.							
	CO2	Analyze small-signal models, frequency response, and feedback amplifiers							
	CO3	Design and apply operational amplifiers for various linear and non-linear applications							
	CO4	Evaluate the performance of analog circuits using simulation tools							
UNIT-I	**Semiconductor Devices and Biasing Circuits**							**Periods: 9**	
Diode Characteristics: Ideal vs. Practical - Diode Circuits: Rectifiers, Clippers, Clampers, Voltage Regulators (Zener) -Bipolar Junction Transistor (BJT) Characteristics -Field Effect Transistor (FET and MOSFET) Characteristics									**CO1**
UNIT-II	**Small Signal and Frequency Response Analysis**							**Periods: 9**	
Biasing Techniques for BJT -Small Signal Models of BJTs -Single-Stage Amplifiers: Common Emitter, Common Collector, Common Base -Frequency Response of Amplifiers									**CO2**
UNIT-III	**Feedback Amplifiers and Oscillators**							**Periods: 9**	
Introduction to Feedback: Negative & Positive Feedback -Types of Feedback Amplifiers and their Analysis -Stability and Barkhausen Criterion -Sinusoidal Oscillators: RC Phase Shift, Wien Bridge, Hartley, Colpitts, and Crystal Oscillators.									**CO2**
UNIT-IV	**Operational Amplifiers and Applications**							**Periods: 9**	
Op-Amp Basics: Characteristics and Parameters -Linear Applications: Inverting, Non-Inverting, Summing, Difference Amplifiers -Non-Linear Applications: Comparators, Schmitt trigger, Precision Rectifiers -Filters: Active Low-Pass, High-Pass, Band-Pass, and Notch Filters									**CO3, CO4**
UNIT-V	**Data Converters, Regulators, Multivibrators, Waveform Generators**							**Periods: 9**	
Data Converters: Digital to Analog, and Analog to Digital -Regulator: Fixed Regulator ICs. Variable regulators -Multivibrators : Astable and Monostable Multivibrators using 555 timer Waveform Genrators: Square, Triangular, sawtooth wave generation									**CO3, CO4**
Total contact Periods: 40	**Total Tutorials: 05**		**Total Practical Classes: 00**				**Total Periods: 45**		
Reference Books:									

1. A. S. Sedra and K. C. Smith, Microelectronic Circuits, 8th ed. New York, NY, USA: Oxford University Press, 2020.
2. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 12th ed. Boston, MA, USA: Pearson Education, 2020.
3. Floyd, Electronic Devices, Pearson Education, 10th Edition , 2021
4. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th ed. New Delhi, India: Pearson Education, 2018.
5. S. Sharma, Electronic Devices and Circu*its*, Latest ed. New Delhi, India: S. K. Kataria & Sons, 2022.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Three**		Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC105	**Transducers and Measurement systems**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite	-							

Course Outcome: At the end of the course the student will be able to		
	CO1	Understand measurement systems, types of errors, and reliability metrics.
	CO2	Analyze static and dynamic characteristics of instruments and transducers.
	CO3	Explain the working principles of active and passive transducers, and signal conditioning techniques.
	CO4	Explore the construction, working, and applications of inductive, capacitive, piezoelectric, IC sensors and smart transducers.

UNIT-I	**Introduction**	**Periods: 9**
Generalized scheme of a measurement system – basic methods of measurements- Errors in measurements –types of errors- Statistical analysis of measurement data, mean, standard deviation – probability of errors – probable error, limiting errors. Propagation of Limiting Errors. Reliability of measurement systems – failure rate – reliability improvement, Availability, redundancy.		**CO1**
UNIT-II	**Static and Dynamic Characteristics**	**Periods: 9**
Static characteristics of instruments –generalized mathematical model of measurement systems – dynamic characteristics – Modelling of Transducers (RTD, Thermocouple) – operational transfer function – zero, first and second order instruments – impulse, step, ramp and frequency response of the above instruments.		**CO2**
UNIT-III	**Active and Passive Transducers**	**Periods: 9**
Resistance potentiometer – loading effect – strain gauges – gauge factor – types of strain gauges – rosettes –semiconductor strain gauges – installation of strain gages – strain measuring circuits - quarter bridge, half bride and full bridge circuits– Resistance thermometers, materials, construction, characteristics – Thermistors and photo resistors (LDR) – hot wire anemometer – constant current and constant temperature operation – Humidity sensors. Signal conditioning circuits for RTD, Thermistor and Thermocouple – Cold junction compensation.		**CO3**
UNIT-IV	**Inductive, Capacitive and Piezoelectric Transducers**	**Periods: 9**
Inductive transducers – variable reluctance transducers – Inductive proximity pick up and Capacitive proximity pickup – Synchros operation and applications – LVDT construction – Equivalent Circuit- signal conditioning circuit, Phase sensitive demodulator circuit – applications. Capacitive transducers – variable area type – variable air gap type – variable permittivity type – signal conditioning circuit – Blumlein bridge – Capacitor microphone – frequency response. Piezoelectric transducers – piezoelectric crystals – charge amplifier.		**CO4**
UNIT-V	**Miscellaneous And Smart Transducers**	**Periods: 9**
Hall effect transducers – Photo electric detector, different types and characteristics – Magneto-strictive Transducer, IC sensor for temperature – signal conditioning circuits, Fiber optic sensors: Temperature, pressure, flow and level measurement using Fiber optic cable. Intelligent and smart transducers- principle- design approach, interface design, configuration support, communication in smart transducer networks. SQUID sensors, HART devices. Film sensors, MEMS – Nano sensors.		**CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. S. Renganathan, Transducer Engineering, Allied Publishers, Fourth Edition, 2003.

2. John. P. Bentley, Principles of Measurement Systems, Pearson Prentice Hall, Fourth Edition, 2005.
3. J.W. Dally, W.F. Riley and K.G. McConnell, Instrumentation for Engineering Measurements, John Wiley & Sons Inc., Second Edition, 1993.
4. H.K.P. Neubert, Instrument Transducers: An Introduction to Their Performance and Design, Clarendon Press, First Edition, 1963.
5. C.D. Johnson, Process Control Instrumentation Technology, Pearson Education, Eighth Edition, 2006.
6. R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Third Edition, 1995.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department :**EIE**		Programme : **B.Tech.-EIE**						
Semester : **Three**		Subject Category: **AEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HSUA103	**Entrepreneurship**	**2**	**-**	**-**	**2**	**40**	**60**	**100**
Prerequisite:	-							

Course Outcome: At the end of the course the student will be able to	**CO1**	Understand entrepreneurial mindset, problem identification, customer segmentation, and value proposition development.
	CO2	Develop and validate business models, test solutions, and create a Minimum Viable Product (MVP) through iterative feedback.
	CO3	Analyze financial planning, revenue models, pricing strategies, and investor expectations for startup funding.
	CO4	Apply sales, branding, digital marketing, automation, and teamwork strategies to successfully launch and scale a venture.

UNIT-I	**Problem Identification and Customer Discovery**	**Periods: 6**
Entrepreneurial mindset – Identifying business opportunities – Effectuation principles – Design Thinking for problem-solving – Consumer segmentation and customer persona – Value Proposition Canvas (VPC) – Unique Value Proposition (UVP) – Market research techniques – Emerging trends: AI in market research.		**CO1**
UNIT-II	**Business Model and Lean Startup**	**Periods: 6**
Types of business models – Lean Canvas vs. Business Model Canvas – Competitor analysis – Blue Ocean Strategy – Building and testing Minimum Viable Product (MVP) – Build-Measure-Learn feedback loop – Digital Prototyping tools – Rapid Experimentation – Agile startup methodology.		**CO1** **CO2**
UNIT-III	**Revenue Models, Costing, and Financial Planning**	**Periods: 6**
Revenue models: Subscription, Freemium, and Pay-per-use – Unit economics: Cost structures and pricing strategies – Funding sources: Bootstrapping, Crowdfunding, Venture Capital – Investor expectations and funding rounds – Pitching to investors – Financial forecasting and break-even analysis – Government startup incentives.		**CO2** **CO3**
UNIT-IV	**Digital Marketing and Sales Strategies**	**Periods: 6**
Brand positioning and storytelling – Social media marketing and digital presence – SEO, SEM, and paid advertising – Data-driven marketing strategies – Sales funnels – Unique Sales Proposition (USP) – B2B vs. B2C sales – CRM tools for customer engagement – Customer retention strategies.		**CO3** **CO4**
UNIT-V	**Team Building, Compliance, and Scaling**	**Periods: 6**
Building and managing startup teams – Remote collaboration tools – Business registration and legal compliance – Intellectual Property Rights (IPR) for startups – Growth hacking and automation – Scaling strategies: Expansion and franchising – Emerging trends: AI in entrepreneurship, blockchain applications – Exit strategies: Mergers, acquisitions, IPOs.		**CO4**

Lecture Periods: 30	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 30**

Reference Books:

1. **Eric Ries,** *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses* by Crown Business, **1st Edition (2011)**.
2. **Alexander Osterwalder & Yves Pigneur,** *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*, Wiley, **1st Edition (2010)**.
3. **Ash Maurya,** *Running Lean: Iterate from Plan A to a Plan That Works*, O'Reilly Media, **2nd Edition (2019)**.

4. **Steve Blank** and **Bob Dorf**, *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*, K&S Ranch, **1st Edition (2012)**.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **Humanities & Social Sciences**		Programme : **B.Tech.-EIE**						
Semester : **Three**		Subject Category: **VAC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
GEUV103	**Environmental Education**	**1**	**-**	**-**	**1**	**100**	**-**	**100**

Prerequisite:	-	
Course Outcome: At the end of the course the student will be able to	**CO1**	Recall the concept of environment ecology and Education.
	CO2	Summaries the effect of population explosion, degradation of environment and global problem due to the anthropogenic activities.
	CO3	Justify the need of pollution control and sustainable development for future.

UNIT-I	**Introduction to Environmental Education**	**Periods: 5**
Concept, scope and importance of Environmental Education - Objectives of Environmental Education - Concept of an Ecosystem: Structure and functions, Types of ecosystem (aquatic and terrestrial) - Biodiversity: Levels, values, threats and conservation - Natural resources: Renewable and Non-renewable resources.		**CO1**
UNIT-II	**Environmental degradation and impact**	**Periods: 5**
Human population growth and its impact on environment - Deforestation: Causes and effects due to expansion of agriculture, firewood, mining and building of new habitats - Pollution: Definition, different types of Pollution - Air and water pollution: Causes and effect on environment - Climate change, Global warming, Ozone layer depletion and impacts on human communities.		**CO2**
UNIT-III	**Conservation of environment**	**Periods: 5**
Control measures for various types of Pollution: use of renewable and alternate source of energy - Environmental laws: Environmental Protection Act (1986), Water Act (1974), Air Act (1981) - International agreements: Montreal and Kyoto Protocol, Paris Agreement - Concept of sustainable development and SDGs - Role of government, NGOs and individual in environmental conservation.		**CO3**

Lecture Periods: 15	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 15**

Reference Books:

- Singh, J.S., Singh, S.P. and Gupta, S.R., 2014. “Ecology, Environmental Science and Conservation”, S. Chand Publishing, New Delhi.
- Sharma, P. D., 2011. “Ecology and Environment”, Rastogi Publications.
- Erach Bharucha, 2010. “Text Book of Environmental Studies”, University Grants Commission, Universities Press (India) Pvt.Ltd., Hyderabad.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech - EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Three</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC106</td><td>Analog Circuits Laboratory</td><td>-</td><td>-</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Basic Electrical and Electronic Circuits</td></tr>
<tr><td rowspan="4">Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Understand and analyze the characteristics of diodes, BJT, and MOSFETs and their applications.</td></tr>
<tr><td>CO2</td><td colspan="7">Design and analyze the frequency response of single-stage amplifiers and active filters.</td></tr>
<tr><td>CO3</td><td colspan="7">Implement and analyze operational amplifier-based circuits for linear and non-linear applications.</td></tr>
<tr><td>CO4</td><td colspan="7">Design and implement multivibrators and data converters for real-time applications.</td></tr>
</table>

List of Experiments	**Periods: 30**
1. Study of Diode Characteristics & Applications	**(CO1**)
2. Design and Implementation of Rectifiers	**(CO1**)
3. BJT and MOSFET Characteristics	**(CO1**)
4. BJT and MOSFET Biasing	**(CO1**)
5. Design and analyze the frequency response of single stage CE amplifier	**(CO2**)
6. Op-Amp Applications: Linear Circuits	**(CO2, CO3)**
7. Op-Amp Applications: Non-Linear Circuits	**(CO2, CO3)**
8. Design and analysis of Active Filter	**(CO2, CO3)**
9. Design astable and monostable multivibrators	**(CO4)**
10. Design and implementation of Data converters	**(CO4)**

Lecture Periods: 00	**Total Tutorials: 00**	**Total Practical Classes: 30**	**Total Periods: 30**

Reference Books:

1. A. S. Sedra and K. C. Smith, Microelectronic Circuits, 8th ed. New York, NY, USA: Oxford University Press, 2020.
2. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 12th ed. Boston, MA, USA: Pearson Education, 2020.
3. Floyd, Electronic Devices, Pearson Education, 10th Edition , 2021
4. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits, 4th ed. New Delhi, India: Pearson Education, 2018.
5. S. Sharma, Electronic Devices and Circu*its*, Latest ed. New Delhi, India: S. K. Kataria & Sons, 2022.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Three</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: LB</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC107</td><td>Transducers and Measurement systems Laboratory</td><td>-</td><td>-</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Apply the characteristics of common transducers such as temperature, optical, and displacement sensors.</td></tr>
<tr><td>CO2</td><td colspan="7">Apply measurement techniques for speed, pH, pressure, and strain using appropriate transducers.</td></tr>
<tr><td>CO3</td><td colspan="7">Analyze sensor data and performance for real-time process monitoring.</td></tr>
<tr><td>CO4</td><td colspan="7">Design and implement basic interfacing and calibration systems using transducers and data loggers.</td></tr>
</table>

Exp. No.	Title	CO
1.	Characteristic of Temperature transducers (LDR, thermistor and thermocouple).	CO1
2.	Characteristics of Optical Transducers (LDR and Phototransistor)	CO1
3.	Measurement of Strain, Load and Level using strain gauges.	CO2
4.	Measurement of Pressure using strain gauges.	CO2
5.	Measurement of pH using a single glass electrode.	CO2
6.	Measurement of Speed using photoelectric pickup transducers.	CO2
7.	Measurement of Displacement using LVDT.	CO1
8.	Design of Linear bridge for RTD.	CO4
9.	Measurement of Temperature using IC Sensor (AD 590).	CO3
10.	Online Modelling of RTD and thermocouple using Data loggers.	CO4

Lecture Periods: 00	**Tutorial Periods: 00**	**Practical Periods: 36**	**Total Periods: 36**

Reference Books:

1. S. Renganathan, Transducers Engineering, Pearson Education, Third Edition, 2008.
2. John. P. Bentley, Principles of Measurement Systems, Longman Publishers, Fourth Edition, 2005.
3. D. Patranabis, Sensors and Transducers, PHI Learning Pvt. Ltd., Second Edition, 2013.
4. Ernest O. Doebelin, Measurement Systems: Application and Design, McGraw-Hill Education, Five Edition, 2004.
5. Ramon Pallas-Areny and John G. Webster, Sensors and Signal Conditioning, Wiley India, Second Edition, 2004.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	2	-	3	-	-	-	1	-	2	3	2
CO2	3	2	2	-	3	-	-	-	1	-	2	3	2
CO3	3	3	3	-	3	-	-	-	2	-	2	3	3
CO4	3	-	3	2	3	-	-	-	1	-	3	3	3

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme **: B.Tech.-EIE**						
Semester : **Four**		Subject Category:**PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC108	**Electrical and Electronic Instruments**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	-							

Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the fundamental principles of different types of Electrical Instruments and their working.
	CO2	Realize the importance of Magnetic Measurements and Potentiometers in Electrical measurements.
	CO3	Learn about Resistance and Impedance Measurements using Bridge Circuits and Cable fault detection.
	CO4	Analyse various waveform generators and displays like Oscilloscopes, LED's and LCD's.

UNIT-I	**Measurements of Voltage, Current , Power and Energy**	**Periods:09**
Galvanometers – D'Arsonoval galvanometer – Theory and application – Principle , Construction and Operation of Moving Coil, Moving Iron, Dynamometer, Induction type, thermal type and Rectifier type Instruments – Extension of range of PMMC Ammeter and Voltmeter – Electrodynamometer Type Wattmeter – Theory, its Errors and their correction – LPF Wattmeter – Induction Type Energy meter – Construction and working – Phantom Loading – Calibration of Wattmeter – Testing of Energy meters.		**CO1**
UNIT-II	**Potentiometers, Magnetic Measurements and Instrument Transformers**	**Periods: 09**
D.C. Potentiometers – Measurement of unknown e.m.f. – Applications – Calibration of Voltmeter, Ammeter , Wattmeter, Measurement of Power and resistance – A.C. Potentiometers – Drysdale Polar and Gall Tinsley Coordinate type – Construction and operation – Magnetic Measurements – Determination of B-H Curve and Hysteresis loop – Step by step method – Method of reversals – Hopkinson's Permeameter – Iron loss measurement by Lloyd Fisher Square – C.T. and P.T. – Construction, Theory and Operation.		**CO2**
UNIT-III	**Resistance and Impedance Measurement**	**Periods: 09**
Measurement of Medium Resistances – Ammeter-Voltmeter Method , Wheatstone Bridge – Kelvin Bridge – Kelvin Double bridge – Series and Shunt Type Ohmmeter – High resistance Measurement – Difficulties – Use of Guard circuit – Direct Deflection Method – Loss of Charge Method -Megger A.C, Bridges – Measurement of Inductance – Maxwell's Inductance-Capacitance bridge, Anderson Bridge – Hay's Bridge – Measurement of Capacitance- Schering Bridge – Wien Bridge for Frequency determination, Campbell Bridge – Introduction to Cable Faults and Eddy Current Measurement.		**CO3**
UNIT-IV	**Signal Generators and Analyzers**	**Periods: 09**
Sine wave Generator – Direct and Indirect Frequency Synthesizer – Sweep frequency Generator – Modes of operation – Pulse and Square wave Generator – Function Generator – XR2206 Monolithic Function Generator.		**CO4**
UNIT-V	**Cathode Ray Oscilloscope, Recorders and Displays**	**Periods:09**
General Purpose Oscilloscope – Deflection – Vertical and Horizontal Deflection Systems – Delay Line – Probes – Dual trace and Dual beam Oscilloscopes – Special Oscilloscopes – Storage Oscilloscopes – Sampling Oscilloscope – XY Recorders – LED display – LCD display – Comparison.		**CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods:00**	**Total Periods: 45**

Reference Books:

1. A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Sons , 2004.
2. Albert .D.Helfrick & William.D.Cooper, " Modern Electronic Instrumentation & Measurement Techniques, Prentice Hall of India, 2002.
3. E.W. Golding & F.C.Widdis, " Electrical Measurements and Measuring Instruments", A.H.Wheeler & Co., 1994.
4. B.M. Oliver and J.M.Cage, " Electronic Measurements and Instrumentation", McGraw Hill International Edition, 1975.
5. Joseph.J.Carr , "Elements of Electronic Instrumentation & Measurements", 3rd Edition, Pearson Education , 2003.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	1	0	3	0	0	0	0	3	3	0
CO2	3	3	1	1	1	2	0	0	0	0	3	3	1
CO3	3	3	1	1	1	3	0	0	0	0	3	3	1
CO4	3	3	1	1	0	3	0	0	0	0	3	3	0

Score: 3 – High; 2 – Medium; 1 – Low; 0 - Not Correlated.

Department **: EIE**			Programme : **B.Tech.-EIE,**					
Semester : **Four**			Subject Category: **PCC**			Semester Exam Type: **TY**		
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC109	**Signal Processing**		**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite	-								
Outcome:	**CO1**	Analyze different types of signals and systems, their properties, and their classification.							
	CO2	Apply Fourier series, Fourier transform, Laplace transform, DFT, FFT and z-transform techniques for signal analysis in the frequency domain.							
	CO3	Utilize Laplace and Z-transforms for analyzing continuous-time and discrete-time systems.							
	CO4	Design and implement digital FIR and IIR filters for signal processing applications.							

UNIT-I	**Introduction to Signals and Systems**	**Periods: 12**
Continuous-time (CT) vs. Discrete-time (DT) signals, Elementary signals: Impulse, Step, Ramp, Sinusoidal, Exponential Classification of signals: Periodic, Aperiodic, Energy, Power signals - Basic signal operations (shifting, scaling, folding)-Classification of systems: Linear, Nonlinear, static, dynamic, time –invariant, time variant, causal and non-causal, stable and unstable Systems-Review of Fourier series, Fourier transform, Sampling theorem , Aliasing effect		**CO1**
UNIT-II	**DTFT, DFT and FFT**	**Periods: 12**
Discrete-Fourier series-Properties, DTFT- properties, frequency response –transfer function. Discrete Fourier Transform, circular convolution, filtering long duration sequences, parameter selection to calculate DFT. Computation of DFT using FFT algorithm – DIT & DIF - FFT using radix 2 – Butterfly structure- FFT applications		**CO2**
UNIT-III	**Analysis of continuous-time Systems**	**Periods: 12**
Representation of an arbitrary CT signals – Impulse response-Convolution Integral-Properties, causality and stability- Review of Laplace transform, Properties of Laplace transform, Inverse Laplace transform, Solution of difference equations using Laplace transform, Transfer function, stability, Analog filter design: Butterworth, Chebyshev filters.		**CO2, CO3**
UNIT-IV	**Analysis of Discrete-time Systems**	**Periods: 12**
Representation of an arbitrary DT signals – Impulse response-Convolution sum-Properties, causality and stability- Definition of z-transform, ROC, Properties of z-transform, Inverse z-Solution of difference equations using z- transform, system function-stability, FIR and IIR Systems, Realization of IIR and FIR Systems using Direct form-I, Direct form-II , Cascade and Parallel forms		**CO2** **CO3**
UNIT-V	**Digital Filter Design**	**Periods: 12**
FIR filter design: Linear phase characteristics- Windowing technique of designing FIR filter–Need and choice of windows, frequency sampling method. **IIR filter design**: Design of digital IIR filters using impulse invariant and bilinear transformation – Warping effect, prewarping		**CO4**

Lecture Periods: 60	**Tutorials Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. J.G Proakis and D.G.Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Pearson Education/ PHI, New Delhi, 2011
2. P. Ramesh Babu, Digital Signal Processing, Seven edition, Scitech publications, 2017.
3. Johny R. Johnson : Introduction to Digital Signal Processing, Prentice Hall, 2004.
4. P.Ramesh Babu & R.Ananda Natrajan, Signals and Systems, Fourth Edition, Scitech Publications (India) Pvt. Ltd.,2014
5. Allan V.Oppenheim, "Signals and systems", Prentice Hall of India, 2011.
6. Roger E.Ziemer, "Signals and Systems Continuous and discrete", McMillan, 2008.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department: **Computer Science and Engineering**		Programme : **B.Tech.-EIE**	
Semester: **Four**		Subject Category: **PCC**	Semester Exam Type: **TY**

Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSUC137	**Data Structures and Object – Oriented Programming**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	-							

Course Outcome: At the end of the course the student will be able to :	**CO1**	Apply the fundamental concepts of data structures in software applications.
	CO2	Implement linear data structures in online marketing.
	CO3	Design algorithms for non-linear data structures applied in Banking sectors.
	CO4	Apply sorting, searching algorithms and Hashing methods in Database Management System.
	CO5	Develop reusable and maintainable software components using OOP principles.
	CO6	Implement file handling techniques in C++ to perform input and output operations with external files using data structures and object-oriented methodologies.

