NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation: 2021

Curriculum and Syllabi

B.E Programme

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Electrical and Electronics Engineering

Department of Electronics and Instrumentation Engineering

Vision of the Department

To develop innovative, globally competent and high quality instrumentation engineers and entrepreneurs who meet the demands of modern industrial world with societal, environmental and human values.

Mission of the Department

To provide students with a supportive learning environment, equipping them with electronics, instrumentation, control, and automation skills to meet industry demands while fostering continuous learning and instilling values of discipline and ethics.

Description of the programme

The undergraduate program in Electronics and Instrumentation Engineering provides a comprehensive curriculum prepared to equip students with the necessary skills for a wide range of career opportunities in this discipline. Students learn specialized subjects like control engineering, industrial instrumentation, embedded systems, industrial automation, virtual instrumentation, process control, SCADA, distributed control systems, programmable logic controllers, and IoT applications. Elective courses in higher semesters allow students to learn deeper into areas such as robotics and automation, machine vision, industrial data networks, and artificial intelligence for robotics. Practical training is emphasized throughout the program, with students engaging in laboratory sessions and projects. Upon graduation, students are equipped to pursue roles as instrumentation engineers, control system engineers, automation specialists, robotics engineers, or research associates across various industries. Graduates are prepared to work in industries such as automation and control systems, oil and gas, manufacturing, renewable energy, biomedical engineering, robotics, aerospace, and more.

Programme Educational Objectives - PEO	
PEO-01	Provide a strong foundation in Electronics and Instrumentation Engineering, enabling graduates to excel in industrial roles or pursue higher education in specialized fields such as process control, robotics, and automation.
PEO-02	Equip students with the ability to apply mathematical, scientific, and engineering principles to solve complex problems in instrumentation, control systems, and electronics.
PEO-03	Foster the ability to design, develop, and implement innovative and sustainable solutions for real-world engineering challenges, emphasizing industrial automation and instrumentation technologies.
PEO-04	Instill professionalism, ethical values, and effective communication skills, preparing graduates to lead and collaborate in multidisciplinary teams.
PEO-05	Create a learning environment that encourages lifelong learning, enabling students to adapt to evolving technologies and excel in their professional careers.

Graduate Attributes-GA	
GA-1	**Innovative Engineering Solutions:** Develop creative and innovative solutions to complex engineering problems, incorporating the latest technologies and approaches to address current and future challenges.
GA-2	**Global Perspective in Engineering:** Understand and apply engineering solutions in a global context, recognizing the diversity of global issues, standards, and the impact of engineering decisions on different cultures and communities.

GA-3	**Sustainable Development and Green Engineering:** Design and implement engineering solutions that prioritize sustainability, resource efficiency, and environmental protection, contributing to a sustainable future.
GA-4	**Social Responsibility and Community Engagement:** Demonstrate a commitment to social responsibility by engaging with and contributing to local communities, understanding societal needs, and addressing social challenges through engineering practices.
GA-5	**Adaptability and Lifelong Learning:** Exhibit a proactive approach to continuous learning and adaptability, keeping pace with technological advancements and industry changes, and engaging in professional development activities.
GA-6	**Entrepreneurship and Innovation:** Foster an entrepreneurial mindset, identifying opportunities for innovation and creating value through new technologies, products, and processes that meet market needs.
GA-7	**Interdisciplinary Collaboration:** Work effectively in interdisciplinary teams, integrating knowledge from various fields to develop comprehensive solutions to complex engineering problems.
GA-8	**Ethical Leadership and Integrity:** Lead with integrity and ethical principles, ensuring transparency, fairness, and respect in all professional and personal interactions.
GA-9	**Digital and Data Literacy:** Utilize advanced digital tools and data analytics techniques to solve engineering problems, optimize processes, and make informed decisions based on data-driven insights.
GA-10	**Safety, Health, and Risk Management:** Prioritize safety, health, and risk management in engineering practices, ensuring the well-being of individuals and communities while minimizing potential risks and hazards.
GA-11	**Effective Communication and Negotiation Skills:** Communicate ideas, solutions, and technical information effectively to a variety of audiences, and engage in negotiation to resolve conflicts and reach consensus.
GA-12	**Impact Assessment and Policy Making:** Assess the impact of engineering projects on society and the environment, and contribute to policy-making processes that promote sustainable and responsible engineering practices.