UNIT-I	**Lists, Stacks and Queues**	**Periods: 09**
Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly-linked lists – Applications of lists – Polynomial ADT – Radix Sort – Multilists – Stack ADT – Operations – Applications – Balancing Symbols – Evaluating arithmetic expressions – Infix to Postfix conversion – Function Calls – Queue ADT – Operations – Circular Queue – DeQueue – Applications of Queues.		**CO1 CO2 CO6**
UNIT-II	**Trees and Graphs**	**Periods: 09**
Tree ADT – Tree Traversals - Binary Tree ADT – Expression trees – Binary Search Tree ADT – AVL Trees – Priority Queue (Heaps) – Binary Heap – B-Tree – B+ Tree – Graph Definition – Representation of Graphs – Types of Graph - Breadth-first traversal – Depth-first traversal — Bi-connectivity – Euler circuits – Topological Sort – Dijkstra's algorithm – Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm		**CO1 CO3 CO6**
UNIT-III	**Searching, Sorting and Hashing Techniques**	**Periods: 09**
Searching – Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Merge Sort – Hashing – Hash Functions – Separate Chaining – Open Addressing –Rehashing – Extendible Hashing.		**CO1 CO4 CO6**
UNIT-IV	**Introduction to Object-Oriented Programming and C++ Basics**	**Periods: 09**
Understanding core OOP concepts: Classes and Objects – Encapsulation and Data Hiding – Abstraction –Inheritance – Polymorphism –Basics of C++ programming: Syntax and Structure – Data Types and Operators – Control Structures (if-else, loops) – Functions and Parameter Passing – Procedural and Object-Oriented Programming – Classes and Objects in C++ – Defining and Implementing Classes – Access Specifiers: public, private, protected – Member Functions and Data Members – Constructors and Destructors: Default Constructors – Parameterized Constructors – Copy Constructors – 'this' Pointer – Static Members.		**CO5 CO6**
UNIT-V	**Inheritance, Polymorphism and Advanced Features in C++**	**Periods:09**
Inheritance: Base and Derived Classes – Types of Inheritance: Single, Multiple, Multilevel, Hierarchical, Hybrid – Constructor and Destructor Behavior in Inheritance – Polymorphism: Compile-Time Polymorphism: Function and Operator Overloading – Run-Time Polymorphism:		**CO5 CO6**

Virtual Functions and Abstract Classes – Pointers to Objects and Virtual Functions – Templates: Function Templates – Class Templates – Exception Handling: try, catch, throw Mechanism – Standard Exceptions – File Handling: File Streams (ifstream, ofstream, fstream) – Reading from and Writing to Files – File Modes and Error Handling – Standard Template Library (STL): Containers, Iterators, Algorithms.	

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2005.
2. Kamthane, Introduction to Data Structures in C, 1st Edition, Pearson Education, 2007.
3. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India).
4. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	1	-	-
CO2	3	2	3	2	2	-	-	-	-	-	1	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-
CO4	3	3	3	2	2	-	-	-	-	-	2	-	-
CO5	3	2	3	2	2	-	-	-	-	-	1	-	-
CO6	3	2	3	2	3	-	-	2	-	-	2	-	-

Department: **EIE**		Programme **: B.Tech.-EIE**							
Semester : **Four**		Subject Category: **PCC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUC110	**Control Systems**	**3**	**1**	**-**	**4**	**40**	**60**	**100**	
Prerequisite	-								

Course Outcome: At the end of the course the student will be able to	**CO1**	Develop mathematical models and transfer functions for electrical, mechanical, thermal, and hydraulic systems and simplify complex systems using block diagrams and signal flow graphs..
	CO2	Analyze time-domain response of first and second-order systems, evaluate steady-state errors, and design PID/ON-OFF controllers based on performance specifications.
	CO3	Interpret frequency response characteristics using Bode, Nyquist, and Nichols plots, and design compensators (Lead, Lag, Lead-Lag) to achieve desired system performance.
	CO4	Formulate and solve state-space representations of control systems, determine system properties such as controllability and observability, and analyze system dynamics using state transition matrix

UNIT-I	**Introduction to Systems**	**Periods: 12**
Basic elements in control systems–Open and Closed loop systems–Feedback characteristics–Effects of feedback –l modeling of physical systems:-Mechanical, Thermal, Hydraulic and Pneumatic systems-Transfer function–AC and DC servomotors–Block diagram reduction techniques–Signal flow graph–Control system components–Computer simulation(For assignments only).		**CO1 CO4**
UNIT-II	**Time Response Analysis**	**Periods: 12**
Time response–Types of test inputs-I and II order system responses–Error coefficients–Generalized error series-Steady state error-Time domain specifications-PID and ON/OFF controllers-Performance criteria- Selection of controller modes - Computer simulation		**CO2**
UNIT-III	**Frequency Response Analysis**	**Periods: 12**
Frequency response-Frequency domain specifications-Bode plot-Polar lot-Determination of phase margin and gain margin-Constant M and N circles–Nichols chart-Determination of closed loop response from open loop response–Computer simulation		**CO3**
UNIT-IV	**Stability of Control System**	**Periods: 12**
Concepts of stability–Location of roots in s-plane for stability–Routh Hurwitz criterion–Root locus techniques– Construction – Nyquist stability criterion -Computer simulation -Lag, Lead, and Lag- Lead networks – Compensator design for desired response using Root locus and Bode diagrams.		**CO3**
UNIT-V	**State-Variable Analysis**	**Periods: 12**
Introduction of state, state variables and state model, derivation of state models from block diagrams, Relationship between state equations and transfer Functions-Characteristic equation, eigenvalues, eigenvectors, canonical forms Diagonalization-solving the time invariant state Equations-State Transition Matrix. Controllability and observability. Computer simulation		**CO4**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: 00**	**Total Periods:60**

Reference books:

1. I.J.Nagrath, M.Gopal, Control System Engineering,New-ageInternational(P),4thEditionLtd.,NewDelhi,2009.
2. M.Gopal, Control Systems, Principles and Design, Tata McGraw-Hill Pub. Co., 2nd Edition, New Delhi, 2006.
3. K.Ogata, Modern Control Engineering,PHI.,5thEdition,NewDelhi,2010.
4. B.C.Kuo, Automatic ControlSystems,PHI.,NewDelhi,2003.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department :**EIE**		Programme : **B.Tech - EIE**							
Semester : **Four**		Subject Category: **BSC**				Semester Exam Type: **TY**			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUC111	**Digital System Design**	**3**	**-**	**-**	**3**	**40**	**60**	**100**	
Prerequisite:	-								

Outcome: At the end of the course the student will be able to	**CO1**	Acquire an insight of Boolean logic, and have the ability to transform a technical challenge into Boolean functions by also obtaining Knowledge of how logic gates are built using transistors
	CO2	Design any combinational logic for any complexity using gates.
	CO3	Evaluate the Concept of sequential circuit to develop any practical digital circuit design techniques.
	CO4	Mastering the different asynchronous sequential circuits design and obtain the ability to design a hazard free asynchronous sequential circuit
	CO5	Able to realize the design of Memory and obtain the ability to develop PLDs used in implementation of large scale logic functions.

UNIT-I	**Minimization Techniques and Logic Gates**	**Periods: 9**
Number System and Boolean algebra: Review of Number systems and codes – Error detecting codes –Hamming Code- Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) –Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions - Quine-McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations - TTL and CMOS Logic and their characteristics –Tristate gates.		**CO1**
UNIT-II	**Combinational Circuits**	**Periods: 9**
Half adder – Full Adder – Half subtractor – Full subtractor - Parallel binary adder - Fast Adder - Carry Look Ahead adder –- BCD adder – Multiplexer - Demultiplexer – Decoder - Encoder – Parity checker – Parity generators - Code converters - Magnitude Comparator.		**CO2**
UNIT-III	**Sequential Circuits**	**Periods: 9**
Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Edge triggering – Level Triggering – Realization of one flip flop using other flip flops –Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters — Ring counter - Design of Synchronous counters: State diagram- State table – State minimization –State assignment -Excitation table and maps-Circuit implementation - Modulo–N counter, Registers – Shift registers -Universal shift registers		**CO3**
UNIT-IV	**Synchronous and Asynchronous Sequential Circuits**	**Periods: 9**
Synchronous Sequential Circuits: General Model – Classification – Design – Analysis of Synchronous Sequential Circuits - Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines– Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits		**CO3, CO4**
UNIT-V	**Memory Devices**	**Periods: 9**
Classification of memories –ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM organization – Write operation – Read operation – Memory cycle – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell– Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) –Complex Programmable Logic Device (CPLD)- Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.		**CO1, CO5**

Lecture Periods: 45	**Tutorials Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. R.Ananda Natarajan , Digital Design, 1st Edition, PHI Learning Pvt. Limited, New Delhi 2015.
2. M. Morris Mano, M.MichaelCiletti , Digital Design, 5th Edition, Pearson Education(Singapore) Pvt. Ltd., New Delhi, 2013.
3. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
4. John.M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
5. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2003.
6. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, 6th Edition, TMH, 2003.
7. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.
8. Thomas L. Floyd, Digital Fundamentals, 8th Edition, Pearson Education Inc, New Delhi, 2003
9. Donald D.Givone, Digital Principles and Design, TMH, 2003.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	-	1	1	-	1	3	2
CO2	3	3	2	2	2	1	-	1	1	-	2	3	2
CO3	3	3	2	2	2	1	-	1	1	-	2	3	3
CO4	3	3	2	2	2	1	-	1	1	-	2	3	2
CO5	3	3	3	3	3	2	-	1	1	-	2	3	2

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department :EIE</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Four</td><td colspan="4">Subject Category: AEC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>HSUA104</td><td>Design Thinking</td><td>2</td><td>-</td><td>-</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Apply Design Thinking to solve engineering problems</td></tr>
<tr><td>CO2</td><td colspan="7">Generate creative solutions for real-world problems using brainstorming and other idea-generation techniques</td></tr>
<tr><td>CO3</td><td colspan="7">Build and test prototypes to validate design ideas and improve them based on user feedback.</td></tr>
<tr><td>CO4</td><td colspan="7">Work in teams and communicate ideas effectively through presentations, reports, and discussions.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction to Design Thinking</td><td colspan="2">Periods: 6</td></tr>
<tr><td colspan="8">Understanding the Need for Design Thinking in Engineering - Five-Stage Process: Empathize, Define, Ideate, Prototype, Test - Case Studies: How Engineering Innovations Used Design Thinking - Mindset Shift: From Problem-Solving to Human-Centered Design
Team Exercise: Identify a real-world engineering problem and discuss how Design Thinking can be applied.</td><td>CO1, CO4</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Empathize</td><td colspan="2">Periods: 6</td></tr>
<tr><td colspan="8">Importance of User Research in Engineering Solutions - Techniques: Interviews, Observations, Surveys, Empathy Mapping - Engineering Constraints vs. User-Centric Needs - Role of Emotional Intelligence in Product Development
Team Exercise: Conduct field research (interview users or observe a process) and create an Empathy Map for an engineering challenge.</td><td>CO1, CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Define & Ideate</td><td colspan="2">Periods: 6</td></tr>
<tr><td colspan="8">Problem Definition Techniques: How to Frame the Right Problem - Creating Point of View (POV) Statements - Brainstorming & Idea Generation Techniques: SCAMPER, Reverse Thinking, Mind Mapping - Evaluating and Selecting Feasible Engineering Solutions
Team Exercise: Define a problem statement and conduct a Brainstorming Workshop to generate innovative solutions.</td><td>CO2, CO4</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Prototyping</td><td colspan="2">Periods: 6</td></tr>
<tr><td colspan="8">Importance of Rapid Prototyping in Engineering - Types of Prototypes: Paper, Digital, Physical Models, Simulation - Tools & Technologies: 3D Printing, CAD, Arduino, Low-Code Development - Iteration & Refinement – Learning from Failures
Team Exercise: Develop a low-fidelity prototype of an engineering solution and present it to peers for feedback.</td><td>CO3, CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Testing, Iteration & Implementation</td><td colspan="2">Periods: 6</td></tr>
<tr><td colspan="8">Methods of Testing: Usability Testing, A/B Testing, Stress Testing - Gathering Feedback: Stakeholder & User Insights - Iteration Strategies: Continuous Improvement & Agile Thinking - Real-World Engineering Applications of Design Thinking
Team Exercise: Conduct a user test on the prototype, refine it based on feedback, and present the final solution in a showcase session.</td><td>CO3, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 30</td><td colspan="2">Tutorial Periods: 00</td><td colspan="2">Practical Periods: 00</td><td colspan="3">Total Periods: 30</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. Michael Lewrick, Patrick Link, and Larry Leifer, The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods, Wiley, 1st Edition, 2020.
2. Teun den Dekker, Design Thinking, Noordhoff Uitgevers bv,International Edition, 2020</td></tr>
</table>

3. Angèle M. Beausoleil, *Business Design Thinking and Doing*, Palgrave Macmillan Imprint, Springer, 2022
4. Soni Pavan, *Design your Thinking*, Penguin Random House India Publishing, 2020
5. E Balagurusamy, *Design Thinking*, McGraw Hill; First Edition, 2024

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	2	2	1	-	1	1	-	1	2	2
CO2	3	3	2	2	2	1	-	1	1	-	2	2	2
CO3	3	3	2	2	2	1	-	1	1	-	2	2	3
CO4	3	3	2	2	2	1	-	1	1	-	2	2	2
CO5	3	3	3	3	3	2	-	1	1	-	2	2	2

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department :Humanities and Social science</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Four</td><td colspan="4">Subject Category: VAC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name:</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>GEUC104</td><td>Universal Human Values</td><td>1</td><td>-</td><td>-</td><td>1</td><td>100</td><td>0</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Develop a Holistic Understanding of Value Education</td></tr>
<tr><td>CO2</td><td colspan="7">Foster Personal and Social Harmony</td></tr>
<tr><td>CO3</td><td colspan="7">Enhance Awareness of Universal Co-existence</td></tr>
<tr><td>CO4</td><td colspan="7">Apply Ethical and Humanistic Principles in Professional and Personal Life</td></tr>
<tr><td>Module--I</td><td colspan="6">Introduction to Value Education</td><td colspan="2">Periods: 3</td></tr>
<tr><td colspan="7">Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations</td><td colspan="2">CO1</td></tr>
<tr><td>Module-II</td><td colspan="6">Harmony in the Human Being</td><td colspan="2">Periods: 3</td></tr>
<tr><td colspan="7">Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health</td><td colspan="2">CO2</td></tr>
<tr><td>Module-III</td><td colspan="6">Harmony in the Family and Society</td><td colspan="2">Periods: 3</td></tr>
<tr><td colspan="7">Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-toHuman Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order</td><td colspan="2">CO2</td></tr>
<tr><td>Module-IV</td><td colspan="6">Harmony in the Nature/Existence :</td><td colspan="2">Periods: 3</td></tr>
<tr><td colspan="7">Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence</td><td colspan="2">CO3</td></tr>
<tr><td>Module-V</td><td colspan="6">Implications of the Holistic Understanding</td><td colspan="2">Periods: 3</td></tr>
<tr><td colspan="7">A Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession</td><td colspan="2">CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 15</td><td colspan="2">Tutorial Periods: 00</td><td colspan="2">Practical Periods:00</td><td colspan="3">Total Periods: 15</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
</table>

1. Student Induction Program Handbook v2 by AICTE NCC-IP sub-committee: Dr. Rajneesh Arora, Chairman NCC-IP, Dr. Shishir Gaur, Convener NCC-IP, Dr. Ruchir Gupta, Member NCC-IP.
2. a foundation course in R R Gaur R Asthana G P Bagaria HUMAN VALUES and professional ethics , R R Gaur R Asthana G P Bagaria
3. Understanding Human Being, Nature and Existence Comprehensively By UHV Team (https://uhv.org.in/uhve)
4. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics RR Gaur, R Asthana, GP Bagaria

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**			Programme **:B.Tech.-EIE**					
Semester: **Four**			Subject Category :**PCC**			Semester Exam Type: **LB**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC112	**Simulation Laboratory**	**-**	**-**	**3**	**1**	**40**	**60**	**100**
Prerequisite	-							

Course Outcome: At the end of the course the student will be able to	**CO1**	Implement Mathematical and Real Time Applications.
	CO2	Analyze Step, Impulse and Dynamic Responses of First Order and Higher Order Systems. Also analyze Root Locus, Bode Plot and Nyquist Plots.
	CO3	Generate and analyze Continuous Time and Discrete Time Signals related to Signal Processing.
	CO4	Implement various Electrical Circuits including Filters, Resonant Circuits, Precision Rectifiers & Waveform Generators.

List of Experiments	**PART-A** 1. Transfer Function, Transient and Fourier Analysis of Circuits. 2. Simulate Filters and Resonant Circuits. 3. Verification of Theorems in Circuit Theory. 4. Precision Rectifiers and Waveform Generation. **5.** Determination of Input and Output Characteristics of Transistor and FET .	**CO1** **CO2**
List of Experiments	**PART-B** 1. Implement Mathematical Applications using simple programs. 2. Generation of Continuous Time and Discrete Time signals using simple programs. 3. Step, Impulse and Dynamic Response of First Order and Second Order Electrical and Mechanical Systems. 4. Study of Real Time Applications using simple programs. 5. Study and Analysis of Root Locus, Bode Plot and Nyquist Plots of Simple Systems.	**CO3** **CO4**

Lecture Periods: 00	**Tutorials Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; – Not Correlated.

Department: **Computer Science and Engineering**			Programme: **B.Tech. -EIE**						
Semester: **Four**			Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
CSUC138	**Data Structures and Object – Oriented Programming Laboratory**		**-**	**-**	**3**	**1.5**	**40**	**60**	**100**
Prerequisite:	-								

Course Outcome: At the end of the course the student will be able to :	**CO1**	Develop proficiency in coding linear data structures such as arrays, linked lists, stacks, queues and enhance their ability to manage the data efficiently.
	CO2	Design and implement non-linear data structures like trees and graphs, also enable them to handle complex data relationships and hierarchies.
	CO3	Apply various sorting and searching algorithms in real-time applications of web search engines, social media platforms and file systems.
	CO4	Apply OOP principles of classes, objects, inheritance, polymorphism, and encapsulation to create modular and reusable code.
	CO5	Apply data structures and OOP Concepts to manage data storage and retrieve them using file operations.
	CO6	Integrate data structures and OOP to design comprehensive software solutions.

Ex. No.	**Experiment Name/Brief Description**	
1. 2. 3. 4. 5.	Write a program to implement Stack, Queue, and Circular Queue using arrays. Develop a program for creating and performing operations on Singly Linked List. Implement Stack and Queue ADTs using Linked List. Write a program for Polynomial addition and multiplication using Linked List. Convert an Infix expression to Postfix and evaluate the Postfix expression.	**CO1** **CO6**
6. 7. 8. 9. 10.	Design a Binary Search Tree and perform insertion, deletion, and traversal operations. Implement AVL Tree with rotations for balancing. Develop a Priority Queue using Heap data structure. Write a C program to find the shortest path using Dijkstra's Algorithm. Construct Minimum Spanning Tree using Prim's Algorithm.	**CO1** **CO2** **CO6**
11. 12. 13. 14.	Implement Linear Search and Binary Search for an array. Sort the given array using Insertion Sort and Selection Sort. Write a program to perform Merge Sort using recursion. Implement Hashing using Open Addressing techniques like Linear Probing and Quadratic Probing.	**CO1** **CO3** **CO6**
11. 12. 13. 14. 15. 16.	Write a program Illustrating Class Declarations, Definition, and Accessing Class Members. Program to illustrate default constructor, parameterized constructor and copy constructors. Write a C++ program to implement the matrix ADT using a class. The operations supported by this ADT are: a) Reading a matrix. b) Addition of matrices. c) Printing a matrix. d) Subtraction of matrices. e) Multiplication of matrices. Write C++ programs that illustrate how the following forms of inheritance are supported: a)Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance.	**CO4** **CO6**

	Write a C++ Program Containing a Possible Exception. Use a Try Block to Throw it and a Catch Block to Handle it Properly. Write a Program to Demonstrate the Catching of All Exceptions.	
17. 18.	A) Create a function template for sorting arrays of various data types. B) Develop a class template for a stack that can handle different data types. A) Utilize STL containers like vector, list, and map to manage collections of data. B) Implement algorithms such as find, sort, and accumulate using ST.	**CO5, CO6**

Lecture Periods: 00	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson Freed, Universities Press.
2. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.
3. Object Oriented Programming with C++ by Balagurusamy
4. C++, the Complete Reference, 4th Edition, Herbert Schildt, TMH.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	2	-	-	-	-	-	-	-	-
CO2	3	3	3	-	2	-	-	-	-	-	-	-	-
CO3	3	3	3	-	2	-	-	-	-	-	-	-	-
CO4	3	2	3	-	2	-	-	-	-	-	-	-	-
CO5	3	2	3	-	2	-	-	-	-	-	-	-	-
CO6	3	3	3	-	2	-	-	-	-	-	-	-	-

Score: 3 – High; 2 – Medium; 1 – Low

Department :**EIE**			Programme : **B.Tech-EIE**						
Semester : **Four**			Subject Category: **HNC**			Semester Exam Type:**TY**			
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUH101	**Design Of Sensors and Transducers**		**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Sensor and Transducer								
Outcome: At the end of the course the student will be able to	**CO1**	Select and design diaphragm for different practical applications							
	CO2	Design strain gauge-based torque, force, load and pressure measurement systems, accelerometer and gyroscope							
	CO3	Design capacitance/ inductance transducers for the measurement of displacement, pressure and level.							
	CO4	Acquire knowledge in design of chemical sensor and its design criterion							

UNIT-I	**Diaphragm Design**	**Periods: 12**
Introduction to diaphragm; Diaphragm performance and materials, Design of flat diaphragms, flat diaphragms with rigid centre – Design of convex diaphragms, semiconductor diaphragms and rectangular diaphragms – Design of corrugated diaphragms.		**CO1**
UNIT-II	**Design of various sensor**	**Periods: 12**
Design of strain gauge based load cells, torque sensors, force sensors , pressure sensors and level sensors;		**CO2**
UNIT-III	**Design of Motion sensor**	**Periods: 12**
Design of displacement sensor, Design of self and mutual inductance transducers for measurement of displacement and other parameters; Design of capacitive and inductive proximity sensors		**CO3**
UNIT-IV	**Design of acceleration and gyroscope**	**Periods: 12**
Accelerometer and Gyroscopic design and its applications. Design of Hall Effect sensors, Electromagnetic sensors, Magneto-elastic sensors		**CO2**
UNIT-V	**Design of chemical sensor**	**Periods: 12**
Introduction to chemical Sensors, characteristics. Design of direct and complex chemical sensors. Design of DO2 sensor, ChemFETs,		**CO4**

Lecture Periods: 45	**Tutorials Periods: 15**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. Karl Hoffmann, An introduction to stress analysis and transducer design using strain gauges, HBM, 1989.
2. James W. Dally, William F. Riley, Kenneth G. McConnell, Instrumentation for Engineering Measurements, Wiley, 1993.
3. Di Giovanni, Flat and Corrugated Diaphragm Design Handbook, CRC Press, 1982.
4. Fraden, Jacob, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer, 3rd Editions, 1993
5. Richard S. Figliola, Donald E. Beasley, Theory and Design for Mechanical Measurements, John Wiley & Sons, Inc, 6th Edition,1991.
6. Authors: Fraden, Jacob, Handbook of Modern Sensors: Physics, Designs, and Applications, Springe, 3rd Editions, 2010.
7. Alexander D. Khazan, Transducers and Their Elements: Design and Application, PTR Prentice Hall,1994 .
8. B.E. Noltingk, Instrumentation Reference Book, Butterworth- Heinemann, 2 nd Edition 1995.
9. Peter H. Sydenham, Richard Thorn, Handbook of Measuring System Design, Wiley,2005 .

10. John G. Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition,2008 .
11. Patranabis, Sensors and Transducers, Prentice Hall, 2nd Edition,2003.
12. Alok Baura, Fundamentals of Industrial Instrumentation, Wiley India Pvt. Ltd, 2011
13. Kirianaki N.V., Yurish S.Y., ShpakN.O., Deynega V.P., Data Acquisition and Signal Processing for Smart Sensors, John Wiley & Sons, Chichester, UK, 2002.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Five</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC113</td><td>Industrial Instrumentation</td><td>3</td><td>1</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Sensors and Transducers</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Understand the role of Instrumentation Engineer by studying different instruments used in industries for Measurement of Pressure, Level , Flow and Temperature.</td></tr>
<tr><td>CO2</td><td colspan="7">Understand the Electrical Methods of Acceleration measurement and Analysis Instruments using mechanical properties.</td></tr>
<tr><td>CO3</td><td colspan="7">Learn about the Electrical Hazards prevalent in industries and Protection.</td></tr>
<tr><td>CO4</td><td colspan="7">Understand the Safety requirements of Industrial Processes, learn about Explosion proofing and to interpret Process Flow diagrams</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Pressure Measurement</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Manometers – different types – Elastic pressure Sensors – Bourdon tube – Bellows – diaphragm – Electrical Methods – elastic elements with LVDT and strain gauges – piezo resistive pressure sensor - Flapper-Nozzle System. Measurement of Vacuum – McLeod Gauge – Thermal conductivity gauges – Ionisation gauge – Testing and calibration of pressure gauges – Dead weight Tester.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Level & Flow Measurement</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Level – Floats – Level switches – Air Purge/Bubbler – differential pressure method – Electrical types of level gauges using resistive and capacitive – Ultrasonic level measurement. Flow – Orifice plate ,Venturi, Pitot Tube- Rotameter – Positive displacement meter – Electromagnetic Flowmeter –Ultrasonic Flow meters - Coriolis Mass Flow meter – solid flow measurement – Calibration of Flow meters – Selection factors for Flow meters.</td><td>CO1</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Temperature Measurement</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Different types of Filled in Systems -Liquid, Gas, vapour – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Resistance thermometers – 3 lead wire and 4 lead wire RTD’s – Thermocouples – Laws of thermocouples – Types – Cold junction compensation – Total radiation and Selective radiation Pyrometers – Optical Pyrometer.</td><td>CO1</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Measurement of Acceleration, Density, Viscosity</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Accelerometers – LVDT Type, Piezo electric, Strain gauge and Variable reluctance type accelerometers – Seismic Instrument as an accelerometer. Pressure Head type densitometer – Float type densitometer – Ultrasonic densitometer – Gas Bridge densitometer. Saybolt Viscometer – Rotameter type viscometer – Industrial consistency meter and online oscillating type consistency meter.</td><td>CO2</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Industrial Safety and Specification</td><td colspan="2">Periods:09</td></tr>
<tr><td colspan="8">EMC: Introduction, Interference Coupling Mechanism, Basics of Circuit layout and Grounding, EMI filtering and shielding. Electrical Hazards - Shocks, Burns, Blasts - Fuses and Circuit breakers , protection methods, purging , Explosion proofing and intrinsic safety. Introduction to Piping and Instrumentation diagram – Process flow sheet – Instrument index sheet.</td><td>CO3
CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods: 00</td><td colspan="2">Practical Periods: 00</td><td colspan="3">Total Periods: 45</td></tr>
</table>

Reference Books:

1. D.Patranabis , " Principles of Industrial Instrumentation", TMH Publishing Ltd., New Delhi,1999.
2. Ernest.O.Doeblin, " Measurement Systems: Application and Design", International Student Edition,IV Edition, McGraw Hill, 1998.
3. R.K.Jain , " Mechanical and Industrial Measurements", Khanna Publishers New Delhi, 1999.
4. Beta . J. Liptak, " Process Measurement and Analysis", Instrument Engineers Handbook, Fourth Edition, 2003.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; – Not Correlated.

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech,-EIE</td><td colspan="3">Semester : Five</td></tr>
<tr><td colspan="2">Semester : Five</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC114</td><td>VLSI Design</td><td>3</td><td>1</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Digital System Design</td></tr>
<tr><td rowspan="4">Outcome:</td><td>CO1</td><td colspan="7">Understand IC fabrication technologies, CMOS logic design, and reconfigurable hardware concepts, including FPGA and CPLD applications.</td></tr>
<tr><td>CO2</td><td colspan="7">Develop and implement digital circuits using VHDL, covering structural, behavioral, and dataflow modeling techniques</td></tr>
<tr><td>CO3</td><td colspan="7">Design and verify combinational and sequential circuits using Verilog, applying procedural and structural design methodologies.</td></tr>
<tr><td>CO4</td><td colspan="7">Analyze and implement advanced VLSI design techniques, including low-power design, AI-driven optimization, and emerging nanoelectronics.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">IC TECHNOLOGIES AND RECONFIGURABLE HARDWARE</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Evolution of IC Technologies and Moore’s Law-Fabrication Process of MOSFETs: PMOS, NMOS, CMOS Technologies-Design and Analysis of CMOS Inverter and Logic Gates-Gate Realization using CMOS (Microwind)-Basics of Hardware Description Languages (HDL)-Introduction to Reconfigurable Hardware: FPGA & CPLD Basics-Applications of VLSI in Modern Computing (AI, IoT, High-Performance Computing).</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">VHDL PROGRAMMING AND DESIGN FLOW</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">VHDL Basics: Data Types, Operators, Libraries-VHDL Levels of Abstraction: Structural, Behavioral, Dataflow-VHDL Design Flow: Entity Declarations, Architectures, configurations-Concurrent and Sequential Signal Assignments-Signal vs. Variable Assignments, Process Sensitivity Lists-Conditional Statements, Loops, and Sequential Constructs-Example Implementations of Digital Circuits in VHDL</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">SYSTEM DESIGN AND SYNTHESIS USING VHDL</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Component Declarations & Instantiation-Named and Positional Association in Design Hierarchy-Packages: Declaration and Body, Use of Procedures and Functions-Test Bench Development for Verification-VHDL Modeling of Combinational Circuits: Multiplexers, Encoders, Decoders, Parity Generators-VHDL Modeling of Sequential Circuits: Flip-Flops, Counters, Shift Registers, FSM Implementation-Introduction to VHDL Synthesis & Design Constraints</td><td>CO2</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">VERILOG PROGRAMMING AND DESIGN METHODOLOGIES</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Introduction to Verilog: Basics, Modules, and Ports--Verilog Levels of Abstraction-Data Types, Operators, and Variable Assignments -Dataflow, Behavioral, and Structural Modeling-Procedural Statements: always, initial, and assign Blocks-Conditional Statements, Loops, and FSMs in Verilog-Example Implementations of Digital Circuits.</td><td>CO3</td></tr>
<tr><td>UNIT-V</td><td colspan="6">SYSTEM SYNTHESIS AND ADVANCE TOPICS IN VLSI</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Structural Design Modeling in Verilog-Test Bench Implementation & Verification Strategies-Combinational and Sequential Circuit Design in Verilog--Logic Synthesis and Physical Implementation using Verilog-Low-Power VLSI Design Techniques-Advanced Topics: AI & Machine Learning in VLSI-Approximate Computing for Power Optimization-3D ICs and Emerging Nanoelectronics-Neuromorphic Computing and Quantum VLSI.</td><td>CO3
CO4</td></tr>
</table>

Lecture Periods: 45	Tutorials Periods: 00	Practical Periods: 00	Total Periods: 45

Reference Books:

1. J. Bhasker ,VHDL Primer, Prentice Hall, 2006.
2. Bhasker,Verilog HDL Synthesis-A Practical Primer,Star Galaxy Publications,1998.
3. Chip Design for Submicron VLSI: CMOS Layout & Simulation, - John P.Uyemura, Thomson Learning.
4. Introduction to VLSI Circuits and Systems - John .P. Uyemura, JohnWiley,2003.
5. Digital Integrated Circuits - John M. Rabaey, PHI, EEE, 1997.
6. **Kaushik Roy & Sharat Prasad,** *"Low-Power CMOS VLSI Circuit Design"*, Wiley

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; – Not Correlated.

Department: **EIE**			Programme : **B.Tech.-EIE**						
Semester : **Five**			Subject Category: **PCC**				Semester Exam Type:**TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC115	System Design using 8051 Microcontroller		3	-	-	3	40	60	100
Prerequisite	-								

Course Outcome: At the end of the course the student will be able to		
	CO1	To understand the architecture, memory organization, and special function registers of the 8051 microcontroller.
	CO2	To learn assembly language programming using 8051 instruction sets and addressing modes.
	CO3	To explore the use of timers, counters, interrupts, and serial communication in embedded applications.
	CO4	To develop interfacing skills with peripheral devices using 8051 in both assembly and Embedded C programming.

UNIT-I	**Introduction to 8051 Architecture and Programming Basics :**	**Periods: 9**
Pin Diagram and Signal Description of 8051 Microcontroller- Internal Architecture of 8051 – CPU, RAM, ROM, Stack - Special Function Registers (SFRs) – Overview and Usage - I/O Ports and Internal Circuitry –Memory Organization – Internal and External Memory - Data Types and Directives in Assembly Language - Addressing Modes – Introduction to Assembly Language Programming – Structure and Syntax - Writing and Executing Simple Programs in Assembly		**CO1**
UNIT-II	**Instruction Set and Programming Constructs :**	**Periods: 9**
Overview of 8051 Instruction Set – Classification and Categories - Data Transfer Instructions - Arithmetic Instructions - Logical Instructions – Bit Manipulation Instructions – Branch and Loop Instructions – Stack and Subroutine Instructions – Writing Structured Programs – Delay Loops, Counters, Conditional Branches Assembly Language Debugging Techniques – Breakpoints, Single Step.		**CO2**
UNIT-III	**Timers, Counters, and Interrupts Programming :**	**Periods: 9**
Overview of Timer/Counter Features in 8051 - Timer Modes and Operation – Programming Timer 0 and Timer 1 using Assembly - Generating Time Delay and Square Wave - Basics of Interrupts in 8051 – Types and Priority - Enabling/Disabling Interrupts – Writing Interrupt Service Routines (ISRs) in Assembly - Use of Polling vs. Interrupts – Applications.		**CO3**
UNIT-IV	**Serial Communication and Interfacing Concepts:**	**Periods: 9**
Basics of Serial Communication – Baud Rate, Framing, Modes - SFRs used – Serial Data Transmission and Reception - Setting Baud Rate using Timer - Assembly Language Program for Serial Communication Mode 1 - Interfacing with RS-232 using MAX232 - Transmit/Receive data - Assembly Programming for Real-Time Data Logging - Interfacing Concepts – External Memory Interfacing – Code and Data Memory - Interface Program Memory.		**CO1, CO2,**
UNIT-V	**Applications and Interfacing with Peripherals:**	**Periods: 9**
Interfacing LEDs – Pattern Generation Using Assembly- Interfacing Push Buttons and DIP Switches – Debounce Techniques - Interfacing Relays and Buzzers - Interfacing 7-Segment Display – Static and Multiplexed - Interfacing Matrix Keypad – Row/Column Scanning - Interfacing LCD 16x2 in Assembly - Interfacing ADC/DAC with 8051 – Sampling Analog Signals - Stepper Motor and DC Motor Control Using 8051 - Using Embedded C Programming for 8051 Microcontrollers.		**CO4**

Lecture Periods: 45	Tutorial Periods: 00	Practical Periods: 00	Total Periods:45
Reference books:			
1. **The 8051 Microcontroller and Embedded Systems: Using Assembly and C"** *by Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay* **Publisher:** Pearson Education 2.**Programming and Customizing the 8051 Microcontroller** *by Myke Predko* **Publisher:** McGraw-Hill Education			

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; 0 – Not Correlated.

Department: **Humanities & Social Sciences**		Programme : **B.Tech.-EIE**						
Semester : **Five**		Subject Category: **AEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods/ Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HSUA105	**Industrial Economics and Management**	2	-	-	2	40	60	100

Prerequisite	-	
Course Outcome: At the end of the course the student will be able to	**CO1**	Demonstrate economic theories, revenue and cost concepts and set of analytical techniques applied to a variety of economic (and non-economic) and financial management issues.
	CO2	Implement various management techniques based on the needs
	CO3	Apply financial planning and Interpret company's income statements and balance sheets to ascertain the financial position of a company.
	CO4	Apply production planning, project scheduling and financial analysis to economic investment and project management problems.
	CO5	Understand fundamental marketing concepts, apply them to real-world scenarios, and develop effective marketing strategies.

UNIT-I	**Micro and Macro Economics and its Applications**	**Periods:6**
Nature and Scope of Economic science – Micro Economics: Economic decisions and Technical decisions, Demand and Supply concepts, Market Equilibrium, Elasticity of Demand, Various concepts of Cost – Break Even Analysis – Market structure. Macro Economics: Measures of National Income – Inflation – Business Cycle.		**CO1**
UNIT-II	**Management Techniques**	**Periods:6**
Introduction to Management – Functions of Management – F.W.Taylor's Scientific Management – Henry Fayol's Principles of Management. Forms of Business Organization, and Types of (Ownership) of a firm.		**CO2**
UNIT-III	**Industrial Finance**	**Periods:6**
Need for Finance –Types of finance – Sources of finance. Final Accounts - Preparation of Trading, Profit and loss Account and Balance Sheet.		**CO3**
UNIT-IV	**Production Management**	**Periods:6**
Types of Production system – Production Planning and control: Planning, Routing, Scheduling, Inspection and Dispatches. Concepts of Productivity – Measurement of Productivity.		**CO4**
UNIT-V	**Marketing Management**	**Periods:6**
Core Concepts of Marketing – Marketing Vs Selling – Channels of Distribution – Promotion Vs. Advertising – Market Research Vs Marketing Research.		**CO5**

Lecture Periods: 30	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 30**

Reference Books

1. Varshney Maheswari, Managerial Economics, S Chand & Co, New Delhi, 2011.
2. Dutt & Sundaram, Indian Economy, S Chand & Co, New Delhi, 2015.
3. Pandey I.M, Elements of Financial Management Wiley Eastern Ltd, New Delhi, 2015.
4. H.L. Ahuja, Macro Economics for Business and Management, S Chand & Company Ltd, 2011.
5. O.P Khanna, Industrial Engineering and Management, Dhanpat Rai and Sons, 2009.
6. Philip B Kotler, Marketing Management, Mac Millan, NewYork, 2011.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	-	1	-	-	-	3	-	-	-	-	2	2	2
CO2	-	-	-	-	-	-	-	-	-	3	2	2	2
CO3	-	1	-	-	-	-	-	-	-	3	2	2	2
CO4	-	-	-	-	-	-	-	-	-	3	2	3	2
CO5	-	-	-	-	-	-	-	-	-	3	2	2	2

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**	Programme :**B.Tech- EIE**	
Semester : **Five**	Subject Category: **PCC**	Semester Exam Type: **LB**

Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC116	System Design using 8051 Microcontroller Laboratory	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**

Prerequisite:	-	
Course Outcome: At the end of the course the student will be able to	**CO1**	develop hands-on skills in writing and executing assembly language programs for basic input/output operations and timer-based control using the 8051 microcontroller.
	CO2	enable students to configure and use 8051 internal peripherals such as timers, interrupts, and serial communication for real-time control applications.
	CO3	provide practical exposure to interfacing external devices like LEDs, 7-segment displays, LCDs, keypads, ADCs, and sensors with the 8051 microcontroller.
	CO4	introduce the use of Embedded C for developing efficient and scalable microcontroller-based applications.

List of Experiments	**PART-A** 1. Blinking an LED connected to Port 1 of 8051 Microcontroller using software-based delay in Assembly Language. 2. Interfacing push button switches to 8051 Microcontroller and displaying their status on LEDs using Assembly Language. 3. Using Timer of 8051 Microcontroller and Generating a hardware time delay using Timer 0 in Mode 1 of 8051 Microcontroller through Assembly Language programming. 4. Configuring 8051 Timer in event counter mode to count external pulses from a switch and display the count. 5. Handling external hardware interrupt (INT0) and Timer interrupt in 8051 Microcontroller 6. Using UART of 8051 Microcontroller to Transmit and Receive Data using Assembly Language.	**CO1,** **CO2,** **CO3**
List of Experiments	**PART-B** 7.Interfacing a common cathode 7-segment display to 8051 Microcontroller and displaying digits 0 to 9 sequentially using Assembly Language. 8. Displaying a static message on a 16x2 LCD display interfaced with 8051 Microcontroller using 8-bit mode in Assembly Language. 9. Interfacing a 4x4 matrix keypad with 8051 Microcontroller and identifying the pressed key using Assembly Language. 10. Interfacing 8051 Microcontroller with ADC0804 to read analog voltage and display equivalent digital value on LEDs. 11. Interfacing temperature sensor LM35 with 8051 Microcontroller via ADC0804 and transmitting temperature data to PC through serial communication. 12. Using Embedded C Programming for 8051 Microcontrollers.	**CO3,** **CO4**

Lecture Periods: 00	**Tutorials Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Five</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: LB</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC117</td><td>VLSI Design Laboratory</td><td>-</td><td>-</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Digital System Design</td></tr>
<tr><td rowspan="5">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">The student will gain conceptual understanding of using a FPGA.</td></tr>
<tr><td>CO2</td><td colspan="7">The students will become knowledgeable about Combinational logic circuits implementation</td></tr>
<tr><td>CO3</td><td colspan="7">The students will gain knowledge about Sequential logic implementation</td></tr>
<tr><td>CO4</td><td colspan="7">The students will learn about design of data acquisition and LCD systems using FPGA</td></tr>
<tr><td>CO5</td><td colspan="7">Student will get understanding of Real time systems and applications using FPGA.</td></tr>
<tr><td>List of Experiments</td><td colspan="6">1. Implementation of Basic Logic Gates, Half and Full Adders in FPGA and logic synthesis.
2. Implementation of Combinational logic circuits- Encoders, Decoders , Multiplexors , Demultiplexors , Comparators in FPGA
3. Implementation of Sequential logic Circuits - Flips Flops, Registers , Counters in FPGA.
4. Implementation of ALU in Structural , Behavioral and Dataflow modes. Validation of Logic outputs.
5. Peripheral Interfacing using FPGA - Switches, LEDs , Segment Displays.</td><td colspan="2">CO1
CO2</td></tr>
<tr><td>List of Experiments</td><td colspan="6">6. Design of Motor Controller using FPGA/CPLD.
7. Design of Display controllers using FPGA/CPLD.
8. Design of Data Acquisition controllers using FPGA/CPLD.
9. Design of Programmable Signal generators using FPGA/CPLD.
10. Design of UART communication controller using FPGA/CPLD</td><td colspan="2">CO3,
CO4,
CO5</td></tr>
<tr><td colspan="2">Lecture Periods: 00</td><td colspan="3">Tutorials Periods: 00</td><td colspan="2">Practical Periods: 45</td><td colspan="2">Total Periods: 45</td></tr>
</table>

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	2	3	2
CO2	3	3	3	2	3	-	-	-	-	-	2	3	2
CO3	3	3	3	2	3	-	-	-	-	-	2	3	2
CO4	3	2	3	3	3	-	-	-	2	2	2	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	3	3

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : Five		Subject Category: **PCC**			Semester Exam Type**: LB**			
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC118	**Instrumentation System design Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**
Prerequisite:	Transducer and measurement system							
Course Outcome: At the end of the course the student will be able to	**CO1**	The students will be able to design, test and calibrate the industrial instruments.						
	CO2	The students will become knowledgeable about Analog circuit design for instrumentation						
	CO3	Student will be able to implement in Real time systems and applications.						
List of Experiments	Design, Testing and calibration of 3½ Digit Digital Voltmeter using ICL 7107. Design, Testing and calibration of Monolithic Function Generator using XR 2206 and LM566 Design, Testing and calibration of Regulator Power supplies. Design, Testing and calibration of Batch counter using TTL ICs. Design ,Testing and calibration of DAC and ADC (both passive and digital)					**CO1, CO2**		
List of Experiments	Design, Testing and calibration of Electronic P, PI, PID & ON/OFF controllers. Design, Testing and calibration of Programmable Timers. Design, Testing and calibration of pH meter using single glass electrode. Design, Testing and calibration of Digital Thermometer. Design, Testing and calibration of F to V and V to F converters. Design and testing of advanced measurement circuits.					**CO3**		
Lecture Periods: 00	**Tutorials Periods: 00**	**Practical Periods: 45**			**Total Periods: 45**			

Reference Books

1. C. D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Prentice Hall, 2006.
2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
3. R.W. Miller, "Flow Measurement Engineering Handbook", Mc-Graw Hill, New York, 1996.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	-	-	2	3	2
CO2	3	3	3	2	3	-	-	-	-	-	2	3	2
CO3	3	3	3	2	3	-	-	-	-	-	2	3	2
CO4	3	2	3	3	3	-	-	-	2	2	2	3	3
CO5	3	3	3	3	3	2	2	2	2	2	3	3	3

Department : **EIE**		**Programme :B.Tech.-EIE**						
Semester : **Five**		Subject Category: **HNC**				Semester Exam Type:**TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUH102	**Measurement Data Analysis**	**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite								

Course Outcome: At the end of the course the student will be able to	**CO1**	Apply the principles of probability theory and various discrete and continuous distributions to solve engineering problems involving uncertainty.
	CO2	Analyze statistical data using sampling distributions, hypothesis testing, and ANOVA to draw valid inferences for decision-making.
	CO3	Organize and represent data effectively using various methods of data classification, tabulation, graphical tools, and measures of central tendency and dispersion.
	CO4	Utilize R and Python programming for data manipulation, visualization, and basic statistical analysis in real-world applications.