Programme Outcome - PO	
PO-A	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to solve the problems pertaining to Electronics and Instrumentation Engineering.
PO-B	Identify, formulate, review and analyze complex instrumentation engineering problems and attain conclusions using first principles of mathematics and engineering sciences.

PO-C	Design solutions and system components or processes for complex engineering problems that fulfill the specified needs taking into account the public health and safety, cultural, societal, and environmental considerations.
P0-D	Use research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to arrive at significant conclusion.
PO-E	Form, select, and apply appropriate techniques, resources, and modern engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also understand their limitations.
PO-F	Assess societal, health, safety issues based on the reasoning received from the contextual knowledge and understand the consequent responsibilities of the Professional Instrumentation Engineer.
PO-G	Understand the impact of the professional engineering solutions in societal and environmental contexts, and exhibit the knowledge of, and the need for sustainable development.
PO-H	Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
PO-I	Function actively and efficiently as an individual or a member/leader in diverse teams, and in multidisciplinary settings.
PO-J	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
PO-K	Demonstrate knowledge and understanding of the engineering and management principles and apply them to own work, as member / leader in teams and multidisciplinary environments.
PO-L	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning, keeping pace with technological challenges in the broadest sense.

Mapping of Graduate Attributes and Programme Educational Objectives (PEO)

GAs / PEOs	**GA-01**	**GA-02**	**GA-03**	**GA-04**	**GA-05**	**GA-06**	**GA-07**	**GA-08**	**GA-09**	**GA-10**	**GA-11**	**GA-12**
PEO-01	H	H	H	H	A	A	A	A	N	N	N	N
PEO-02	A	H	H	H	A	A	A	A	N	N	N	N

PEO-03	H	H	H	H	H	A	A	A	N	N	A	H
PE0-04	A	A	A	H	A	N	A	H	N	N	H	N
PEO-05	H	A	A	A	H	H	H	A	N	N	N	N

H- Highly Associated A- Associated Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs / PEOs	**GA-01**	**GA-02**	**GA-03**	**GA-04**	**GA-05**	**GA-06**	**GA-07**	**GA-08**	**GA-09**	**GA-10**	**GA-11**	**GA-12**
PO-A	H	H	H	A	A	A	H	N	H	A	A	N
PO-B	H	H	H	A	A	A	H	N	H	A	A	N
PO-C	H	H	H	H	H	A	H	A	A	A	A	H
P0-D	A	A	A	A	H	A	H	A	H	A	A	N
PO-E	H	H	H	A	H	H	A	A	H	A	A	N
PO-F	A	A	H	A	A	N	H	A	A	H	A	N
PO-G	A	A	H	H	H	N	H	A	A	H	A	H
PO-H	A	A	H	H	A	A	H	H	A	A	A	A
PO-I	A	H	A	A	A	A	H	A	A	A	A	N
PO-J	A	H	H	A	H	A	H	A	A	A	H	N

PO-K	A	H	H	A	H	H	H	H	A	A	A	N
PO-L	A	H	H	A	A	H	A	A	A	A	A	N

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO / PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05
PO-A	H	H	H	H	A
PO-B	H	H	H	A	A
PO-C	H	H	H	H	H
P0-D	H	H	H	N	N
PO-E	H	H	H	A	H
PO-F	A	A	H	N	H
PO-G	A	N	H	N	A
PO-H	A	N	A	H	A
PO-I	A	A	H	H	H
PO-J	A	N	N	H	N
PO-K	H	N	N	H	N
PO-L	A	N	N	N	H