UNIT-I	**Periods: 12**
Sample Spaces- Events - Axioms – Counting - Conditional Probability and Bayes' Theorem – The Binomial Theorem – Random variable and distributions: Mean and Variance of a Random variable- Binomial-Poisson-Exponential and Normal distributions. Curve Fitting and Principles of Least Squares- Regression and correlation	**CO1**
UNIT-II	**Periods:12**
The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Sampling distributions (Chi-Square, t, F, z). Test of Hypothesis- Testing for Attributes – Mean of Normal Population – One-tailed and two-tailed tests, F-test and Chi-Square test - - Analysis of variance ANOVA – One way and two way classifications.	**CO1, CO2**
UNIT-III	**Periods: 12**
PRESENTATION AND CLASSIFICATION OF DATA : Methods of collection of primary data, Discrete and Continuous Variables, Frequency Distributions, Cumulative Frequency distribution and gives, Bivariate Frequency Distributions; Tabulation of data. MEASURES OF LOCATION AND DISPERSION: Arithmetic mean: The Arithmetic mean of grouped Data, The Median: The mode; The variance and standard deviation: Interpretation of SD, Chebyshev's Lemma or Rule (for sample),	**CO2, CO3**
UNIT-IV	**Periods: 12**
GRAPHICAL REPRESENTATION: Line graphs, Geometric Forms, Pictorial Diagrams, Control Charts, Radar charts, Parteto Diagrams, Histograms, Pie Charts, Histogram, Scatter diagram, Flow charts TIME SERIES ANALYSIS: Characteristics Movements in a time series; Time series models; Measurement of Trend; Secular Trend; Seasonal Movements; Cyclical Movements; Irregular Movements; Long Cycles	**CO4**
UNIT-V	**Periods: 12**
Introduction to R- Packages- Scientific Calculator- Inspecting Variables- Vectors Matrices and Arrays- Lists and Data Frames- Functions- Strings and Factors- Flow Control and Loops- Advanced Looping- Date and Times. Introduction to Python Packages- Fundamentals of Python- Inserting and Exporting Data- Data Cleansing Checking and Filling Missing Data- Merging Data- Operations- Joins.	**CO4**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: 00**	**Total Periods:60**

Reference Books:

1. Richard Cotton, “Learning R”, O’Reilly, 2013.
2. Dalgaard, Peter, “Introductory statistics with R”, Springer Science & Business Media, 2008.
3. Brain S. Everitt, “A Handbook of Statistical Analysis Using R”, Second Edition, 4 LLC, 2014.
4. Samir Madhavan, “Mastering Python for Data Science”, Packt, 2015.
5. Sheldon M. Ross,”Introduction to Probability and Statistics for Engineers and Scientists”, 4 th edition, Academic Press; 2009.
6. Paul Teetor, “R Cookbook, O’Reilly, 2011.
7. Mark Lutz ,”Learning Python”, O’Reilly,5th Edition,2013

CO-PO Mapping

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

Department : **EIE**			Programme : **B.Tech.-EIE**						
Semester : **Six**			Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC119	**Analytical Instruments**		3	-	-	3	40	60	100
Prerequisite:	Transducers and measurement system								
Course Outcome: At the end of the course the student will be able to	**CO1**	Explain the basic principles of spectroscopy, chromatography, and electrochemical analysis							
	CO2	Identify and compare different analytical instruments used in industry and healthcare.							
	CO3	Demonstrate the working of spectrometers, chromatographs, and sensors through practical experiments.							
	CO4	Choose suitable analytical instruments for environmental, industrial, and biomedical applications.							
UNIT-I	**Fundamentals of Spectroscopy & Optical Methods**							**Periods: 9**	
Electromagnetic radiation and its interaction with matter – Beer-Lambert law – UV-Visible spectroscopy – Components of spectrometers: Light sources, monochromators, filters, and detectors – Basics of fluorescence and Raman spectroscopy – Applications in material and biomedical analysis									**CO1, CO2**
UNIT-II	**Infrared & Atomic Spectroscopy**							**Periods: 9**	
Infrared (IR) spectroscopy – FTIR principles and applications – Atomic absorption spectroscopy (AAS) – Flame emission spectroscopy – Basics of X-ray fluorescence (XRF) – Introduction to laser-based spectroscopy – Simple industrial and medical applications.									**CO1, CO3**
UNIT-III	**Mass Spectrometry & NMR Techniques**							**Periods: 9**	
Basic principles of mass spectrometry (MS) – Time-of-Flight (TOF) and Quadrupole MS – Simple applications in chemical and biomolecular analysis – Basics of Nuclear Magnetic Resonance (NMR) – Application of NMR in material and medical imaging.									**CO2, CO3**
UNIT-IV	**Electrochemical & Sensor-Based Analysis**							**Periods: 9**	
pH measurement – Ion-selective electrodes – Conductivity and dissolved oxygen measurement – Basics of biosensors – Simple applications of smart sensors for chemical analysis – Overview of non-invasive sensors in healthcare									**CO3, CO4**
UNIT-V	**Chromatographic & Environmental Monitoring**							**Periods: 9**	
Basic principles of gas and liquid chromatography (GC & HPLC) – Applications in food and pharmaceutical industries – Flue gas analysis – Measurement of CO, CO_2, NOx, SOx – Basics of air and water quality sensors – Simple methods for pollution control monitoring.									**CO2, CO4**
Lecture Periods: 45		**Tutorial Periods: 00**			**Practical Periods: 00**		**Total Periods: 45**		
Reference Books:									

1. **"Chemical Analysis: Modern Instrumentation Methods and Techniques"** – *Francis Rouessac & Annick Rouessac*, 3rd Edition, February 2022.
2. **"Ewing's Analytical Instrumentation Handbook"** – *Nelu Grinberg & Sonia Rodriguez,* 4th Edition, March 2019.
3. **"Instrumental Analytical Chemistry"** – *James W. Robinson,* 1st Edition, 2022

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**							
Semester : **Six**		Subject Category: **PCC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUC120	**Embedded System Design**	**3**	**-**	**-**	**3**	**40**	**60**	**100**	
Prerequisite:	Microcontroller								
Course Outcome: At the end of the course the student will be able to	**CO1**	To learn the basic parts of an embedded system and how microcontrollers are used in their design.							
	CO2	To understand the working of the LPC2148 microcontroller and write programs using Embedded C.							
	CO3	To learn how to connect and control external devices like LEDs, motors, displays, and keypads with LPC2148.							
	CO4	To understand advanced features of LPC2148 and use Real-Time Operating Systems (RTOS) in embedded applications.							
UNIT-I	**REVIEW OF EMBEDDED SYSTEMS**							**Periods: 9**	
Introduction to Embedded Systems – Components of an Embedded System – Processor Specifications – Role of Microcontrollers in Embedded System Design – Features of Microcontrollers – On-board Peripherals – Processor Selection Criteria – Microcontroller Specifications – Word Length – Performance Metrics – Power Consumption – Package Types – Electrical Requirements – Reset Hardware – Oscillator Design – Power Consideration – Development Tools – Firmware Development Options – Assembly Language Vs High-level Language Programming – Intel Hex File Format.									**CO1**
UNIT-II	**LPC2148 MICROCONTROLLER ARCHITECTURE AND PROGRAMMING**							**Periods: 9**	
LPC2148 Microcontroller Bus Architecture – Features of LPC2148 Microcontroller – Firmware Development Using Embedded C – Data Types, Conditional Statements, Loops – Programs Using Embedded C – General Purpose I/O (GPIO) Programming – Timer/Counter Programming – UART Configuration and Programming – Interrupt Handling– ADC and DAC Interfacing and Programming.									**CO1, CO2**
UNIT-III	**PERIPHERAL INTERFACING WITH LPC2148**							**Periods: 9**	
Design of I/O Systems Using Switches, LEDs, and Buzzers – Current Source and Sink Concepts – Interfacing Seven Segment Display - Character and Graphical LCD Displays – DC Motor Speed Control Using PWM – Speed Measurement Using Input Capture – Design of Digital Frequency Meter – Relay Control – Keypad Interfacing – Interfacing SD Cards– PC-Based Control Systems via UART.									**CO2, CO3**
UNIT-IV	**ADVANCED INTERNAL PERIPHERALS OF LPC2148**							**Periods: 9**	
SPI, I2C, and USB Features of LPC2148 – Watchdog Timer (WDT) – Pulse Width Modulation (PWM) and generation of variable duty cycle PWM signals – Real Time Clock (RTC)– Brown-out detection and power management features – Idle and Power-down modes – Memory Acceleration Module (MAM) – In-System Programming (ISP) and In-Application Programming (IAP) mechanisms.									**CO3**
UNIT-V	**REAL-TIME OPERATING SYSTEMS (RTOS) AND APPLICATIONS**							**Periods: 9**	

RTOS Concepts and Terminology – Components of RTOS - Task and Task States – Scheduling Algorithms: Round Robin, Preemptive Scheduling – Tasks and Data, Semaphores and Shared Data – OS Services: Message Queues, Events, Memory Management – Interrupt Handling in an RTOS Environment – RTOS Porting on LPC2148 – Application Development Using RTOS.	**CO3, CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. **Shibu K.V., *Introduction to Embedded Systems***, McGraw Hill Education, 2nd Edition, 2017.
2. **Mazidi Muhammad Ali, Rolin D. McKinlay, and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems: Using Assembly and C***, Pearson Education, 2nd Edition, 2006.
3. **Raj Kamal, *Embedded Systems: Architecture, Programming and Design***, McGraw Hill Education, 3rd Edition, 2017.
4. **James K. Peckol, *Embedded Systems: A Contemporary Design Tool***, Wiley India Pvt. Ltd., 2nd Edition, 2019.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**							
Semester : **Six**		Subject Category: **PCC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUC121	**Process Control**	**3**	**-**	**-**	**3**	**40**	**60**	**100**	
Prerequisite:	-								
Course Outcome: At the end of the course the student will be able to	**CO1**	To introduce the terminology and concepts associated with Process control domain.							
	CO2	To impart knowledge in the various types of controller and PID controller tuning for processes.							
	CO3	To familiarize the students with characteristics, selection, sizing of control valves.							
	CO4	To elaborate different types of advanced control schemes							

UNIT-I	**PROCESS CONTROL SYSTEM:**	**Periods: 9**
Terms and objectives, piping and Instrumentation diagram, instrument terms and symbols. Regulatory and servo control, classification of variables. Process characteristics: Process equation, degrees of freedom, modeling of simple system, Self-regulating processes, interacting and noninteracting processes, Process lag, load disturbance and their effect on processes.		**CO1**
UNIT-II	**CONTROLLER MODES:**	**Periods: 9**
Basic control action, two position, multi-position, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, P-D, P-I-D, Integral wind-up and prevention. Auto/Manual transfer, Bumpless transfer. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.		**CO2**
UNIT-III	**CONTROLLER TUNING METHODS:**	**Periods: 9**
Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Auto tuning. Closed loop response of I & II order systems, with and without valve, measuring element dynamics.		**CO2**
UNIT-IV	**FINAL CONTROL ELEMENT**	**Periods: 9**
Pneumatic and electrical actuators, Valve positioners. Pneumatic and electrical dampers, Control valves types, construction details, various plug characteristics. Energy efficient valves - Valve sizing - selection of control valves. Inherent and installed valve characteristics. Fail-safe operation, Cavitation and flashing in control valves, Instrument air supply specifications		**CO3**
UNIT-V	**ADVANCED CONTOL SCHEMES**	**Periods: 9**
Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Case Studies: Distillation column, Basic features of composition control schemes. Control of overhead composition, Bottom composition and both product compositions and CSTR .		**CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. G. Stephanopoulos, Chemical Process Control-An Introduction to Theory and Practice. Prentice Hall of India, New Delhi, 3rd Edition,2008.
2. D.R. Coughanowr, Steven E LeBlanc, Process Systems Analysis and Control, McGraw Hill, Singapore, 3rd Edition,2009.
3. B.W. Bequette, Process Control Modeling, Design and Simulation. Prentice Hall of India, New Delhi,2004.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Six**		Subject Category**: PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Hours /Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC122	**Process Control Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**

Prerequisite		
Outcome At the end of the course the student will be able to	**CO1**	Understand the structure and components of process control systems, including the Piping and Instrumentation Diagram (P&ID), and analyze control valve characteristics.
	CO2	Apply tuning techniques and implement closed-loop control strategies for various industrial processes such as level, flow, temperature, and pressure.
	CO3	Design and implement basic and advanced controllers, including ON/OFF controllers and PID controllers, for temperature and other industrial processes.
	CO4	Analyze, simulate, and implement digital and embedded PID controllers for both mathematically modeled and electronic processes using appropriate algorithms and techniques.

List of Experiments	Study of Process Control Training System and Piping and Instrumentation diagram of a plant. Study of Inherent and Installed Characteristics of Control Valves.	**CO1**
	Tuning and Closed-loop control of Level Process. Tuning and Closed-loop control of Flow Process. Tuning and Closed-loop control of Temperature Process. Tuning and Closed-loop control of Pressure Process.	**CO2**
	Design and implementation of ON/OFF Controller for the Temperature Process. PID Implementation Issues and configuring Industrial PID Controller. Tuning PID Controller for soft processes (Mathematically described processes). Design and simulation of Digital Controllers (Dead Beat, Dahlin’s, Kalman’s).	**CO3**
	Tuning and Closed-loop control of Electronic Processes. Design and implementation of Embedded PID Controller.	**CO4**

Lecture Periods: 00	**Tutorials Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. G.Stephanopoulis,ChemicalProcessControl,PHIlearning,NewDelhi,2008.
2. D.P.Eckman, Automatic Process Control, Wiley Eastern Ltd., New Delhi,2008.
3. Donald R.Coughanowr,Steven E.Leblanc, Process System Analysis Control, 3rd edition, 2013.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme : B.Tech.-EIE						
Semester : **Six**		Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC123	**Embedded System Laboratory**	**-**	**-**	**3**	**3**	**40**	**60**	**100**

Prerequisite:	Microprocessor and applications	
Course Outcome: At the end of the course the student will be able to	**CO1**	To develop Embedded C programs for interfacing and controlling GPIO, timers, UART, PWM, ADC, and RTC modules of the LPC2148 microcontroller.
	CO2	To design and implement drivers for digital I/O and serial communication to interface peripherals like LCD, Bluetooth, and sensors.
	CO3	To apply embedded system concepts to control real-time devices such as motors, relays, and buzzers using input/output logic and conditional programming.
	CO4	To implement and analyze real-time operating system (RTOS) features on the LPC2148 for multitasking and efficient task management.

Expts	**Title**	**COs**
1	Interfacing the GPIO of the LPC2148 Microcontroller using Embedded C	CO1
2	Developing a DPIO driver for the LPC2148 Microcontroller	CO2
3	Controlling a relay and buzzer using GPIO output and conditional logic based on input pins	CO3
4	Utilizing the PLL and Timer modules of the LPC2148 Microcontroller	CO1
5	Interfacing a 16x2 LCD display with the LPC2148 Microcontroller	CO2
6	Implementing UART communication using the LPC2148 Microcontroller	CO2
7	Generating a PWM waveform using the LPC2148 for DC motor speed control	CO3
8	Interfacing an LM35 temperature sensor via the ADC channel of the LPC2148	CO1
9	Programming the RTC in the LPC2148 to display the current time and date	CO1
10	Interfacing a Bluetooth transceiver with the LPC2148 and controlling output devices	CO2
11	Implementing an RTOS on the LPC2148 Microcontroller	CO4

Lecture Periods: 00	**Tutorial Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Mohammed Ali Mazidi and Janice Gillispie Mazidi, “The 8051 Microcontroller and Embedded System”, Pearson Education Asia, New Delhi, 2006.
2.David E Simon, " An embedded software primer ", Pearson education Asia, 2001.
3. Trevor Martin,”The Insider's Guide to the Philips ARM7-Based Microcontrollers”,Hitex Pubications(UK),2005.
4. Michael J Pont,"Patterns for Time-Triggered Embedded Systems",Addison-Wesley Professional,2001.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department	EIE	Programme : **B.Tech.-EIE**						
Semester	**Six**	Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC124	**Virtual Instrumentation Laboratory**	**-**	**-**	**3**	**1.5**	**40**	**60**	**100**
Prerequisite	Transducers and measurement systems							

Course Outcome: At the end of the course the student will be able to	**CO1**	Apply fundamental concepts such as loops, case structures, arrays, clusters, and file handling to develop basic Virtual Instrumentation (VI) applications.
	CO2	Develop communication-based applications using serial transmission (VISA), Ethernet (TCP/IP), and cloud data transfer (HTTP).
	CO3	Implement instrument control techniques using GPIB and DAQ interfacing for real-time measurement and automation.
	CO4	Design and test Virtual Instrumentation applications for engineering problems in Control System, Electronic Instruments, Signal & Image Processing

Expts	**Title**	**COs**
1	Basics I - subVI, Loops & case structures, Local & Global Variables, Formula Node & Expression Node, Graphs & Charts	**CO1**
2	Basics II - Shift Registers, Event Structures, Arrays & Clusters, Express VI's, String Processing, File Processing	**CO1**
3	Serial Transmission using VISA	**CO2**
4	Development of Programmable LED Controller	**CO1, CO2 CO3, CO4**
5	Development of Programmable Digital Voltmeter	**CO1, CO2 CO3, CO4**
6	Instrument Control using GPIB: Calibration of DRB/RPS	**CO2, CO3**
7	Instrument Control using ETHERNET using TCP/IP	**CO2, CO3, CO4**
8	DAQ Interfacing	**CO3**
9	Transmission & Reception of Data to Cloud using HTTP Protocol	**CO2, CO4**
10	Control System Applications	**CO4**
11	Image Processing Applications	**CO4**
12	Mini Project	**CO1, CO2 CO3, CO4**

Lecture Periods: 00	**Tutorial Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. "LabVIEW Student Edition" by Robert H. Bishop, 1st Edition, August 2014
2. "Virtual Instrumentation Using LabVIEW" by Jovitha Jerome, 1st Edition, 2010.
3. "LabVIEW for Everyone: Graphical Programming Made Easy and Fun" by Jeffrey Travis and Jim Kring, 3rd Edition, 2006.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Six**		Subject Category: **PCC**				Semester Exam Type:		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC125	**Internship**	**-**	**-**	**-**	**2**	**100**	**-**	**100**
Prerequisite:								

Course Outcome: At the end of the course the student will be able to :	**CO1**	Apply theoretical knowledge gained during coursework to real-world projects and tasks.
	CO2	Develop soft skills such as communication, teamwork, problem-solving, and time management.
	CO3	Demonstrate proficiency in relevant industry technologies or platforms.
	CO4	Handle the demands and challenges of a professional setting

The student is required to undergo 'internship' in industry / research laboratory / higher learning institution for a period of at least 4 weeks in a maximum of 2 spells during vacations. Each spell of internship shall be for a period of not less than 2 weeks. The main purpose of internship is to enhance the general professional outlook and capability of the student to advance his chances of improving the career opportunities. The student should get prior approval from the Head of the Department before undertaking the internship and submit a detailed report after completion for the purpose of assessment. A departmental committee shall evaluate the performance of the students.	**CO1, CO2, CO3, CO4**

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Six**		Subject Category: **HNS**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUH103	**Field Instruments for Process Control**	**3**	**1**	**-**	**4**	**40**	**60**	**100**

Prerequisite:		
Course Outcome: At the end of the course the student will be able to	**CO1**	Learner will be able to learn the Industrial Automation and various communication busses
	CO2	Learner will be able to learn the terminologies of Instrumentation, Measurement Techniques and concepts of control system environment
	CO3	Able to understand the importance of Field instruments
	CO4	Able to perceive the Automation protocols, Instrumentation and Industrial Engineering
	CO5	Able to suitable P&ID for industrial process

UNIT-I	**INDUSTRIAL AUTOMATION**	**Periods: 12**
Orientation to Industrial Automation - Overview of the Process Plant – Refineries – Petrochemicals - Fertilizers, Chemical – Pharmaceuticals - Overview of the Process Plant - Crude Oil Distillation - Power generation – Reactors - Boiler Unit - Cracker unit - Introduction to various Industrial Automation - Single Loop Controllers - Programmable Logic Controllers - Distributed Control Elements - Introduction to various Communication Protocols – HART – BRAIN - Ethernet - Serial Communication - Modbus Communication - Fieldbus Communication		**CO1**
UNIT-II	**INSTRUMENTATION BASICS**	**Periods: 12**
Introduction to Instrumentation Basics - Introduction to Industrial Measurement techniques - Pressure Measurement - Temperature Measurement - Flow Measurement - Level Measurement -Basic Control Loops and Tuning		**CO2**
UNIT-III	**FIELD INSTRUMENTS**	**Periods: 12**
Introduction to Field Instruments - Principle and Operation of Transmitters - Principle and Operation of Flow meters - Principle and Operation of Control Valves - Single Loop Controllers and Operation - Principle and Operation of Data acquisition System		**CO3**
UNIT-IV	**INDUSTRIAL ENGINEERING**	**Periods: 12**
Project Engineering - Panel Engineering - Nest loading - Process Wiring – Industrial Safety		**CO4**
UNIT-V	**DIAGRAMS AND SCHEMES**	**Periods: 12**
Process Diagrams - Process flow diagrams - Process Flow Schemes - P&ID		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: 00**	**Total Periods:60**

Reference Books:

1. Terry L. M. Bartelt, Instrumentation and Process Control, Delmar Cengage Learning, 1st edition, 2006.
2. Gregory K. Mcmillan, Douglas M. Considine, Process/Industrial Instruments and Controls Handbook, McGraw-Hill
   Education; 5 edition, 1999.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Seven**		Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC126	**PLC& DCS**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite:	Control Systems and Process Control	
Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the basics of PLC and its Interfaces to the Real world.
	CO2	Develop programs for simple and Complex Control related applications.
	CO3	Enhance the knowledge on Data Networks and the latest Networking Technologies.
	CO4	Understand the significance of DCS in Industry and its Architecture and Functioning.

UNIT-I	**PLC Architecture and Interface Modules**	**Periods: 09**	
PLC Architecture – Block diagram – Comparative study of Industrial PLC's – Interface modules – Discrete AC and DC input and output modules – analogue and BCD input and output modules – TTL Modules – Communication modules. PID -Thermocouple -Stepper motor - Encoder/Counter, Servo and language modules.			**CO1**
UNIT-II	**PLC Programming**	**Periods: 09**	
Ladder logic – Boolean language – Instruction Set – Program control instructions – Data manipulation – Math instructions – Shift register and Sequencer instructions – Structured Text programming – Sequential Function chart.			**CO2**
UNIT-III	**Data Network Fundamentals**	**Periods: 09**	
Network Hierarchy and switching – ISO/OSI Reference model – Data link control protocol – HDLC, SDLC- Multiple access protocols – Token ring, Token Bus and CSMA/CD, Polling, reservation, TDMA, FDMA CDMA. Addressing Concepts: Classful, classless addressing and Network address translation. TCP/IP -Bridges, routers, gateways – Standard Ethernet.			**CO3**
UNIT-IV	**Distributed Control System**	**Periods: 09**	
Evolution – Hybrid and Centralized Architecture – Local Control Unit – Output configurations -Redundancy Concepts – Manual Backup Configurations – Operator Interface – LLOI and HLOI – Displays – Communication Networks and communication standards in DCS – Factors to be considered in selecting a DCS.			**CO4**
UNIT-V	**HART and Fieldbus**	**Periods: 09**	
Introduction to HART Communication protocol – Communication modes – HART networks – HART commands -HART applications – Fieldbus – Introduction – Fieldbus architecture – Benefits – Basic requirements of Fieldbus standard – Fieldbus Topology – Interoperability and Interchangeability – Smart Transmitters.			**CO3**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. Frank.D.Petrezuella , " Programmable Logic Controllers", McGraw Hill , Six Edition, 22nd Sept,2023.
2. Lucas.M.P., "Distributed Control Systems" , Van Nostrand and Reinhold Company, NY, 1980.
3. Hughes.T.," Programmable Controllers", ISA Press, 2000.
4. M.Chidambaram, "Computer Control of Process", Narosa Publishing House,2002.
5. D.M.Considine, " Process Instruments and Control Handbook", McGraw Hill, 1985.
6. R.G.Jamkar, " Industrial Automation using PLC, SCADA & DCS/ PLC & SCADA BOOK// Engineering Book/(1004), Second Edition,2018.
7. B.G.Liptak, " Instrumentation in Process Industries", Vol. I and II , Chilton Books, 1973.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; 0 – Not Correlated.

Department : **EIE**			Programme : **B.Tech.-EIE**						
Semester : **Seven**			Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC127	**System Design Using Single Board Computer**		**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite:	Microprocessor , Embedded System Design								
Course Outcome: At the end of the course the student will be able to	**CO1**	Explain the concepts of Single Board Computers and its components.							
	CO2	Understand the Operating System for SBC and Programming concepts of SBC using Python Language							
	CO3	Implement System Design using SBC with peripheral and sensor interfacing.							
	CO4	Implement Internet of Things and Programmable Instruments							
UNIT-I	**Introduction to Single Board Computers**							**Periods: 12**	
Review of Single Board Computers - Introduction to Raspberry Pi, Comparison of various Rpi Models, Understanding SoC architecture and SoCs used in Raspberry Pi, Pin Description of Raspberry Pi , On-board components of Rpi									**CO1**
UNIT-II	**Operating System for SBC**							**Periods: 12**	
Booting up RPi - operating System and Linux Commands - Linux- Introduction – Architecture - File System - Raspberry Pi Operating System – Introduction - Installing Raspberry Pi OS - First boot and Basic Configuration of Pi - Popular Linux Commands.									**CO1 CO2**
UNIT-III	**Understanding Python**							**Periods: 12**	
RPi using Python – Introduction - Python vs. Other Languages - Applications of Python – Variables – Keywords - Operators and Operands - Data Types in Python - Importing Libraries - Flow Control, Conditional Statement - Loops – Functions - Modules and Packages - File Handling									**CO2 CO3**
UNIT-IV	**System Design Using SBC**							**Periods: 12**	
System Design Basics – Using GPIO of Raspberry Pi - Interfacing Input and Output Devices - Sensor Interfacing - Interfacing Temperature Sensor - Humidity Sensors - Motion Sensor - Ultrasonic sensor – UART Communicating using RPi- GSM interfacing – Bluetooth communication - Accessing on-board Wi-Fi – Using camera - Connecting Database with RPi									**CO3**
UNIT-V	**Internet of Things**							**Periods: 12**	
IoT Applications based on Pi, Web-server, GPIO Control over Web Browser, Creating Custom Web Page - Communicating data using on-board module - Home automation using Pi – Image Processing using Pi – Designing Programmable Digital Instruments using Pi.									**CO3 CO4**
Lecture Periods: 45		**Tutorial Periods: -15**			**Practical Periods: 00**		**Total Periods: 60**		
Reference Books:									
1. Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition by Simon Monk McGraw Hill Professional, 04-Jun-2021 2. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition by Derek Molloy, wiley publications 2016. 3. The Computer Programming Bible: A Step by Step Guide On How To Master From The Basics to Advanced of Python, C, C++, C#, HTML Coding Raspberry Pi3 by C.P.A Inc 2020. 4. Raspberry Pi IoT Projects: Prototyping Experiments for Makersby John C. Shovic, APress 2016									

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech.-EIE</td><td colspan="3"></td></tr>
<tr><td colspan="2">Semester : Seven</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUC128</td><td>Robotics and Automations</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Explain the fundamental principles and components of industrial robots, automation systems, and their integration into manufacturing.</td></tr>
<tr><td>CO2</td><td colspan="7">Analyze robot kinematics, workspace, and configurations for various industrial applications.</td></tr>
<tr><td>CO3</td><td colspan="7">Apply control techniques and automation tools like linear feedback system, PID and computed torque control for robotic operations.</td></tr>
<tr><td>CO4</td><td colspan="7">Evaluate the role of robotics in manufacturing and interpret emerging trends in industrial automation.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Robotics- Basics, Anatomy and Components – Laws of Robotics - Robot Configurations and its types. Actuators- Electric, hydraulic and pneumatic actuators. Sensors and vision systems: robot transducers and sensors - Tactile sensors – Proximity and range sensors – ultrasonic sensor- touch sensors - slip sensors. Vision systems – Image processing and analysis – Image data reduction – Segmentation feature extraction – Object recognition.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">End Effectors - Types</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, work space analysis work envelope - workspace fixtures- pick and place operation- continuous path motion-interpolated motion straight line motion.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Robot Motion Analysis</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics-arm equation-link coordinates-Homogeneous transformations and rotations and Robot dynamics.</td><td>CO2, CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Robot manipulator control</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.</td><td>CO3</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Industrial and Non industrial Robot Applications</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Industrial and non-industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries</td><td>CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods: 00</td><td colspan="3">Practical Periods: 00</td><td colspan="2">Total Periods: 45</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education, Fourth Edition, 2016.
2. Robert J.Schilling, Fundamentals of Robotics-Analysis and Control, PHI, 2007.
3. K. S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics – Control, Sensing, Vision and Intelligence”, McGraw Hill, First Edition, 1987.
4. Klafter, Thomas, Negin, “Robotic Engineering: An Integrated Approach”, PHI Learning, First Edition, 2003.</td></tr>
</table>

5. S. R. Deb, “Robotics Technology and Flexible Automation”, McGraw Hill Education, Second Edition, 2013.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department :**EIE**		Programme : **B.Tech.- EIE**						
Semester : **Seven**		Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC129	**Industrial Automation Laboratory**	**-**	**-**	**1.5**	**1.5**	**40**	**60**	**100**
Prerequisite:								

Outcome: At the end of the course the student will be able to	**CO1**	Acquires practical issues of applications of PLC hardware and programming a PLC.
	CO2	Acquires adequate knowledge about practical issues of implementations of PLC and DCS.
	CO3	Acquires adequate knowledge about practical issues of calibration of Process instruments
	CO4	Acquires adequate knowledge about practical issues of various controllers.

(Any 10 Experiments)	
Study of basic programming of PLC Analog operation in PLC Arithmetic operation, Timer, Counter operation using PLC Annunciator design using PLC PLC based control of Level Process , Temperature Process.	**CO1**
DCS based simultaneous control of Level Process , Pressure Process and Flow Process. DCS based Batch Process control	**CO2**
Calibration of Pressure gauge using Dead weight Tester. Calibration of manometers and Control valves Calibration of Control valves, I to P and P to I converters Calibration of Pressure Switch, RTD and Thermocouple.	**CO3**
Design of PID Controller and Auto tuning of PID Controller Analysis of Multi-input Multi-output System(Four-tank System) Design of Multi-Loop PID Controller and Multivariable PID Controller. Design of Gain scheduling controller Design of Self-Tuning Controller Design of Deterministic/stochastic State Observer Design of State Feedback	**CO4**

Lecture Periods: 00	**Tutorials Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department	**EIE**	Programme : **B.Tech.-EIE**						
Semester	**Seven**	Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC130	**System Design Using Single Board Computer Laboratory**	-	-	3	3	40	60	100
Prerequisite	Microprocessor , Embedded System Design							

Course Outcome: At the end of the course the student will be able to	**CO1**	Apply fundamental concepts of Operating Systems and Installation of OS on SBC.
	CO2	Use GPIO of Raspberry Pi and Implement simple SBC based systems.
	CO3	Build Instrumentation systems and Image Processing using SBC
	CO4	Demonstrate the Internet of Things using SBC and Programmable Instruments

Expts	**Title**	**COs**
1	Install Raspberry Pi Operating System and Basic Configuration of Pi	**CO1**
2	Implementation of Digital Input and Digital Output using GPIO of Raspberry Pi.	**CO1**
3	Interfacing Display Devices using Raspberry Pi	**CO2**
4	Design of Motor Control System using Raspberry Pi	**CO1, CO2 CO3, CO4**
5	Interfacing Camera with Raspberry Pi and Implementing Image acquisition.	**CO1, CO2 CO3, CO4**
6	Building GSM Based System using Raspberry Pi	**CO2, CO3**
7	System Design using Bluetooth communication with Raspberry Pi	**CO2, CO3, CO4**
8	Implementation of Image Processing using Raspberry Pi	**CO3**
9	Building IoT Application Using Raspberry Pi	**CO2, CO4**
10	Designing Programmable Instruments using Raspberry Pi	**CO4**
11	Implementation of Home Automation Using Raspberry Pi	**CO4**
12	Mini Project	**CO1, CO2 CO3, CO4**

Lecture Periods: 00	**Tutorial Periods: 00**	**Practical Periods: 45**	**Total Periods: 45**

Reference Books:

1. Programming the Raspberry Pi, Second Edition: Getting Started with Python 2nd Edition by Simon Monk McGraw Hill Professional, 04-Jun-2021
2. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux 1st Edition by Derek Molloy, wiley publications 2016.
3. The Computer Programming Bible: A Step by Step Guide On How To Master From The Basics to Advanced of Python, C, C++, C#, HTML Coding Raspberry Pi3 by C.P.A Inc 2020.
4. Raspberry Pi IoT Projects: Prototyping Experiments for Makersby John C. Shovic, APress 2016

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department	EIE	Programme : **B.Tech.-EIE**						
Semester	**Seven**	Subject Category: **PCC**				Semester Exam Type: **-**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC131	**Mini Project**	**-**	**-**	**4**	**2**	**100**		**100**
Prerequisite:								

Course Outcome: At the end of the course the student will be able to	CO1	Carry out literature survey, understand state of art techniques.
	CO2	Identify and apply appropriate tools to solve a problem.
	CO3	Transform knowledge into an algorithmic/experimental process.
	CO4	Prepare and present reports on the project work.

The objective of this course is to enable the students to carry out the mini-project in a group. The topic shall be chosen in consultation with the Faculty coordinators. Each group of students is expected to make a detailed review of the literature, formulate the problem, carry out the mini project and prepare a report on the work done. The mini project can be a small project work or it can be a part of the work planned for the main project. The students should present the results of the work in the review committee meetings. A departmental committee shall evaluate the performance of the students.	**CO1, CO2, CO3, CO4**

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**					
Semester : **Seven**		Subject Category: **PCC**			Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC132	**Comprehensive Viva**	**-**	**-**	**-**	**1**	**100**		**100**
Prerequisite								

Course Outcome: At the end of the course the student will be able to :	**CO1**	Demonstrate a broad understanding of the subject area
	CO2	Present complex concepts in an easy-to-understand way, answering questions confidently.
	CO3	Handle unexpected and challenging questions.
	CO4	Respond thoughtfully to feedback, and participate actively in discussions.

Comprehensive viva is an oral examination conducted to evaluate the critical thinking, analytical abilities, and how well a student can discuss and apply concepts learned throughout their studies. A committee comprising of five faculty members will conduct the comprehensive viva examination and evaluate the students. Experts from the industry may also be included in this committee. The Head of the Department shall constitute this committee	CO1, CO2, CO3, CO4

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme : **B.Tech.-EIE**							
Semester : **Seven**		Subject Category: **HNC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUH104	**Advanced Control Engineering**	**3**	**1**	**-**	**4**	**40**	**60**	**100**	
Prerequisite	Control system								
Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the fundamentals of sampled data systems, including sampling processes, sample and hold circuits, signal reconstruction, pulse transfer functions, and stability analysis.							
	CO2	Develop state-space models for physical systems, including mechanical and electrical systems, and analyze state variable representations for different control systems.							
	CO3	Apply state variable analysis techniques, including decomposition methods, state transition matrices, eigenvalues, controllability, and observability, to assess system behavior.							
	CO4	Analyze nonlinear control systems using phase plane analysis, describing function methods, and various nonlinearities such as saturation, dead zone, and backlash.							
UNIT-I	**SAMPLED DATA SYSTEM**							**Periods: 12**	
Sampled data theory – Sampling process – Sample and hold circuits – Signal reconstruction –Pulse transfer function-Response of Sampled data system to step and Ramp inputs- Stability analysis of sampled data systems									**CO1**
UNIT-II	**STATE SPACE MODEL**							**Periods: 12**	
I Introduction to generalized state model – state diagram - state variable analysis for physical variable – mechanical and electrical systems – state model for armature and field controlled dc motor - phase variable and canonical variables model for continuous time systems – state model to transfer function.									**CO2**
UNIT-III	**STATE VARIABLE ANALYSIS**							**Periods:12**	
Decomposition techniques – Direct, cascade and parallel forms - Solution of homogeneous state equations – state transition matrix – Laplace transformation and cayley hamiltan methods - Eigen values and eigen vector - Controllability and Observability.									**CO3**
UNIT-IV	**NON LINEAR SYSTEM ANALYSIS**							**Periods: 12**	
Types of non-linearity – Phase plane analysis – Singular points – Limit cycle – jump resonance - construction of phase trajectories – analytical method and isoclines method – Describing function analysis – Saturation, Dead zone, saturation-dead zone , Relay and Backlash.									**CO4**
UNIT-V	**STABILITY ANALYSIS**							**Periods: 12**	
Definiteness of scalar functions –quadratic forms – Basics of stability theorems – Liapunov functions – Direct method liapunov – constructing of liapunov functions using kravskii‟s method.									**CO3**
Lecture Periods: 45		**Tutorial Periods: 15**			**Practical Periods: 00**			**Total Periods:60**	

Reference Books:

1. Gopal M., Modern Control Systems Theory, 3rd Edition, New Age International Publishers, New Delhi, 2015
2. Robert H Bishop and Richard C Dorf, Modern Control Systems, 12th Edition, Pearson Education, 2010
3. K.K.Agarwal, “Control system analysis and Designs”, Khanna Publishers, 2003.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low; 0 – Not Correlated.

Department	EIE		Programme **: B.Tech.-EIE**						
Semester	**Eight**		Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUC133	**Main Project**		-	-	16	8	60	40	100
Prerequisite									
Course Outcome: At the end of the course the student will be able to	**CO1**	Carry out literature survey, understand state of art techniques.							
	CO2	Identify and apply appropriate tools to solve a problem.							
	CO3	Transform knowledge into an algorithmic/experimental process.							
	CO4	Prepare and present reports on the project work.							
In this project work, the team would solve the problem taken up for study. Simulation studies and/or hardware development would be completed. Necessary inferences have to be drawn from the studies carried out and the same should be presented before the committee members. If the project involves intensive analytical procedure, the analysis has to be completed and suitable comparison to existing methodologies reported in literature should be done to validate the correctness as well as effectiveness of the work. Rigorous review by the committee will be carried out in the process to ascertain whether the work qualifies as a suitable project at the graduate level. Each team is expected to present their work at National/International conferences or at the students' technical symposiums. Team that has come out with novel contribution will be encouraged to publish their work in any referred journals.									**CO1, CO2, CO3, CO4**

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department	**EIE**	Programme **: B.Tech.-EIE**						
Semester	**Eight**	Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUH105	**Seminar**	-	-	-	2	100	-	100
Prerequisite								
Course Outcome: At the end of the course the student will be able to :	**CO1**	Carry out literature survey, understand state of art techniques.						
	CO2	Apply theoretical knowledge to real-world scenarios or case studies						
	CO3	Take initiative in exploring topics beyond the curriculum and developing self-directed research habits						
	CO4	Present complex ideas concisely and clearly						
The objective of the seminar is to enable the students to present a seminar on any chosen topic related to their field of study. The topic shall be chosen in consultation with the Faculty coordinators. The student will present a Seminar on a topic in an emerging area in his/her discipline of Engineering. The student will make the presentation for duration of 20 to 25 minutes and also submit a brief report on the seminar topic for the purpose of evaluation. A departmental committee shall evaluate the performance of the students.								CO1 CO2 CO3 CO4

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

epartment	**EIE**	Programme : **B.Tech.-EIE**						
Semester	**Five**	Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE101	**Digital Image Processing**	3	1	-	4	40	60	100
Prerequisite	Digital Signal Processing							

Course Outcome: At the end of the course the student will be able to	**CO1**	Explain image processing concepts like color models, visual perception, and image representation
	CO2	Apply image enhancement techniques to improve image quality.
	CO3	Use segmentation and edge detection for object recognition and defect detection.
	CO4	Analyse image compression techniques for efficient storage and transmission.

UNIT-I	**Fundamentals of Digital Image Processing**	**Periods: 12**
Basics of image formation and visual perception – Light, luminance, brightness, contrast, hue, saturation – Image representation in grayscale and color models: RGB, HSV, YCbCr – Practical applications in medical imaging, industrial vision systems, and remote sensing – Introduction to edge AI in image processing.		**CO1**
UNIT-II	**Image Enhancement Techniques**	**Periods: 12**
Spatial domain processing techniques: contrast stretching, intensity slicing, bit-plane slicing – Frequency domain processing using Fourier Transform and Wavelets – Histogram processing: equalization, specification, and contrast improvement – Applications in automated inspection and biomedical image enhancement –Image enhancement using deep learning techniques such as CNNs and GANs.		**CO2**
UNIT-III	**Image Segmentation and Feature Extraction**	**Periods: 12**
Edge detection techniques using Sobel, Prewitt, Canny, and Laplacian operators – Thresholding techniques including Otsu’s method and adaptive thresholding – Region-based segmentation using region growing and Watershed algorithm – Feature extraction based on texture, shape, and color descriptors – Practical implementations in face recognition and object detection in Industry 4.0 – Deep learning-based image segmentation using U-Net and Mask R-CNN.		**CO3** **CO4**
UNIT-IV	**Image Compression and Storage**	**Periods: 12**
Lossless compression methods including Huffman coding and Run-Length Encoding – Lossy compression methods such as JPEG, WebP, HEIF, and MPEG-4 – AI-driven image compression advancements including Google’s RAISR and Facebook's AI compression – Applications in smart cameras and efficient image transmission for IoT-based instrumentation.		**CO2** **CO3**
UNIT-V	**Image Processing for Smart Instrumentation Systems**	**Periods: 12**
Real-time image processing for automation with PLC and DCS integration – Embedded vision systems using Raspberry Pi, Jetson Nano, and OpenCV – Thermal imaging and infrared processing for condition monitoring – LiDAR and depth sensing applications in industrial and medical fields – Recent trends in AI-powered defect detection for smart factories, autonomous vehicles, and biomedical AI-assisted diagnosis.		**CO1** **CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. **Rafael C. Gonzalez & Richard E. Woods (2020)** – *Digital Image Processing*, 4th Edition, Pearson
2. **Anil K. Jain (2021)** – *Fundamentals of Digital Image Processing*, 2nd Edition, Pearson.
3. **Jayaraman, Esakkirajan & Veerakumar (2011)** – *Digital Image Processing*, McGraw Hill.
4. **William K. Pratt (2013)** – *Digital Image Processing: PIKS Scientific Inside*, 4th Edition, Wiley.

5. **Dhiren P. Patel (2021)** –*Digital Image Processing Using MATLAB and Python*, McGraw-Hill.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme **:** **B.Tech - EIE**						
Semester : **Five**		Subject Category: **PEC**				Semester Exam Type:**TY**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE102	**Power Plant Instrumentation**	**4**	**-**	**-**	**4**	**40**	**60**	**100**

Prerequisite	Basics of Instrumentation, Control Systems, and Power Plants	
Outcome:	**CO1**	Understand the types of power plants and their instrumentation systems for monitoring key parameters.
	CO2	Analyze different sensors and measurement techniques used in power plants for temperature, pressure, flow, and level monitoring.
	CO3	Evaluate control systems in power plants, including boiler control, feedwater control, and combustion optimization.
	CO4	Apply modern automation techniques, safety measures, and performance optimization strategies in power plants.

UNIT-I	**Introduction to Power Plants & Instrumentation**	**Periods: 12**
Types of Power Plants: Thermal, Hydroelectric, Nuclear, Gas, Solar, and Wind Power Plants -Role of Instrumentation and Control in Power Plants		**CO1**
UNIT-II	**Measurement & Sensors in Power Plants**	**Periods: 12**
Temperature Measurement: Thermocouples, RTDs, Infrared Sensors -Pressure Measurement: Bourdon Tubes, Strain Gauges, Piezoelectric Sensors -Flow Measurement: Orifice Plates, Venturi Meters, Ultrasonic and Magnetic Flowmeters -Level Measurement: Float Type, Capacitive, Ultrasonic, Radar Sensors		**CO2**
UNIT-III	**Control Systems in Power Plants**	**Periods: 12**
Boiler Instrumentation and Control -Feed Water Control Systems -Steam Temperature and Pressure Control -Drum Level Control -Combustion Control and Optimization		**CO3**
UNIT-IV	**Performance Optimization and Safety in Power Plants**	**Periods: 12**
Turbine Monitoring and Control -Emission Monitoring and Control -Efficiency Improvement Techniques -Safety Systems and Alarm Management		**CO4**
UNIT-V	**Automation & Modern Trends in Power Plant Instrumentation**	**Periods: 12**
SCADA & DCS for Power Plants -Smart Sensors and IoT in Power Plant Monitoring -Condition Monitoring and Predictive Maintenance -Cybersecurity in Power Plant Automation -Case Studies on Power Plant Automation		**CO4**

Lecture Periods: 60	**Tutorials Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. **K. Krishnaswamy and M. Ponni Bala, Power Plant Instrumentation, 2nd ed. New Delhi, India: PHI Learning, 2020.**
2. **Swapan Basu & Ajay Kumar Debnath** – *Power Plant Instrumentation and Control Handbook: A Guide to Thermal Power Plants*, 2nd Edition, Elsevier Science, 2019.
3. **David Lindsley** – *Thermal Power Plant Control and Instrumentation: The Control of Boilers and HRSG Systems*, 2nd Edition, Institution of Engineering and Technology, 2018.

4. **J. G. Joshi, Power Plant Instrumentation and Control Handbook: A Guide to Thermal Power Plants, 2nd ed. Amsterdam, Netherlands: Elsevier, 2022.**
5. **D. P. Eckman, Industrial Instrumentation,** 2nd ed. New Delhi, India: CBS Publishers, 2022.
6. **B. Wayne Bequette,** Process Control: Modelling, Design, and Simulation, 2nd Edition, Pearson Education, 2023.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department :**EIE**		Programme : **B.Tech.-EIE**							
Semester :**Five**		Subject Category: **PEC**			Semester Exam Type: **TY**				
Course Code	Course Name	Periods / Week		Credit	Maximum Marks				
		L	T	P	C	CA	SE	TM	
EIUE103	**Industrial Electronics**	**3**	**1**	**-**	**4**	**40**	**60**	**100**	
Prerequisite									

Course Outcome: At the end of the course the student will be able to	**CO1**	Employ safety procedures presently being used in local manufacturing environments.
	CO2	Communicate effectively using the appropriate written or oral techniques.
	CO3	Modify or repair currently used manufacturing systems to operate in accordance with industry requirements and standards
	CO4	Perform maintenance and troubleshooting functions
	CO5	Apply industrial electronics in Industrial Heating Applications

UNIT-I	**Regulated Supplies and SCR**	**Periods:12**
Switched Mode Voltage Regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators, Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators, Current boosting. Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors, Classes A, B, C, D, E and F, Ratings of SCR		**CO1**
UNIT-II	**Applications of SCR-I**	**Periods: 12**
Static circuit breaker, Protection of SCR, Inverters, Classification, Single Phase inverters, Converters, single phase Half wave and Full wave. Chopper circuits, Principle, methods and Configurations, Diac and Triac – Triggering modes, Firing Circuits, Commutation		**CO2**
UNIT-III	**Applications of SCRS-II**	**Periods: 12**
Voltage compensator – solid state DC voltage regulation – DC shunt motor – armature control and field control of motor speed – electronic control of DC motor – speed regulator action – full wave motor speed regulation by one SCR		**CO3**
UNIT-IV	**Industrial Timers**	**Periods: 12**
Industrial timers -Classification, types, Electronic Timers, Classification, RC and Digital timers, Time base Generators. Electric Welding , Classification, types and methods of Resistance and ARC wielding		**CO4**
UNIT-V	**Industrial Heating Applications**	**Periods: 12**
High Frequency heating, principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating, principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics, Generation and Applications.		**CO5**

Lecture Periods:60	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods:60**

Reference Books:

1. G.K. Mithal and Maneesha Gupta, Industrial and Power Electronics, Khanna Publishers, 19th Ed., 2003.
2. M. Ramamurthy, Thyristors and applications, East-West Press, 1977.
3. S.K. Bhattacharya and Chatterjee, Industrial electronics and control, Tata Mc Graw Hill, 1995.
4. Frank D. Petruzella, Industrial Electronics, McGraw Hill International Editions, 1996.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Five**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE104	**Virtual Instrumentation**	**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Electrical and Electronic Instruments							
Course Outcome: At the end of the course the student will be able to	**CO1**	Explain the fundamentals of Virtual Instrumentation and graphical programming concepts.						
	CO2	Develop VI programs using data flow concepts, programming structures, and debugging techniques.						
	CO3	Implement various programming structures and interface DAQ hardware with communication protocols for data acquisition.						
	CO4	Apply Virtual Instrumentation tools for real-time industrial applications such as control, data logging, and machine vision.						
UNIT-I	**Introduction to Virtual Instrumentation**						**Periods: 12**	
Evolution of Virtual Instrumentation (VI) – Advantages of VI – Block diagram and architecture of a Virtual Instrument (VI) – Graphical programming – Comparison with conventional programming – Introduction to National Instruments and LabVIEW – Application areas of VI in industries.								**CO1**
UNIT-II	**VI Programming Basics**						**Periods:12**	
Controls and indicators – Labels and text – Shape, size, and color considerations – Data types, formats, precision, and representation – Data flow programming model – Editing, debugging, and running a Virtual Instrument – Concept of subVI and its applications – Front panel and block diagram structure in LabVIEW.								**CO1 CO2**
UNIT-III	**Programming Structures in LabVIEW**						**Periods: 12**	
FOR Loops and WHILE Loops in LabVIEW – CASE structure – Formula nodes – Sequence structures – Local and Global Variables – Arrays and Clusters – Array operations – Bundle, Unbundle by name – Graphs and charts – String and file I/O operations – Error handling in LabVIEW.								**CO2 CO3**
UNIT-IV	**Interface Standards and Data Acquisition (DAQ)**						**Periods: 12**	
DAQ hardware configuration – Sampling methods and grounding techniques – Analog I/O, Digital I/O, and Counter/Timer – DAQ software architecture – Overview of interface standards: RS232, RS485, GPIB – Backplane buses: PCI, PCI-Express, PXI, PXI-Express – Communication protocol overview: Industrial Ethernet, CAN – Signal conditioning in data acquisition systems.								**CO3**
UNIT-V	**Application Modules and Toolkits in VI**						**Periods:12**	
Machine vision and image processing applications – Motion control systems using VI – Data logging and supervisory control systems – Control design and simulation tools in LabVIEW – System identification tools – Simulation interface tools – Industrial applications and case studies using VI – Integrating VI with hardware modules for real-time applications.								**CO3 CO4**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: 00**				**Total Periods: 60**		
Reference Books:								

1. "LabVIEW Based Advanced Instrumentation Systems" – *S. Sumathi, P. Surekha* (2007), Springer
2. "Virtual Instrumentation Using LabVIEW" – *Jovitha Jerome* (2010), PHI Learning Pvt. Ltd.
3. "Applied Virtual Instrumentation" – *Roman Baican, Dan S. Necsulescu* (2000), CRC Press

4. "LabVIEW for Everyone: Graphical Programming Made Easy and Fun" – *Jeffrey Travis, Jim Kring* (2006), Prentice Hall/Pearson Education