H- Highly Associated A- Associated Not – Not Associated

Duration of the programme: 4 Years/ 8 Semesters
Total credits: 162

CURRICULUM & SYLLABI

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						

6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

SEMESTER III

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	MA3201	Engineering Mathematics III	3	1	0	4
2.	EE3210	Electrical Machines	3	0	0	3
3.	EI3201	Circuit Theory	3	0	0	3
4.	EI3202	Communication Engineering	3	0	0	3
5.	EI3203	Electronic Devices and Circuits	3	0	0	3
6.	EI3204	Measurements and Instrumentation	3	0	0	3
PRACTICAL						
7.	EE3278	Electrical Machines Laboratory	0	0	2	1
8.	EI3271	Electronic Devices and Circuits Laboratory	0	0	2	1
9.	EI3272	Measurements and Instrumentation Laboratory	0	0	2	1
TOTAL			**18**	**1**	**6**	**22**

SEMESTER IV

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	MA3203	Numerical Methods	2	1	0	3

2.	BS3201	Environmental Studies	2	0	0	2
3.	EI3205	Digital Logic Circuits	3	0	0	3
4.	EI3206	Linear Integrated Circuits	3	0	0	3
5.	EI3207	Transducer Engineering	3	0	0	3
6.	ME3210	Thermodynamics and Fluid Mechanics	3	0	0	3
PRACTICAL						
7.	EI3273	Transducer Engineering Laboratory	0	0	2	1
8.	EI3274	Linear and Digital Integrated Circuits Laboratory	0	0	2	1
9.	ME3278	Thermodynamics and Fluid Mechanics Laboratory	0	0	2	1
10.	EI32P1	Summer Internship-I	0	0	0	2
TOTAL			**16**	**1**	**6**	**22**

SEMESTER V

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EI3208	Industrial Instrumentation	3	0	0	3
3.	EI3209	Control Engineering	3	1	0	4
4.	EI3210	Analytical Instrumentation	3	0	0	3
5.	EI3211	Embedded Instrumentation Systems and IoT	3	0	0	3
6.	EI32**	Programme Elective - I	3	0	0	3
PRACTICAL						
7.	EI3275	Industrial Instrumentation Laboratory	0	0	2	1

8.	EI3276	Embedded Instrumentation Systems and IoT Laboratory	0	0	2	1
9.	EE3280	Control Systems Laboratory	0	0	2	1
TOTAL			**17**	**1**	**6**	**21**

SEMESTER VI

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	EI3212	Virtual Instrumentation	3	0	0	3
2.	EI3213	Process Control	3	0	0	3
3.	EI3214	Digital Signal Processing Techniques	3	0	0	3
4.	EI32**	Programme Elective-II	3	0	0	3
5.	EI32**	Programme Elective-III	3	0	0	3
6.	XXXXXX	Open Elective - I	3	0	0	3
PRACTICAL						
7.	EI3277	Virtual Instrumentation Laboratory	0	0	2	1
8.	EI3278	Process Control Laboratory	0	0	2	1
9.	EI32P2	Summer Internship-II	0	0	0	2
TOTAL			**18**	**0**	**4**	**22**

SEMESTER VII

Sl. No	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EI3215	Industrial Automation	3	0	0	3
3.	EI3216	Computer Control of Processes	3	0	0	3
4.	EI32**	Programme Elective-IV	3	0	0	3

5.	XXXXXX	Open Elective	3	0	0	3
PRACTICAL						
6.	EI3279	Industrial Automation Laboratory	0	0	2	1
7.	EI3280	Computer Control of Process Laboratory	0	0	2	1
8.	EI32P3	Mini Project	0	0	6	3
TOTAL			**14**	**0**	**10**	**19**

SEMESTER VIII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EI32**	Programme Elective-V	3	0	0	3
2.	EI32**	Programme Elective - VI	3	0	0	3
PRACTICAL						
3.	EI32P5	Project Work	0	0	20	10
TOTAL			**6**	**0**	**20**	**16**