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="3">Department : EIE</td><td colspan="5">Programme : B.Tech.-EIE</td></tr>
<tr><td colspan="3">Semester :Five</td><td colspan="4">Subject Category: PEC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUE105</td><td colspan="2">Instrumentation System Design</td><td>3</td><td>1</td><td>-</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="9">Transducer and measurements systems</td></tr>
<tr><td rowspan="5">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="8">Capable of Design and developing the Instrumentation design to cater the industrial requirements</td></tr>
<tr><td>CO2</td><td colspan="8">The students will become knowledgeable about the design of sensor and gripper.</td></tr>
<tr><td>CO3</td><td colspan="8">The students will gain manipulator dynamics of robots</td></tr>
<tr><td>CO4</td><td colspan="8">Develop the concept into a model, analyze the model on computer using engineering software packages</td></tr>
<tr><td>CO5</td><td colspan="8">Student will get understanding of Robotic applications also to Develop an engineering report and demonstrate the robot’s performance</td></tr>
<tr><td>UNIT-I</td><td colspan="7">Design of Signal Conditioning Circuits</td><td colspan="2">Periods:12</td></tr>
<tr><td colspan="9">Design of V/I Converter and I/V Converter- Analog and Digital Filter design – Signal conditioning circuit for pH measurement –Compensation circuit - Signal conditioning circuit for Temperature measurement - Cold Junction Compensation – Thermocouple Linearization – Software and Hardware approaches</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="7">Design of Transmitters</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="9">Design of Temperature Transmitters – using RTD, Thermocouple - Design of Capacitance based Level Transmitter – Air-purge Level Measurement – Design of Smart Flow Transmitters</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="7">Design of Data Logger and Controller</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="9">Design of Electronic Controllers: ON / OFF and PID Controller – Microcontroller Based Digital PID Controller and Data Logger – Design of PC based Data Acquisition Cards</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="7">Flow meters and Control Valve Sizing</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="9">Orifice Sizing and design: - Liquid, Gas and steam services - Rotameter Design. Control Valves – types – Valve body:- Commercial valve bodies – Control valve sizing – Liquid, Gas and steam Services – Cavitation and flashing –Selection criteria.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="7">Design of Alarm and Annunciation Circuit</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="9">Alarm: Fire alarm circuit, Fire alarm control panel- annunciator control panel. Alarm and Annunciation circuits using Analog and Digital Circuits – Design Alarm and annunciator circuits using Relays and Programmable Logic Controller.</td><td>CO5</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods:15</td><td colspan="3">Practical Periods: 00</td><td colspan="3">Total Periods: 60</td></tr>
<tr><td colspan="10">Reference Books:</td></tr>
<tr><td colspan="10">1. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2006.
2. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
3. R.W. Miller, “Flow Measurement Engineering Handbook”, Mc-Graw Hill, New York, 1996.</td></tr>
</table>

CO-PO Mapping

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

Department : **EIE**		Programme : **B.Tech.-EIE**							
Semester : **Six**		Subject Category: **PEC**				Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUE106	**Biomedical Instrumentation**	4	-	-	4	40	60	100	
Prerequisite:	Sensors & Transducers								
Course Outcome: At the end of the course the student will be able to	**CO1**	Analyse and interpret various physiological signals using biomedical instrumentation principles.							
	CO2	Design and implement biomedical sensor-based systems for real-time health monitoring.							
	CO3	Understand and evaluate modern medical imaging techniques, AI-driven diagnostics, and telemedicine applications.							
	CO4	Demonstrate expertise in therapeutic instrumentation by analysing pacemakers, defibrillators, ventilators, and robotic surgery systems, integrating safety standards.							
UNIT-I	**Fundamentals of Biomedical Signals & Physiological Systems**							**Periods: 12**	
Cell Structure and Basic Functions - Sources of Biomedical Signals - Physiology of Cardiovascular System - Physiology of Nervous System - Physiology of Respiratory System - Special Senses: Auditory and Vision System - Engineering Analogy of Physiological Systems - Biofeedback Mechanisms in Biomedical Applications								**CO1**	
UNIT-II	**Biomedical Signal Acquisition & Processing**							**Periods: 12**	
Challenges in Measuring Signals from Living Systems - Biopotential Electrodes - Electrode-Electrolyte Interface and Half-cell Potential - Biomedical Transducers - Bio-signal Amplifiers - Notch Filters and Digital Signal Processing Techniques - Electrical Safety of Medical Equipment and Patients - International Safety Standards - IEC 60601 - FDA Regulations.								**CO1 CO2**	
UNIT-III	**Diagnostic & Therapeutic Instrumentation**							**Periods: 12**	
ECG: Einthoven Triangle and 12-Lead ECG Recording System - EEG: Brain Wave Types and 10-20 EEG Recording System - EMG: Role of Actin & Myosin in Neuromuscular Function - Measurement of Blood Pressure and Cardiac Output – Phonocardiography - Respiratory Rate, Lung Volumes, and Capacities - Pneumotachograph and Total Body Plethysmography - Wearable Biosensors for Continuous Health Monitoring.								**CO1 CO2 CO4**	
UNIT-IV	**Medical Imaging & Biotelemetry Systems**							**Periods: 12**	
Ultrasound Scanner - X-Ray Imaging and Digital Radiography - CT Scan and Photon-Counting CT - MRI Imaging – Ultra High Field MRI - PET Scan - AI-assisted Radiology – Endoscopy - Biotelemetry Systems: Single and Multi-channel Telemetry - Smart Implants and BioMEMS - Telemedicine and AI-driven Remote Patient Monitoring								**CO3**	
UNIT-V	**Therapeutic & Life-Support Equipment**							**Periods: 12**	
Electrotherapy: Shortwave, Microwave, and Ultrasonic Diathermy - Pacemakers: Implantable and Leadless Pacemakers - Defibrillators and Implantable Cardioverter-Defibrillators (ICD) - Heart-Lung Machine - ECMO Systems - Ventilators – AI driven Respiratory Support Systems - Audiometry, Hearing Aids, and Cochlear Implants - Dialysis Machines and Wearable Artificial Kidneys - Robotic Surgery.								**CO3 CO4**	
Lecture Periods: 60	**Tutorial Periods: 00**	**Practical Periods: 00**				**Total Periods: 60**			
Reference Books:									
1. R.S. Khandpur, Handbook of Biomedical Instrumentation, McGraw-Hill Education, 3rd Edition, reprinted in 2023.									

2. John G. Webster, Medical Instrumentation: Application and Design, Wiley, 4th Edition, reprinted in 2019.
3. Andrew G. Webb, Principles of Biomedical Instrumentation, Cambridge University Press, 1st Edition, reprinted in 2019.
4. Leslie Cromwell, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, reprinted in 2015.
5. Ananda Natrajan R, Biomedical Instrumentation, PHI India, 2019

CO-PO Mapping

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

<table>
<tr><td colspan="2">Department: EIE</td><td colspan="8">Programme : B.Tech.</td></tr>
<tr><td colspan="2">Semester : Six</td><td colspan="5">Course Category Code: PEC</td><td colspan="3">Semester Exam Type:TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUE107</td><td>Cyber Security in Industrial Automation</td><td>3</td><td>1</td><td>-</td><td>4</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8"></td></tr>
<tr><td rowspan="5">Course Outcome
At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Describe in detail about cyber security for Industrial Control System</td></tr>
<tr><td>CO2</td><td colspan="7">Discuss about treats in Industrial Control System</td></tr>
<tr><td>CO3</td><td colspan="7">Explain in detail about Industrial Control System vulnerabilities</td></tr>
<tr><td>CO4</td><td colspan="7">Discuss about cyber security in SCADA system</td></tr>
<tr><td>CO5</td><td colspan="7">Explain about Industrial Sectors Cyber Security.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">CYBER SECURITY FOR INDUSTRIAL CONTROL SYSTEM</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="7">Industrial Control System-Industrial control system security different than regular IT security-ICS-ICS compare to safety instrument system-Components of Typical ICS/SCADA systems-SCADA system-Supervisory Control and Data Acquisition-Remote Terminal Unit (RTU)-Distributed Control System (DCS)- Programmable Logic Controller (PLCs)-Human Machine Interface (HMI)</td><td colspan="2">CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">THREATS TO ICS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="7">Threats to ICS: Threat treatment in ICS and IT-Threats to ICS-Threat –to and threat-from-most series treat to ICS-Hi-jacking malware-The reproductive cycle of modern malware- A socks 4/sock 5/HTTP connect proxy-SMTP spam engine-porn dialers</td><td colspan="2">CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">ICS VULNERABILITIES</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="7">ICS Vulnerability versus IT vulnerability-Availability, Integrity and Confidentiality-Purdue Enterprise Reference Architecture-PERA levels-Levels 5- level 4-level 3-level 2-level1-level 0- an ironic comment on PERA</td><td colspan="2">CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">CYBER SECURITY FOR SCADA SYSTEMS</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="7">SCADA security architecture: Commercial hardware and software vulnerabilities-Operating system- TCP/IPFirewalls-Traditional security feature of SCADA system-Eliminating the vulnerabilities of SCADA system</td><td colspan="2">CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">INDUSTRIAL SECTORS CYBER SECURITY</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="7">ICS Application security: Application security-Application security testing_ ICS application patching-ICS secure SDLC-Case Studies: Water/waste water industry specific cyber security-Piping Industry-specific cyber security issues-Emerging cyber threat to SCADA system</td><td colspan="2">CO5</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods:15</td><td colspan="3">Practical Periods: 00</td><td colspan="2">Total Periods: 60</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
</table>

1. Pascal Ackerman “Industrial Cyber Security Efficiently secure critical infrastructure systems”, Packt publisher,2017
2. William T.Shaw, “Cyber security for SCADA systems”, Pennwel publisher,2006
3. R.A.Kisner, W.W.Manges, “Cyber security through Real-time Distributed Control Systems”, UT-Battelle publisher, 2010
4. Eric D. Knapp, Joel Thomas Langill “Industrial Network Security: Securing Critical Infrastructure”, Syngress publisher,2014
5. B.R. Mehta, Y. Jaganmohan Reddy “Industrial Process Automation Systems”, Butterworth-Heinemann publisher,
   2014.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low; **0**-No

Department :**EIE**			Programme : **B.Tech.-EIE**						
Semester : **Six**			Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUE108	**Design of Process Control System Components**		**3**	**1**	**-**	**4**	**40**	**60**	**100**
Prerequisite									
Course Outcome: At the end of the course the student will be able to	**CO1**	The student gain the knowledge about design of signal conditioning circuits required for selected sensors.							
	CO2	The students will become knowledgeable about electronic PID controller design							
	CO3	The students will gain knowledge about flow measuring and design							
	CO4	To familiarize the student with the methods of selecting control valve and design the required sizing of control valve given flow condition and alarm and interlock design							

UNIT-I	**DESIGN OF SIGNAL CONDITIONING CIRCUITS**	**Periods: 12**
Design of V/I Converter and I/V Converter - Signal conditioning circuit for Thermocouple and RTD- Cold Junction Compensation circuit for thermocouple using RTD - Transmitters – Design of RTD based Temperature Transmitter, Thermocouple based Temperature Transmitter - zero and span adjustment in and temperature transmitters.		**CO 1**
UNIT-II	**AIR PURGE SYSTEM AND PID CONTROLLER DESIGN**	**Periods: 12**
Bourdon gauges - factors affecting sensitivity - design aspect of Bourdon tube -design of Air purge system for level measurement. Electronic P+I+D controllers - design - adjustment of set point, bias and controller settings.		**CO 2**
UNIT-III	**DESIGN OF FLOW METER**	**Periods: 12**
Orifice meter - design of orifice for given flow condition - Liquid, Gas and steam services rotameter-design of rotameter for the given flow condition-zero and span adjustment in differential pressure transmitter.		**CO 3**
UNIT-IV	**CONTROL VALVE SIZING**	**Periods: 12**
Control valves - characteristics of control valves - types of valve bodies - valve characteristics - materials for body and trim - sizing of control valves - cavitations, flashing in control valves selection of body materials and characteristics of control valves for typical applications		**CO 4**
UNIT-V	**DESIGN OF ALARM AND ANNUNCIATION CIRCUIT**	**Periods: 12**
Interlocks and alarms: Interlock design principles, fail-safe design - alarms and their types. Design of logic circuits for alarm and annunciator circuits, interlocks design.		**CO 4**

Lecture Periods: 60	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. N.A.Anderson, Instrumentation for Process Measurement and Control, Chilton Company, 1980. 2. D.M.Considine, Process Instruments and Controls Handbook,McGraw-Hill., 1985.
3. J.P.Bentley, Principles of Measurment Systems, Longman Inc., 1983.
4. C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, 1998.
5. Bela G. Liptak, “Instrument Engineers Handbook - Process Control and Optimization”, CRC Press, 4th Edition, Vol.2, 2008.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department :**EIE**			Programme : **B.Tech.-EIE**						
Semester :Six			Subject Category: **PEC**				Semester Exam Type:**TY**		
Course Code	Course Name:		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUE109	**Applied Soft Computing**		4	-	-	4	40	60	100
Prerequisite:									
Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the fundamentals of ANN.							
	CO2	Apply neural networks for system modeling and control.							
	CO3	Comprehend fuzzy set theory and fuzzy logic.							
	CO4	Explore fuzzy logic for modeling and control.							
UNIT-I	**Artificial Neural Network**							**Periods: 12**	
Review of fundamentals – Biological neuron, Artificial neuron, activation function, single layer perceptron limitation – multilayer perceptron- Back propagation algorithm – recurrent network- adaptive resonance theory based network – radial base function network- online learning algorithms, BP through time- RTRL algorithm reinforce learning									**CO1**
UNIT-II	**Neural Networks for Modeling And Control**							**Periods: 12**	
Modeling of non-linear systems using ANN- generation of training data – optimal architecture – model validation – control of non- linear systems using ANN – direct and indirect neuro control schemes – adaptive neuro controller – familiarization with neural network toolbox									**CO2**
UNIT-III	**Fuzzy Set Theory**							**Periods: 12**	
Fuzzy set theory- fuzzy sets- operation on fuzzy sets- Scalar cardinality, fuzzy cardinality, union and intersection complement (Yeger and sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation- fuzzy membership functions									**CO3**
UNIT-IV	**Fuzzy Logic For Modeling And Control**							**Periods: 12**	
Modeling of nonlinear systems using fuzzy models – TSK model – fuzzy logic controller- fuzzification – knowledge base- decision making logic – defuzzification – adaptive fuzzy systems – Familiarization with fuzzy logic toolbox									**CO4**
UNIT-V	**Hybrid Control Schemes**							**Periods: 12**	
Fuzzification and rule base using ANN – Neuro fuzzy systems ANFIS – Fuzzy neuron – Introduction to GA –Optimization of membership function and rule base using Genetic algorithm – Introduction to support vector machine – particle swarm optimization – case study – familiarization with ANFIS toolbox									**CO5**
Lecture Periods: 60		**Tutorial Periods: 00**	**Practical Periods:00**				**Total Periods:60**		

Reference Books:

1. Laurene V.Fausett, Fundamentals of Neural Networks, Architecture, Algorithms, and Applications, Pearson Education, 2008.
2. Timothy J.Ross, Fuzzy Logic with Engineering Applications, Wiley, Third Edition, 2010.
3. David E.Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Pearson Education, 2009.

4 George J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications,PHI, First Edition, 1995.

5. W.T.Miller, R.S.Sutton and P.J.Webrose, Neural Networks for Control, MIT Press, 1996.
6. C.Cortes and V.Vapnik, Support-Vector Networks, Machine Learning, 1995.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Six**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE110	**Sustainable Instrumentation Design**	**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Sensors & Transducers							

Course Outcome: At the end of the course the student will be able to	**CO1**	Explain the concepts of Circular Economy and Sustainability in Instrumentation Design.
	CO2	Design and optimize instrumentation systems using sustainable materials and energy-efficient technologies.
	CO3	Implement circular economy concepts in sensor design, industrial automation, and IoT-based monitoring.
	CO4	Evaluate real-world case studies and propose innovative, sustainable solutions for instrumentation applications.

UNIT-I	**Introduction to Circular Economy & Sustainability**	**Periods: 12**
Basics of the circular economy – Difference between linear and circular economy – Why sustainability matters in electronics and instrumentation – Introduction to Sustainable Development Goals (SDGs) – Understanding product life cycles – Managing electronic waste – Using eco-friendly materials in sensors.		**CO1**
UNIT-II	**Energy-Efficient Instrumentation & Smart Sensors**	**Periods: 12**
Designing low-power electronics – Energy-saving sensors – Using biodegradable materials – Capturing energy from vibrations, heat, and sunlight – Role of IoT and AI in saving energy – Self-powered sensors – Smart energy meters – Reducing waste in automation systems.		**CO1 CO2**
UNIT-III	**Circular Economy in Industrial Automation**	**Periods: 12**
Reducing resource waste in automation – Reusing and refurbishing sensors and controllers – Redesigning old systems for better sustainability – Green manufacturing techniques – Turning industrial waste into useful products – Case studies on sustainable automation.		**CO2 CO3**
UNIT-IV	**Sustainable Embedded & IoT-based Instrumentation**	**Periods: 12**
Designing eco-friendly embedded systems – Reducing waste with AI – Combining multiple sensors for efficient performance – How IoT helps in sustainability – Smart cities and waste management using IoT – Sustainable wearable devices – Using AI at the edge to save energy.		**CO3**
UNIT-V	**Industrial Case Studies & Future Trends in Circular Instrumentation**	**Periods: 12**
Environment-friendly electronics – Reducing carbon footprint in instrumentation – Using bio-based electronic components – Industry policies on sustainability – International standards for green instrumentation – Latest trends in sustainable design – Case studies from leading companies.		**CO3 CO4**

Lecture Periods:60	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. Walter R. Stahel, *The Circular Economy: A User's Guide*, Routledge, 2019.
2. William McDonough & Michael Braungart, *Cradle to Cradle: Remaking the Way We Make Things*, North Point Press, 2002.
3. Peter Lacy, Jessica Long, Wesley Spindler, *The Circular Economy Handbook: Realizing The Circular Advantage*, Palgrave Macmillan UK, 2021

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Seven**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE111	**Fiber Optics and Laser Instrumentation**	**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Optical communication							
Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the transmission of optical signal and the various losses associated with it.						
	CO2	Study the different types of Lasers and their properties.						
	CO3	Acquire knowledge of the Optical fibre and Laser for Measurement purposes.						
	CO4	Study in depth the Industrial and Medical applications of Laser.						
UNIT-I	**Optical Fibres and their Properties**						**Periods: 12**	
Principles of light propagation through a fibre – Different types of fibres and their properties – Fibre Characteristics – Absorption Losses – Scattering losses – Dispersion losses – Connectors & Splices – Optical Sources – Optical Detectors.								**CO1**
UNIT-II	**Industrial Applications of Optical Fibres**						**Periods: 12**	
Fibre Optic Sensors – Fibre Optic Instrumentation – Electro optic, Acousto optic and Travelling wave Modulators – Interferometric Method of Measurement of Length – Moire fringes – Measurement of Pressure, Temperature, Current , Voltage, Liquid level and Strain.								**CO3**
UNIT-III	**Laser Fundamentals**						**Periods: 12**	
Fundamental Characteristics of Lasers – Three level and Four level Lasers – Properties of Lasers – Laser Modes – Resonator Configuration – Q-Switching and Mode locking – Cavity dumping – Types of Lasers – Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers.								**CO2**
UNIT-IV	**Industrial Applications of Lasers**						**Periods: 12**	
Laser for Measurement of Distance, Length , Velocity, Acceleration, Current, Voltage and Atmospheric Effect – Material Processing – Lase Heating, Welding, Melting, Trimming and Material Remaoval and Vaporisation.								**CO3**
UNIT-V	**Hologram and Medical Applications**						**Periods: 12**	
Holography – Basic Principle – Methods – Holographic Interferometry and applications, Holography for Nondestructive testing – Medical Applications of Lasers, Lasers and Tissue Interaction – Laser Instrumentation for Surgery, Removal of Tumours of Vocal Cords, Brain surgery , Plastic Surgery.								**CO4**
Lecture Periods: 60	**Tutorial Periods: 00**	**Practical Periods: 00**				**Total Periods: 60**		

Reference Books:

1. G.Keiser, Optical Fibre Communication , McGraw Hill , Fourth Edition, 2011.
2. Ajoy Ghatak Thiagarajan, Optical Electronics, Cambridge University Press, 2009.
3. J.M.Senior , OFC - Principles and Practice, PHI, & Pearson Education, 2009.
4. Dr. Manjeet Singh, Lasers – Theory, Princi[les and Applications, VEI, Vayu Education of India, 2011.
5. J.Wilson and J.F.Bhawkes, Introduction to Optical Electronics, PHI, 2001.
6. Mr.Gupta, Fibre Optics Communication, PHI, 2004.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech - EIE**						
Semester : **Seven**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE112	**MEMS**	**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Fundamentals of Electronics, Material Science, and Mechanics							

Outcome:	**CO1**	Understand the fundamentals, historical development, and scaling laws of MEMS technology
	CO2	Analyze MEMS materials and fabrication techniques, including photolithography, etching, and micromachining.
	CO3	Evaluate the mechanical behavior and dynamic characteristics of MEMS structures.
	CO4	Apply sensing, actuation, packaging, and integration techniques in MEMS device development.

UNIT-I	**Introduction to MEMS**	**Periods: 12**
Overview of MEMS and Microsystems -Historical Development and Applications -Scaling Laws and Their Importance Review of Electrical and Mechanical Concepts in MEMS		**CO1**
UNIT-II	**Materials and Fabrication Techniques**	**Periods: 12**
Materials for MEMS: Silicon, Polymers, Metals, and CeramicsMicrofabrication Processes: Photolithography, Etching, DepositionMicromachining Techniques: Bulk and Surface Micromachining		**CO2**
UNIT-III	**Mechanics and Dynamics of MEMS Structures**	**Periods: 12**
Review of Electrical and Mechanical Concepts in MEMS Mechanical Behavior of MEMS Materials -Modeling of Beams, Plates, and Membranes -Resonant Frequency and Quality Factor Analysis		**CO3**
UNIT-IV	**Sensing and Actuation Principles**	**Periods: 12**
Electrostatic, Piezoelectric, Thermal Actuation and SMA -Sensing Mechanisms: Capacitive, Piezoresistive, Optical -Case Studies of MEMS Sensors and Actuators		**CO4**
UNIT-V	**MEMS Packaging and Integration**	**Periods: 12**
Packaging Challenges and Solutions-Integration with CMOS and Other Technologies -Reliability and Testing of MEMS Devices		**CO4**

Lecture Periods: 60	**Tutorials Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. **Chang Liu** – *Foundations of MEMS*, 2nd Edition, Pearson Education, 2019.
2. **Nadim Maluf and Kirt Williams** – *An Introduction to Microelectromechanical Systems Engineering*, 4th Edition, Artech House, 2020.
3. **Stephen D. Senturia**, *Microsystem Design*, 1st Edition, Springer, 2022 (Reprint)
4. **Marc Madou**, *Fundamentals of Microfabrication and Nanotechnology, Volume II: Manufacturing Techniques for Microfabrication and Nanotechnology*, 4th Edition, CRC Press, 2021.
5. **Tai-Ran Hsu**, *MEMS and Microsystems: Design and Manufacture*, 2nd Edition, Wiley India, 2020.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Seven**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE113	**Computer Control of Process**	**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite								

Course Outcome: At the end of the course the student will be able to		
	CO1	understand fundamentals required for computer control of a process. Analyze a system in discrete domain
	CO2	Design and develop digital control algorithms
	CO3	Understand various system identification and modeling techniques in time domain and in frequency domain.
	CO4	Able to understand the multi-loop control and adaptive control

UNIT-I	**ANALYSIS OF SAMPLED DATA CONTROL SYSTEM:**	**Periods: 12**
Need for computer in a control system- Building blocks of a computer control system, Representation and analysis of Sampled data control systems- review of Z transform –modified Z transform- selection of sampling period – mathematical representation of sampler- transfer function of zero order hold and first order hold device-Pulse transfer function – –open loop and closed response of linear sample data control system for step input – stability analysis: Jury’s test and bilinear transformation.		**CO1**
UNIT-II	**DIGITAL CONTROL ALGORITHMS**	**Periods: 12**
Design for Set point and load changes: Deadbeat Algorithm - Dahlin's method - Kalman's approach - ringing phenomenon in digital controller- discrete PID controller algorithms - tuning techniques - selection of sampling time - dead-time compensation: Smith Predictor algorithm.		**CO2**
UNIT-III	**SYSTEM MODELING AND IDENTIFICATION**	**Periods: 12**
Mathematical model for processes – first order. Second order processes without and with pure delay higher order systems – process modeling form step test data – pulse testing for process identification – time – domain identification – linear least square algorithm		**CO3**
UNIT-IV	**MULTI-LOOP REGULATORY CONTROL**	**Periods: 12**
Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs – The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.		**CO4**
UNIT-V	**ADAPTIVE CONTROL**	**Periods: 12**
Concepts of Adaptive control –types of adaptive control - gain scheduling, self-tuning and model reference adaptive control -Hammerstein and wiener system Case studies on adaptive PID controllers		**CO4**

Lecture Periods: 60	**Tutorial Periods: 00**	**Practical Periods:00**	**Total Periods: 60**

Reference Books:

TEXT BOOKS

5. P.B. Deshpande and R.H. Ash, Elements of Computer Process Control, Instrument Society of America, 1981.
6. Frank D.Petruzella, Programmable Logic Controllers, McGraw Hill Education India Private Limited, Fourth edition, 2016.

REFERENCES

1. C.D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2005.
2. Stuart Bennet, Real Time Computer Control, Second Edition,Pearson Education, 2005.
3. C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 1972.
4. Donald R.Coughnowr, Process Systems Analysis and Control, Mc-Graw Hill Education, Third Edition,2008

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**			Programme : **B.Tech - EIE**						
Semester :**Seven**			Subject Category:**PEC**			Semester Exam Type: **TY**			
Course Code	Course Name		Hours / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUE114	**Instrumentation in Petrochemical Industry**		**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Fundamentals of Instrumentation, Process Control, and Chemical Engineering								
Outcome:	**CO1**	Understand the fundamentals of petrochemical processes and the role of instrumentation in the industry.							
	CO2	Analyze various process variables and measurement techniques used in petrochemical plants.							
	CO3	Evaluate analytical instrumentation, control systems, and automation techniques in petrochemical industries.							
	CO4	Apply safety measures, maintenance strategies, and regulatory standards in petrochemical instrumentation.							
UNIT-I	**Introduction to Petrochemical Industry and Instrumentation**							**Periods: 12**	
Overview of the Petrochemical Industry-Role of Instrumentation in Petrochemical Processes-Common Processes and Operations in Petrochemical Plants									**CO1**
UNIT-II	**Process Variables and Measurement Techniques**							**Periods: 12**	
Temperature Measurement: Thermocouples, RTDs, ThermistorsPressure Measurement: Manometers, Bourdon Tubes, Pressure TransducersFlow Measurement: Orifice Plates, Venturi Meters, Turbine FlowmetersLevel Measurement: Float Gauges, Ultrasonic Sensors, Radar Level Transmitters									**CO2**
UNIT-III	**Analytical Instrumentation in Petrochemical Plants**							**Periods: 12**	
Gas Chromatography-Mass Spectrometry-pH and Conductivity Analyzers-Moisture and Humidity Measurement									**CO3**
UNIT-IV	**Control Systems and Automation**							**Periods: 12**	
Process Control Fundamentals-Distributed Control Systems (DCS)-Programmable Logic Controllers (PLC)-Supervisory Control and Data Acquisition (SCADA)									**CO3**
UNIT-V	**Safety and Maintenance in Petrochemical Instrumentation**							**Periods: 12**	
Safety Instrumented Systems (SIS)Hazard and Operability Study (HAZOP) Instrumentation Maintenance Strategies Standards and Regulations in Petrochemical Instrumentation									**CO4**
Lecture Periods: 60		**Tutorials Periods: 00**		**Practical Periods: 00**			**Total Periods: 60**		
Reference Books:									

1. Thomas A. Weedon – *Instrumentation and Process Control*, Workbook Edition, American Technical Publishers, 2014.
2. William C. Dunn – *Fundamentals of Industrial Instrumentation and Process Control*, 2nd Edition, McGraw-Hill Education, 2018.
3. B. G. Lipták, Instrument Engineers' Handbook: Process Measurement and Analysis, 4th ed. Boca Raton, FL, USA: CRC Press, 2023.
4. W. L. McCabe, J. C. Smith, and P. Harriott, Unit Operations of Chemical Engineering, 7th ed. New York, NY, USA: McGraw Hill Education, 2021.

5. S. K. Singh, Industrial Instrumentation and Control, 3rd ed. New Delhi, India: McGraw Hill Education, 2021.

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department : **EIE**		Programme : **B.Tech.-EIE**						
Semester : **Seven**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUE115	**Basic Troubleshooting for Instrumentation Engineers**	**4**	**-**	**-**	**4**	**40**	**60**	**100**
Prerequisite	Electrical and Electronic Instruments							

Course Outcome: At the end of the course the student will be able to	**CO1**	Apply basic principles of instrumentation and safety to identify faults in industrial systems.
	CO2	Diagnose instrumentation issues using standard tools and techniques including both hardware and software methods.
	CO3	Apply systematic troubleshooting approaches such as RCA, Fishbone, and FTA to resolve instrumentation-related problems.
	CO4	Analyze and evaluate real-world troubleshooting case studies to propose effective maintenance and documentation practices.

UNIT-I	**Fundamentals of Troubleshooting**	**Periods: 12**
Introduction to troubleshooting and its significance in industrial instrumentation – Overview of basic electrical and electronic principles relevant to instrumentation – Understanding of instrumentation loops including open and closed loop systems – Safety protocols, ESD precautions, and industry-standard troubleshooting procedures.		**CO1 CO2**
UNIT-II	**Common Faults in Instrumentation Systems**	**Periods: 12**
Analysis of sensor and transmitter faults – Identification of signal conditioning and transmission errors – Common issues in controllers and PLCs – Troubleshooting actuator and final control element failures – Detection and correction of power supply, earthing, and grounding issues.		**CO1 CO2**
UNIT-III	**Diagnostic Tools and Techniques**	**Periods: 12**
Practical use of multimeters, oscilloscopes, and signal analyzers for fault detection – Loop checking and calibration procedures – Introduction to HART communicator, Fieldbus diagnostics, and SCADA-based fault identification – Application of vibration analysis and thermal imaging – Use of data logging and trend analysis for predictive maintenance.		**CO2 CO4**
UNIT-IV	**Systematic Troubleshooting Methods**	**Periods: 12**
Principles of Root Cause Analysis (RCA) – Construction of Fishbone diagrams and application of the 5 Whys technique – Stepwise elimination and signal isolation methods – Basics of Fault Tree Analysis (FTA) – Importance of systematic documentation and reporting during troubleshooting.		**CO3 CO4**
UNIT-V	**Case Studies and Practical Applications**	**Periods: 12**
Troubleshooting pressure transmitter issues in refinery settings – Diagnosis of faulty temperature control loops – Handling signal noise and interference in process signals – Correction of valve positioner failures and tuning issues – Industrial case study reviews and lessons learned from field applications.		**CO2 CO3 CO4**

Lecture Periods: 60	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 60**

Reference Books:

1. Kirk D. Hagen, Industrial Process Control Systems, Cengage Learning, 1st Edition, 2021 – covers Unit I, II, and IV
2. Bela G. Liptak, Instrument Engineers' Handbook: Process Control and Optimization, CRC Press, 5th Edition, 2018 – (covers Unit II, III, and V)
3. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGraw Hill Education, 2nd Edition, 2018 – (covers Unit I, II, and III)

4. Norman A. Anderson, Instrumentation for Process Measurement and Control, CRC Press, 4th Edition, 2022 – (covers Units I, II, III, and IV)
5. Raghunathan Rajamani, Process Control: Modeling, Design, and Simulation, CRC Press, 2nd Edition, 2020 – (covers Units III and IV)
6. S. K. Singh, Industrial Instrumentation and Control, McGraw Hill Education, 4th Edition, 2019 – (covers Units II and V)

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Annexure II

Syllabi of the *Ancillary Stream Elective Courses* offered by the Electronics and Instrumentation Engineering Department

Ancillary stream Elective courses:

Ancillary Stream Elective Title 1: Industrial Measurements & Control (For other Department students)	
Course code	Course Name
EIUN101	Transducer Engineering
EIUN102	Industrial Measurements
EIUN103	Fundamentals of Control Systems
EIUN104	Industrial Automation Systems

Ancillary Stream Elective Title 2: Smart Electronics and IoT (For other Department students)	
Course code	Course Name
EIUN105	Electronic Design & Fabrication
EIUN106	Fundamentals of Embedded systems
EIUN107	Industrial IoT
EIUN108	Fundamental of MEMS

Ancillary Stream Elective Title: Computing Techniques for Instrumentation (Interdisciplinary-For students of EIE Department)	
Course code	Course Name
EIUI101	Python Programming
EIUI102	Visual Programming for Instrumentation Engineers
EIUI103	Modelling and Simulation
EIUI104	AI and ML for Instrumentation

Department : **EIE**		Programme : **B.Tech.**						
Semester : **Four**		Course Category Code: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUN101	**Transducer Engineering**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:								

Course Outcome: At the end of the course the student will be able to	**CO1**	Understand measurement systems, types of errors, and reliability metrics.
	CO2	Analyze static and dynamic characteristics of instruments and transducers.
	CO3	Explain the working principles of active and passive transducers, and signal conditioning techniques.
	CO4	Explore the construction, working, and applications of inductive, capacitive, piezoelectric, IC sensors and smart transducers.

UNIT-I	**Basic of transducers**	**Periods: 9**
General concepts and terminology of measurement systems, transducer classification, general input- output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.		**CO1**
UNIT-II	**Resistive, Inductive and capacitive transducers**	**Periods: 9**
Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement, Digital displacement transducer. Self and mutual inductive transducers- capacitive transducers, eddy current transducers, proximity sensors, tacho-generators and stroboscope.		**CO2**
UNIT-III	**Piezoelectric transducers**	**Periods: 9**
Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers,		**CO3**
UNIT-IV	**MISCELLANEOUS TRANSDUCERS**	**Periods: 9**
Eddy current transducers. Hall effect transducers – Optical sensors, IC sensor for temperature – signal conditioning circuits, Introduction to Fiber optic sensors – Temperature, pressure, flow and level measurement using fiber optic sensors.		**CO4**
UNIT-V	**Intelligent and smart transducers**	**Periods: 9**
Intelligent and smart transducers- principle- design approach, interface design, configuration support, communication in smart transducer networks. SQUID sensors, Film sensors, MEMS – Nano sensors. Basics of Gyroscope. Introduction to semiconductor sensor, materials, scaling issues and basics of micro fabrication.		**CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods:45**

Reference Books:

1. John P.Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
2. Doebelin E.0, Measurement Systems -Application and Design, McGraw-Hill, 4thEdition, 2004.
3. S.M. Sze, Semiconductor sensors, John Wiley & Sons Inc., 1994.
4. Murthy D. V. S, Transducers and Instrumentation, Prentice Hall, 2ndEdition, 2011.
5. James W.Dally, Instrumentation for Engineering Measurements, Wiley, 2ndEdition, 1993.
6. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2ndEdition, 2008.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="7">Programme : B.Tech.</td></tr>
<tr><td colspan="2">Semester : Five</td><td colspan="4">Subject Category: ANC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUN102</td><td>Industrial Measurements</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8"></td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Understand the principles and characteristics of industrial measurement systems.</td></tr>
<tr><td>CO2</td><td colspan="7">Explain and apply various techniques for accurate measurement of pressure, flow, and level in industrial processes.</td></tr>
<tr><td>CO3</td><td colspan="7">Analyze temperature measurement systems and calibration techniques in process industries.</td></tr>
<tr><td>CO4</td><td colspan="7">Select suitable transducers/instruments for specific industrial applications considering standards and requirements.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction to Industrial Measurements</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Definition and significance of measurement in industry - Elements of measurement systems - Static and dynamic characteristics - Errors in measurement and error analysis - Standards of measurement - Classification of industrial sensors and transducers</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Pressure Measurement</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Manometers and elastic-type pressure gauges - Bourdon, bellows, diaphragm. Electrical/electronic pressure transducers: strain gauge, capacitive, piezoelectric, LVDT. Vacuum measurement – McLeod gauge, Pirani gauge, Ionization gauge. Pressure switches and transmitters. Selection criteria and applications</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Flow Measurement</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Principle of flow measurement - Obstruction meters: Orifice, Venturi, Nozzle, and Dall tube. Variable area meters: Rotameter. Electromagnetic and Ultrasonic flowmeters. Turbine and Vortex flowmeters. Positive displacement meters and mass flowmeters. Open channel flow measurement – Weirs and flumes</td><td>CO2</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Level Measurement</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Direct methods: Sight glass, float-type, dipsticks. Indirect methods: Displacer, bubbler, hydrostatic pressure. Electrical methods: Capacitance, ultrasonic, radar, optical. Radioactive level detection. Selection and installation guidelines</td><td>CO2</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Temperature Measurement and Calibration</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Temperature scales and standards - Thermocouples, RTDs, Thermistors – construction, working, comparison - Radiation methods – Optical and infrared pyrometers - IC temperature sensors. Calibration techniques and industrial practices. Introduction to calibration standards (NABL, ISO)</td><td>CO3, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods: 00</td><td colspan="2">Practical Periods: 00</td><td colspan="3">Total Periods: 45</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. E.O. Doebelin and D.N. Manik, Measurement Systems: Application and Design, McGraw Hill, 6th Edition, 2011.
2. D.P. Eckman, Industrial Instrumentation, Wiley India Pvt. Ltd, Reprint Edition, 2014.
3. John. P. Bentley, Principles of Measurement Systems, Pearson Education, Fourth Edition, 2005.
4. R.K. Jain, Mechanical Measurements, Khanna Publishers, 19th Edition, 2020
5. Bela.G.Liptak,” Process Measurement and Analysis”, Instrument Engineers handbook, fourth Edition, 2003.
6. D.Patranabis, “Principles of Industrial Instrumentation”, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.</td></tr>
</table>

7. K.Krishnaswamy," Industrial Instrumentation-II", New Age publishers, 2005.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**		Programme : **B.Tech**						
Semester : **Six**		Subject Category: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUN103	**Fundamentals of Control Systems**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

Prerequisite	-	
Outcome:	**CO1**	Develop mathematical models for mechanical, thermal, hydraulic, pneumatic, pressure, and level processes using transfer function and state variable approaches and analyze the systems using block diagram reduction and signal flow graphs.
	CO2	Analyze the time response of first and second-order control systems, evaluate steady-state errors, and design controllers (ON/OFF, P, PI, PD, PID) to achieve desired performance.
	CO3	Evaluate the frequency response of control systems using Bode plots, Polar plots, and study the system stability.
	CO4	Apply controller tuning methods and advanced control strategies for optimizing process control systems.

UNIT-I	**Introduction to control systems**	**Periods:09**
Basic elements in control systems–Need for Process control -Open and Closed loop systems–Feedback characteristics–Effects of feedback Mathematical modeling of physical systems:-Mechanical, Hydraulic, Pneumatic systems, thermal, pressure and level processes -Transfer function- Block diagram reduction techniques–Signal flow graph.		**CO1**
UNIT-II	**Time Response Analysis and Controllers**	**Periods: 09**
Time response–Types of test inputs-I and II order system responses–Steady state error-Time domain specifications- Basic control actions - characteristics of ON/OFF, proportional, integral and derivative control modes–P+I,P+D and P+I+D control modes–Auto manual transfer–Final control elements-VFD-TPC-Control valves: Characteristics – inherent and installed- Performance criteria-Selection of controller modes		**CO2**
UNIT-III	**Frequency Response Analysis and stability**	**Periods: 09**
Frequency response-Frequency domain specifications-Bode plot-Polar plot-Determination of phase margin and gain margin- Concepts of stability–Location of roots in s-plane for stability–Routh Hurwitz criterion– Root locus techniques– Construction – Nyquist stability criterion		**CO3**
UNIT-IV	**Controller Tuning and Multiloop Control**	**Periods: 09**
Determination of optimum settings for process models using time response and frequency response–Tuning– Process reaction curve method–Ziegler Nichols method-Evaluation criteria– IAE ISE,ITAE and ¼decay ratio– Damped oscillation method. Feed-forward control–ratio control-cascade control–inferential control–split- range control–introduction to multivariable control: Distillation column and boiler systems.		**CO4**
UNIT-V	**State-Variable Analysis**	**Periods:09**
Introduction of state, state variables and state model, derivation of state models from block diagrams, Relationship between state equations and transfer functions-Characteristic equation, eigenvalues, eigenvectors, canonical forms Diagonalization-solving the time invariant state equations-State Transition Matrix. Controllability and observability. Computer simulation		**CO1**

Lecture Periods: 45	Tutorials Periods: 00	Practical Periods: 00	Total Periods: 45

Reference Books:

1. I.J.Nagrath, M.Gopal, Control System Engineering, New-age International(P),4thEditionLtd.,NewDelhi,2009.
2. G.Stephanopoulis, Chemical Process Control, PHI learning, New Delhi, 2008.
3. D.P.Eckman, Automatic Process Control, Wiley Eastern Ltd., New Delhi, 2008.
4. Donald R.Coughanowr, Steven E.Leblanc, Process System Analysis Control, 3rd edition, 2013.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

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<tr><td>EIUN104</td><td colspan="2">Industrial Automation Systems</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="9">-</td></tr>
<tr><td rowspan="4">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="8">Explain the fundamentals of automation systems, sensors, actuators, and control elements used in industrial environments.</td></tr>
<tr><td>CO2</td><td colspan="8">Interpret and analyse automation system components such as relays, contactors, and timers used in industrial circuits.</td></tr>
<tr><td>CO3</td><td colspan="8">Design and troubleshoot basic PLC programs and control strategies for industrial automation applications.</td></tr>
<tr><td>CO4</td><td colspan="8">Demonstrate understanding of DCS systems, HART communication protocol and Fieldbus in real-time industrial process control.</td></tr>
<tr><td>UNIT-I</td><td colspan="7">Introduction</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="9">Introduction- Automation in production system - Principles and strategies of automation - Basic elements of an automated system - Advanced automation functions - Levels of automations - Automated flow lines and transfer mechanisms - Analysis of transfer lines without storage - Automated flow lines with storage buffers.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="7">Material handling</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="9">Material handling and identification technologies -Overview of material handling systems - Types of material handling equipment -Design of the system - Conveyor system - Automated guided vehicle system - Automated storage systems - Interfacing handling and storage with manufacturing - Overview of Automatic Identification Methods.</td><td>CO1, CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="7">Programmable Logic Controller (PLC)</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="9">Programmable Logic Controller (PLC)- Architecture - Block diagram of PLC, Programming languages of PLC - Basic ladder diagram programs - Timers and counters - Design of alarm and interlocks - Interface modules- AC and DC input and output modules - Communication modules.</td><td>CO2, CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="7">Distributed Control System (DCS)</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="9">Evolution – Architecture of DCS – Local control unit functions – Operator Interface – LLOI and HLOI – redundancy concepts – Displays – Communication networks and communications standards in DCS – Engineering Interface – Factors to be considered in selecting a DCS.</td><td>CO3, CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="7">Hart and Fieldbus</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="9">Introduction HART communication protocol – communication modes - HART networks – HART commands – HART application – Fieldbus: Introduction – fieldbus architecture, Basic requirements of field bus standard – fieldbus topology – Interoperability and Interchangeability.</td><td>CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td>Tutorial Periods: 00</td><td colspan="4">Practical Periods: 00</td><td colspan="3">Total Periods: 45</td></tr>
<tr><td colspan="10">Reference Books:</td></tr>
<tr><td colspan="10">1. Geoffrey Williamson, “Industrial Automation: Systems and Engineering”, Arcler Press, First Edition, 2021.
2. Jon Stenerson, “Industrial Automation and Process Control”, Prentice Hall, First Edition, 2003.
3. Frank D. Petruzella, “Programmable Logic Controllers”, McGraw Hill Education, Third Edition, 2010.
4. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Company, First Edition, 1986.
5. Thomas A. Hughes, Programmable Controllers, ISA Press, Fourth Edition, 2005.
6. M. Chidambaram, Computer Control of Processes, Narosa Publishing House, First Edition, 2002.</td></tr>
</table>

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**			Programme **: B.Tech.**					
Semester : **Four**			Subject Category: **ANC**			Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks	
			L	T	P	C	CA	SE	TM
EIUN105	**Electronic Design and Fabrication**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	-								
Course Outcome: At the end of the course the student will be able to	**CO1**	Understand the fundamentals of electronic system design and the Arduino platform for embedded applications.							
	CO2	Develop and debug firmware for Arduino-based systems using various programming constructs and I/O interfaces.							
	CO3	Interface sensors and peripheral devices with microcontrollers for building interactive embedded applications.							
	CO4	Design, simulate, and fabricate real-time embedded systems and translate them into physical implementations using PCB design and fabrication tools.							

UNIT-I	**Introduction to Electronic System Design**	**Periods: 09**	
Building blocks of electronic system design– Key Design Metrices- Introduction to Analog I/O - Digital I/O – Introduction to Arduino platform- Hardware features – Types of Arduino boards – Features of Arduino Uno - pin details - Arduino IDE – configuration settings - basic sketch in Arduino – compiling and downloading sketches.			CO1
UNIT-II	**Arduino Firmware Development**	**Periods: 09**	
Data types, operators, Decision Making statements, Looping statements, Arrays, Functions, Classes, Arduino Libraries, debugging. Built in I/O Functions, Programming digital I/O, analog I/O, UART communication, PWM and Interrupt programming - Intel Hex File format.			CO1 CO2
UNIT-III	**Peripherals and Sensors**	**Periods: 09**	
Peripherals: LEDs, switches, Relays, Buzzers, Seven segment displays, Keypads, Character LCDs, Graphical LCDs, SD card memory, DC and Servomotors. Sensors: Temperature, Infrared, Moisture and Humidity sensor, Pressure, Light, Gas Sensor, Motion Sensor, Speed, PIR Sensor, Accelerometer.			CO2 CO3
UNIT-IV	**Design of Electronic systems**	**Periods: 09**	
Study of temperature control system – Robotic system using DC motors – Ultrasonic Range system – Security system using sensors – weather monitoring system – Street light control system – GSM based systems – WiFi and Bluetooth based systems – PC based Measurement and Control.			CO3 CO4
UNIT-V	**PCB Design and Fabrication**	**Periods: 09**	
Introduction to PCB Designing - Steps in PCB Designing and Manufacturing- Electronics Components and their Packaging- Schematic Editor - Schematic Diagram - Board/Layout Editor- Converting Schematic into Board - Layers - Routing - Important Guidelines and standards - Gerber file generation.			CO4

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**
Reference Books:			

1. Simon Monk, “Programming Arduino Next Steps: Going Further with Sketches”, McGraw Hill Education, 2nd Edition, 2018.
2. Michael Margolis, Arduino Cookbook, O’Reilly Media, 3rd Edition, 2020.
3. Jeremy Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, Wiley, 2nd Edition, 2019.
4. Mark Geddes, Arduino Project Handbook: Volume One – 25 Practical Projects to Get You Started, No Starch Press, 1st Edition, 2016.
5. Muhammad Ali Mazidi, Shujen Chen, Eshragh Ghaemi, Arduino Programming from Beginning to Advanced, MicroDigitalEd, 1st Edition, 2018.

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department : **EIE**			Programme **: B.Tech.**						
Semester : **Five**			Subject Category: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUN106	**Fundamentals of Embedded systems**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	Microprocessors								
Course Outcome: At the end of the course the student will be able to	**CO1**	Explain the fundamentals and classification of embedded systems with examples from real-world applications.							
	CO2	Describe the architecture and functionalities of microcontrollers and illustrate basic embedded programs.							
	CO3	Demonstrate the working and interfacing of sensors and actuators with embedded systems.							
	CO4	Analyze the application of embedded systems in IoT and design conceptual solutions for smart environments.							
UNIT-I	**Introduction to Embedded Systems**							**Periods: 9**	
Definition and characteristics of embedded systems – Comparison between embedded and general-purpose systems – Components of an embedded system including processor, memory, and interface circuits – Classification of embedded systems based on functionality and performance – Applications in domains like industrial automation, medical electronics, transportation, and consumer electronics.									**CO1**
UNIT-II	**Microcontroller Architecture**							**Periods: 9**	
Basics of microcontrollers with examples like 8051 and ARM Cortex-M – Internal architecture including CPU, memory organization, buses, and stack – Functions of I/O ports, timers, and interrupt controllers – GPIO concepts and pin multiplexing – Interfacing external peripherals with microcontroller ports.									**CO1 CO2**
UNIT-III	**Embedded Programming Fundamentals**							**Periods: 9**	
Embedded C programming structure – Data types, operators, and control structures – LED blinking and switch-based input programs – Timer-based delays and event counting – Overview of interrupt handling – Development environment including compiler, linker, and debugger – Use of simulation tools and IDEs for basic program testing.									**CO2 CO3**
UNIT-IV	**Sensors and Actuators Interfacing**							**Periods: 9**	
Types of sensors such as temperature, ultrasonic, IR, and LDR – Operating principles of actuators including DC motors, stepper motors, relays, and servos – Basics of signal conditioning – Analog to digital conversion and its role in interfacing – Practical interfacing techniques between sensors/actuators and a microcontroller using GPIO – Example applications like obstacle detection and motor control.									**CO3 CO4**
UNIT-V	**Embedded Systems in IoT**							**Periods:9**	
Overview of IoT and embedded systems integration – IoT architecture layers and their relevance to embedded hardware – Popular boards like Arduino and NodeMCU (ESP8266) – Communication protocols like UART, I2C, and SPI with brief functional understanding – Embedded systems in smart city, smart agriculture, and health monitoring – Problem solving through case studies – Capstone idea discussion for mini-project.									**CO4**
Lecture Periods: 45		**Tutorial Periods: 15**	**Practical Periods: 00**				**Total Periods: 60**		

Reference Books:

Textbooks

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd Edition, McGraw-Hill Education, 2017. ISBN: 9789352606045

2. K.V. Shibu, Introduction to Embedded Systems, McGraw-Hill Education, 1st Edition, 2009. ISBN: 9780070144679
1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, 2nd Edition, Pearson Education, 2006. ISBN: 9788120323189
2. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, 5th Edition, CreateSpace Independent Publishing Platform, 2017. ISBN: 9781543147432

CO – PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

<table>
<tr><td colspan="2">Department : EIE</td><td colspan="4">Programme : B.Tech.</td><td colspan="4"></td></tr>
<tr><td colspan="2">Semester : Six</td><td colspan="4">Subject Category: ANC</td><td colspan="4">Semester Exam Type:TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUN107</td><td>Industrial IoT</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite:</td><td colspan="8">Basics of Embedded Systems, Communication Protocols, and Industrial Automation</td></tr>
<tr><td rowspan="4">Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="7">Describe the architecture, components, and communication technologies of Industrial IoT systems.</td></tr>
<tr><td>CO2</td><td colspan="7">Integrate industrial sensors, controllers, and edge devices into IIoT environments.</td></tr>
<tr><td>CO3</td><td colspan="7">Analyze data acquisition, processing, and real-time analytics using cloud and edge computing.</td></tr>
<tr><td>CO4</td><td colspan="7">Design secure, scalable IIoT solutions for industrial applications such as predictive maintenance and automation.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction to Industrial IoT</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Evolution from traditional automation to IIoT -IIoT architecture: sensors, edge, cloud, analytics -IIoT vs IoT: industrial requirements and challenges -Use cases: Smart factory, Industry 4.0, energy and utilities</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Industrial Communication and Networking</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Industrial protocols: Modbus, PROFIBUS, CAN, HART -Wireless protocols: Zigbee, LoRaWAN, NB-IoT, Wi-Fi, 5G -MQTT, CoAP, OPC-UA and their application in IIoT -Time-sensitive networking and industrial ethernet</td><td>CO1, CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Sensing, Edge Computing & Controllers</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Industrial sensors and transducers -Edge computing platforms: Raspberry Pi, Jetson, Arduino -PLC and SCADA in IIoT context -Interfacing sensors and actuators with microcontrollers</td><td>CO2</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Cloud Integration and Data Analytics</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">IIoT platforms: AWS IoT, Azure IoT Hub, Google Cloud IoT - Real-time data collection, filtering, and storage -Introduction to analytics: stream processing, ML, dashboards -Visualization tools: Grafana, Power BI</td><td>CO3</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Applications, Cybersecurity and Future Trends</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Predictive maintenance, smart energy, remote monitoring -Security challenges in IIoT: encryption, authentication, network security -Standards and compliance (ISA/IEC) -Trends: Digital Twin, AI at Edge, Cyber-physical systems</td><td>CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorials Periods: 00</td><td colspan="3">Practical Periods: 00</td><td colspan="2">Total Periods: 45</td></tr>
<tr><td colspan="9">Reference Books:</td></tr>
<tr><td colspan="9">1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 2nd Edition, Apress, 2022.
2. Pethuru Raj, Anupama Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, 2nd Edition, CRC Press, 2021.
3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-on Approach, 2nd Edition, VPT, 2022.
4. Samuel Greengard, The Internet of Things, MIT Press Essential Knowledge Series, 2023.</td></tr>
</table>

5. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things: Principles and Paradigms, 1st Edition, Morgan Kaufmann, Latest Reprint 2023.

CO – PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**		Programme : **B.Tech.-EIE**							
Semester : **Seven**		Course Category Code: **ANC**				Semester Exam Type:**TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EIUN108	**Fundamental of MEMS**	**3**	**-**	**-**	**3**	**40**	**60**	**100**	
Prerequisite:	-								

Course Outcome: At the end of the course the student will be able to	**CO1**	Ability to understand the basic characteristics of MEMS sensors and materials
	CO2	Able to understand the micromachining methodology such bulk, surface and LIGA
	CO3	Able to design the MEMS sensors and actuators-I using basic concepts
	CO4	Able to understand and design piezoresitive and piezo electric mems devices
	CO5	Ability to design the optical MEMS devices and polymer mems devices

UNIT-I	**Introduction to MEMS**	**Periods: 9**
Introduction to MEMS and Microsystems, Materials and Substrates for MEMS, Sensors/ Transducers, Sensors characterization and classifications, microactuators, Application of MEMS.		**CO1**
UNIT-II	**Material Properties**	**Periods: 9**
MEMS materials, structural and sacrificial materials, properties of silicon, mechanical, electrical and thermal properties of materials, Basic modeling of elements in electrical and mechanical systems.		**CO2**
UNIT-III	**MEMS Fabrication**	**Periods: 9**
MEMS Fabrication Technologies, single crystal growth, micromaching, photolithography, microsterolithography, thin film deposition, impurity doping, diffusion, etching, bulk and surface micromaching, etch stop technique and microstructure, LIGA.		**CO3**
UNIT-IV	**Mechanical Sensors & Actuators**	**Periods: 9**
Stress and Strain, Hooke's Law. Stress and Strain of Beam Structures, Cantilever, Pressure sensors, Piezoresistance Effect, Piezoelectricity, Piezoresistive Sensor, capacitive sensors, Inductive sensors, MEMS inertial sensors, micromachined microaccelerometer for MEMS, Parallel-plate Actuator, piezoactuators.		**CO4**
UNIT-V	**Thermal Sensors:**	**Periods: 9**
Temperature coefficient of resistance, Thermo-electricity, Thermocouples, Thermal and temperature sensors, heat pump, micromachined thermocouple probe, thermal flow sensors, shape memory allloy.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods:45**

Reference Books:

1. R.S. Muller, Howe, Senturia and Smith, “Microsensors”, IEEE Press.
2. **2.** S. M. Sze, Semiconductor Sensors, Willy –Interscience Publications
3. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.

CO – PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low

Department: **EIE**			Programme **: B.Tech.-EIE**						
Semester: **Four**			Subject Category: **ANC**				Semester Exam Type: **TY**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EIUI101	**Python Programming**		**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite:	-								
Course Outcome: At the end of the course the student will be able to :	**CO1**	Interpret the building blocks in python programming language to construct basic programs.							
	CO2	Extract packages and modules for developing different solutions for real time problems.							
	CO3	Build Web application using GUI components and Database connectivity.							
	CO4	Perform numerical computations and Data Manipulations using NumPy and Pandas.							
	CO5	Illustrate programming concept for Visualization with Matplotlib.							
UNIT-I	**Basic Python Programming Concepts**							**Periods: 09**	
Features and Applications – Development Environment – Interactive vs Script mode Programming - Input and Output Statements – Branching – Looping – Operators – Datatypes – Arrays - Lists – Tuples – Set - Dictionary – Comprehensions.									**CO1, CO2**
UNIT-II	**Modules and Functions**							**Periods: 09**	
Libraries – Modules – Packages - Functions – Lambda Functions - File Handling – Exception Handling – Object-Oriented Concepts – Multithreading.									**CO1, CO2**
UNIT-III	**GUI Programming and Database Connectivity**							**Periods: 09**	
Web Application using Flask: Adding HTML tags – Adding CSS – Calling External Scripts. GUI using Tkinter: Controls and Attributes - Database Access: Connecting MySQL and Python.									**CO3**
UNIT-IV	**Data Manipulation Using NumPy and Pandas**							**Periods: 09**	
NumPy: Numerical Computations – Array Attributes and Operations - Distributions Pandas: Series – Data Frames – Read CSV – Read JSON – Analyze Data – Cleaning Data – Correlations.									**CO4**
UNIT-V	**Visualization with Matplotlib**							**Periods:09**	
Basic functions of Matplotlib: Pyplot – Plotting – Markers – Line – Labels – Grid – Subplot. Plot Types: – Line Plot – Scatter Plot – Density and Contour Plots – Histograms – Colour Bars – Pie-charts. Introduction to Seaborn Library – Plotting using Seaborn.									**CO5**
Lecture Periods: 45		**Tutorial Periods: 00**	**Practical Periods: 00**				**Total Periods: 45**		
Reference Books:									

1. Vamsi Kurama, Python Programming: A Modern Approach, Kindle Edition, Pearson, 2017.
2. John Paul Mueller, Luca Massaron, “Python for Data Science for Dummies”, 2nd Edition, John Wiley& Sons, 2019.
3. Jesus Rogel-Salazar, “Data Science and Analytics with Python”, CRC Press Taylor and Francis Group, 2017.
4. Brian Draper, “Python Programming A Complete Guide for Beginners to Master and Become an Expert in Python Programming Language”, CreateSpace Independent Publishing Platform, 2016.
5. Eric Matthes, Python Crash Course, Second Edition, No Starch Press, 2016.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1-	PO11	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	1	1	1	3	2
CO2	3	2	3	2	3	-	-	-	2	1	1	3	3
CO3	3	2	3	2	3	1	-	1	2	2	1	3	3
CO4	3	3	3	3	-	-	-	-	2	1	1	3	3
CO5	3	2	2	3	-	-	-	-	2	1	1	3	3

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="3">Department :EIE</td><td colspan="6">Programme : B.Tech.-EIE</td></tr>
<tr><td colspan="3">Semester :Five</td><td colspan="4">Subject Category: ANC</td><td colspan="2">Semester Exam Type:TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2" colspan="2">Course Name</td><td colspan="3">Periods / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUI102</td><td colspan="2">Visual Programming for Instrumentation Engineers</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="9">C Programming</td></tr>
<tr><td rowspan="5">Course Outcome: At the end of the course the student will be able to</td><td>CO1</td><td colspan="8">The student can understand fundamentals of .net, vb.c# and vb.net</td></tr>
<tr><td>CO2</td><td colspan="8">The student can understand advanced concepts in c# and vb in .net</td></tr>
<tr><td>CO3</td><td colspan="8">The student can able to choose a platform and language for developing instrumentation software</td></tr>
<tr><td>CO4</td><td colspan="8">The student can create database applications</td></tr>
<tr><td>CO5</td><td colspan="8">The student can create sample applications for instrument control.</td></tr>
<tr><td>UNIT-I</td><td colspan="7">Net Frame Work and C# Basics</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">.Net Frame work : Introduction – Components of .NET architecture –Principal Design features-web services C# basics: Introduction –Data Types-Access Modifiers-Variables and Constants –Statements –OO concepts-arrays –strings-System collections-delegate and events –indexer-properties-versioning</td><td colspan="2">CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="7">C# Using Libraries</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Name space System-Input and output- Multithreading-Windows Forms –data handling and Exception handling</td><td colspan="2">CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="7">Advanced Features Using C#</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Web services –Window services-Messaging, Reflection and COM- Localization and Globalization- - XML- Unsafe Model- Graphical Device Interface</td><td colspan="2">CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="7">Introduction to VB.Net</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Concepts and Simple Applications- variables, constants and Functions – processing decisions- Loop Structure and List File and Database Application: File access-Dialog Boxes –exception handling , Menus in Vb.net- Connecting to databases.</td><td colspan="2">CO1 CO2,CO3,CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="7">Advanced Programming Constructs</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="8">Sub Procedures –Functions –Modules-Arrays-Structure –Collection .Net Architecture and Advanced Tools: OOP with VB.net – Creating Distributed Web applications – Graphics, Printing ,Reporting Case Study: Case studies in developing applications for Instrumentation</td><td colspan="2">CO2 CO3, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorial Periods: 00</td><td colspan="4">Practical Periods: 00</td><td colspan="2">Total Periods: 45</td></tr>
<tr><td colspan="10">Reference Books:</td></tr>
<tr><td colspan="10">1. ISRD Group, Application of .net Technology, Tata Mcgraw Hill Education Private Limited, 2011.
2. Balagurusamy E, Programming with C#., Tata Mcgraw Hill 2008.
3. Chappell D , Understanding .NET , Pearson Edition 2007.</td></tr>
</table>

CO – PO Mapping

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

Score: **3** – High; **2** – Medium; **1** – Low

Department :**EIE**		Programme : **B.Tech - EIE**						
Semester : **Six**		Subject Category: **ANC**				Semester Exam Type:**TY**		
Course Code	Course Name	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUI103	**Modelling and Simulation**	**3**	**-**	**-**	**3**	**40**	**60**	**100**
Prerequisite								
Outcome:	**CO1**	Model instrumentation system components using equivalent circuits and dynamic equations.						
	CO2	Apply multi-domain analogies to develop mathematical models of physical systems.						
	CO3	Simulate and analyze the dynamic response of models using tools like MATLAB, Scilab, or Python.						
	CO4	Develop and validate simulation-based case studies for instrumentation applications.						
UNIT-I	**Modelling of Instrumentation Elements**						**Periods: 9**	
Modelling of sensors and transducers such as temperature sensors, strain gauges, LVDT, and thermocouples using equivalent electrical circuits – Analysis of static and dynamic characteristics – Time constant, sensitivity, and linearity in system response – Effect of hysteresis, resolution, and non-linearity on system behaviour.								**CO1**
UNIT-II	**Physical System Modelling Across Domains**						**Periods: 9**	
Multi-domain system modelling using analogies between electrical, mechanical, thermal, and fluid systems – Force-voltage and effort-flow analogies – Derivation of governing equations for simple systems – Concept of lumped parameter models – Modelling of coupled systems relevant to process instrumentation.								**CO2**
UNIT-III	**Introduction to Bond Graph Modelling**						**Periods: 9**	
Basic elements of bond graphs: effort, flow, source, sink, and storage – Junction structure and causality assignment – Bond graph modelling of typical instrumentation systems – Energy flow representation and system interaction in multi-domain environments.								**CO2**
UNIT-IV	**Simulation Techniques and Tools**						**Periods: 9**	
Overview of simulation process – Numerical integration methods: Euler, Modified Euler, and Runge-Kutta – Discretization and solver settings – Simulation of first- and second-order dynamic systems – Introduction to simulation tools: MATLAB/Simulink, Scilab, Python (SciPy), and LabVIEW – Implementation of models for instrumentation components.								**CO3**
UNIT-V	**Case Studies and Applications**						**Periods: 9**	
Simulation of measurement systems like flow sensors, pressure transducers, and temperature control loops – Biomedical sensor system modelling (e.g., ECG acquisition chain) – Validation of models using theoretical and/or experimental data – Error estimation and model refinement – Mini-projects focused on virtual modelling of real-world instrumentation applications.								**CO4**
Lecture Periods: 45	**Tutorials Periods: 00**			**Practical Periods: 00**			**Total Periods: 45**	
Reference Books:								
1. William Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering," Pearson Education.								

2. Dukkipati R.V., "Modelling and Simulation," New Age International Publishers.
3. Karnopp D.C., Margolis D.L., and Rosenberg R.C., "System Dynamics: Modelling, Simulation, and Control of Mechatronic Systems," Wiley India.
4. M. Gopal, "Control Systems: Principles and Design," McGraw Hill (for simulation aspects).
5. MATLAB/Simulink, Scilab, and Python (SciPy) official documentation and user guides.

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	3	3	2	0	0	0	1	1	0	3	3
CO2	3	3	3	3	3	0	0	0	1	1	0	3	3
CO3	3	3	3	3	3	0	0	0	1	1	0	3	3
CO4	3	3	3	3	3	1	0	1	2	2	2	3	3

Score: **3** – High; **2** – Medium; **1** – Low

<table>
<tr><td colspan="2">Department :EIE</td><td colspan="5">Programme : B.Tech – EIE</td></tr>
<tr><td colspan="2">Semester : Seven</td><td colspan="3">Subject Category: ANC</td><td colspan="2">Semester Exam Type:TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course Name</td><td colspan="3">Hours / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EIUI104</td><td>AI and ML for Instrumentation</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8"></td></tr>
<tr><td rowspan="4">Outcome:</td><td>CO1</td><td colspan="7">Understand and describe the fundamental concepts of AI and machine learning relevant to instrumentation systems.</td></tr>
<tr><td>CO2</td><td colspan="7">Apply suitable supervised and unsupervised learning techniques for sensor data analysis and pattern recognition.</td></tr>
<tr><td>CO3</td><td colspan="7">Design and develop AI/ML-based software models for automation, fault detection, and intelligent control in instrumentation.</td></tr>
<tr><td>CO4</td><td colspan="7">Evaluate AI/ML models and deploy them for real-time instrumentation applications using appropriate programming tools.</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction to AI and ML</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="7">Definition of AI – History and evolution – AI vs ML vs DL – Importance of AI in instrumentation – Typical AI-enabled instrumentation architecture – Introduction to datasets and feature engineering – Types of machine learning – Linear regression – Logistic regression – Use cases in sensor calibration and drift compensation</td><td colspan="2">CO1. CO2</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Supervised Learning Techniques</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="7">Decision trees – Random forests – k-nearest neighbors – Support vector machines – Model accuracy metrics (precision, recall, F1-score, confusion matrix) – Cross-validation – Instrumentation case studies: classification of fault patterns in sensors – gas leakage detection – condition monitoring using ML</td><td colspan="2">CO2, CO3</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Unsupervised and Reinforcement Learning</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="7">Clustering: k-means, hierarchical clustering – Dimensionality reduction using PCA – Anomaly detection – Introduction to reinforcement learning – Q-learning concepts – Application examples: grouping similar signal patterns – smart control logic for adaptive instrumentation systems</td><td colspan="2">CO2, CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">AI in Embedded and Edge Devices</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="7">Introduction to edge AI – Microcontrollers with ML capability – Overview of tools: Edge Impulse, TensorFlow Lite – Data acquisition and preprocessing – Real-time inference – Deployment of ML models in low-power IoT nodes – Case study: predictive maintenance of process control valves – implementation using Python and embedded tools</td><td colspan="2">CO3, CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Software Development Tools</td><td colspan="2">Periods: 9</td></tr>
<tr><td colspan="7">Introduction to Scikit-learn, Pandas, Matplotlib – Simple project development: sensor health monitoring, activity detection using wearable data, smart flow measurement – Dataset handling, model training, testing and deployment</td><td colspan="2">CO3, CO4</td></tr>
<tr><td colspan="2">Lecture Periods: 45</td><td colspan="2">Tutorials Periods: 00</td><td colspan="3">Practical Periods: 00</td><td colspan="2">Total Periods: 45</td></tr>
<tr><td colspan="9"></td></tr>
</table>

Reference Books:

1. Ethem Alpaydin – Introduction to Machine Learning – MIT Press – 4th Edition – 2020 – Units 1, 2, 3
2. Aurélien Géron – Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – O'Reilly – 3rd Edition – 2022 – Units 4, 5
3. Stuart Russell and Peter Norvig – Artificial Intelligence: A Modern Approach – Pearson – 4th Edition – 2021 – Units 1, 3
4. Srinivasan D. and Sengupta A. – Artificial Intelligence and Applications in Smart Instrumentation – Springer – 1st Edition – 2023 – Units 3, 4
5. Sandeep Nagar – Introduction to Machine Learning with Python – Apress – 1st Edition – 2018 – Units 4, 5

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	2	2	1	1	0	1	1	1	3	3
CO2	3	3	3	3	3	1	1	1	1	1	1	3	3
CO3	3	3	3	3	3	1	1	1	1	1	1	3	3
CO4	3	3	3	3	3	1	2	1	2	2	2	3	3

Score: **3** – High; **2** – Medium; **1** – Low

Department : **EIE**		Programme: **B.Tech.**						
Semester : IV		Course Category Code: ASC				Semester Exam Type: TY		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EIUC151	**Instrumentation and Sensor Technologies for Civil Engineering Applications**	3	-	-	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Identify the basics of all indicating instruments
	CO2	Apply the instrument techniques for structural related problem in civil engineering
	CO3	Apply seismic instruments for measuring the vibration motion in structures
	CO4	Quantity the environmental related problems by using the various measuring instruments

UNIT-I	**Measurement of Voltage, Current, Impedance**	**Periods: 9**	
Introduction - Permanent moving coil instrument- Moving iron instruments Construction and operating principles of attraction and repulsion types - Errors in measurements - Shunts and Multipliers - Wheat stone bridge - Kelvin's double bridge - Maxwell's bridge-Hay's bridge- Schering bridge- Wein bridge			**CO1**
UNIT-II	**Instruments and Recorders**	**Periods: 9**	
Classification of transducers – Resistive, Capacitive, Inductive, piezoelectric transducer - LVDT - Load cell, Hydraulic load cell - Pneumatic load cell, Load cells using strain gauges - Torque meter - Cathode ray tube, Principle of operation - Strip chart recorder, X-Y recorder ,Structural and Construction instrumentation			**CO2**
UNIT-III	**Motion Measurements**	**Periods: 9**	
Relative motion measuring devices - Vibration measurements - Principle of seismic instruments - Displacement measurements, Acceleration measurement - Velocity measurement - Photo electric type tachometer- Eddy current drag cup tachometer - Angular motion measurement- Pneumatic gauges - Surface roughness measurements - Material thickness measurement			**CO3**
UNIT-IV	**Environmental pollution and level measurement**	**Periods: 9**	
Orsat apparatus , Gas chromatograph - Measurement of automobile emission, stack emission - Viscosity measurement - Capillary tube viscometer - Rotameter type viscometer - Efflux viscometer, Liquid level measurement - Capacitance type , Ultrasonic type.			**CO4**
UNIT-V	**Flow measurements**	**Periods: 9**	
Orifice meter- Venturi meter- Ultrasonic flow meter, Electromagnetic flow meter - Turbine flow meter - Lobed impeller meter, Rotary vane flow meter.			**CO4**

Lecture Periods: 45	**Tutorial Periods: 00**	**Practical Periods: 00**	**Total Periods: 45**

Reference Books:

1. Keith Cheatle, "Fundamentals of Test Measurement Instrumentation", ISA publishers, 2004.
2. Michael D. Whitt, "Successful Instrumentation and Control systems design ", ISA publishers, 2004.
3. Jim Strothman, "ISA Handbook of Measurement Equations and Tables", 2nd Edition, ISA publishers, 2006.
4.Albert D.Helfrick& William D. Cooper, Modern Electronic Instrumentation & Measurement Techniques, Prentice Hall of India, 2002.
5. A.K. Sawhney, Electrical & Electronic Measurements and Instrumentation, Dhanpath Rai & Co (P) Ltd, 2004.
6. Joseph. J. Carr, Elements of Electronic Instrumentation & Measurements, III edition, Pearson Education, 2003.
7. Albert D.Helfrick& William D. Cooper, Modern Electronic Instrumentation & Measurement Techniques, Prentice Hall of India, 2002.
8. Patranabis, Principles of Electronic Instrumentation - PHI, 2007

CO-PO Mapping

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

Score: 3 – High; 2 – Medium; 1 – Low