LIST OF ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
List of Programme Electives						
1.	EI32A1	Biomedical Instrumentation and Measurements	3	0	0	3
2.	EI32A2	Robotics and Automation	3	0	0	3
3.	EI32A3	Instrumentation System Design	3	0	0	3
4.	EI32A4	Thermal Power Plant Instrumentation	3	0	0	3
5.	EI32A5	Applied Soft Computing	3	0	0	3
6.	EI32A6	Industrial Data Networks	3	0	0	3
7.	EI32A7	Instrumentation in Petrochemical Industries	3	0	0	3
8.	EI32A8	Field and Service Robotics	3	0	0	3

9.	EI32A9	Artificial Intelligence for Robotics	3	0	0	3
10.	EI32B1	Digital Twin and Industry 5.0	3	0	0	3
11.	EI32B2	Electric and Hybrid Vehicle Technology	3	0	0	3
12.	EI32B3	SCADA System and Applications	3	0	0	3
13.	EI32B4	Fibre Optics & Laser Instrumentation	3	0	0	3
14.	EI32B5	Nuclear Instrumentation	3	0	0	3
15.	EI32B6	Machine Vision	3	0	0	3
16.	EI32B7	Introduction to Autonomous Mobile Robots	3	0	0	3

Duration of the program: 4 Years/ 8 Semesters
Total credits: 162

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

EG3101	**TECHNICAL ENGLISH**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

- To develop the linguistic, communicative and critical thinking competencies of First Year Engineering students.
- To enhance the understanding of the complex grammatical structures of the English language to students.
- To improve the language proficiency of students in English with emphasis on Vocabulary, Grammar, Listening, Speaking, Reading, and Writing skills
- To introduce the students to the basic phonetics of English and make them grasp the various sounds of the English language to improve their pronunciation

Course Outcome		**Cognitive Skill**
CO-01	The students will be able to improve their vocabulary relating to Engineering and Technology, and use articles and prepositions effectively in sentences.	R

CO-02	The students will be able to learn grammatical items like tense, voice, compound nouns etc. and thereby enhance their linguistic competence.	U
CO-03	The students will be able to learn definitions of technical terms, relative pronouns etc. which will develop their language competence.	A
CO-04	The students will be able to acquire the essentials of writing skills relating to CV, Resume, Formal and Business Letters.	U
CO-05	The students will be able to learn English phonemes such as Vowels, Diphthongs and Consonants which will be instrumental in improving their pronunciation and speaking skills.	R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	S	S	M	S	S	S	M	M	S	S
CO-02	M	S	M	M	S	S	M	S	M	S	M	M	S
CO-03	S	M	M	S	M	M	S	M	S	M	M	S	M
CO-04	M	S	M	M	S	M	S	M	M	S	M	M	S
CO-05	S	M	S	S	M	S	M	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT-I **9**

Word formation with prefixes and suffixes **–** Articles – Conjunctions **–** Prepositions – Expansion of Abbreviations and Acronyms – Writing Checklists **–** Writing Instructions.

UNIT-II **9**

Tense **–** Voice **–** Punctuation **–** Expansion of Compound Nouns – Writing Recommendations – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence**-–** Organizing Principles of Paragraphs in Documents.

UNIT-III **9**

Discourse Markers **–** Gerunds and Present Participles – Relative Pronouns – Conditional Clauses – Definitions of Technical Terms – Transcoding: Bar Chart - Flow Chart - Pie Chart - Tree Diagram - Tabular Column.

UNIT –IV **9**

Concord – Clauses – Phrases – Numerical Adjectives – CV/Resume Writing – Virtual Communication**:** E-Mail Writing – Essay Writing : Basic Format of an Essay - Types – Examples.

UNIT-V **9**

Basic Phonetics**:** Phonemes – Vowels, Diphthongs and Consonants – Classification**:** Pure Vowels/Monophthongs – Vowel Glides /Diphthongs.

L: 45 + T: 15, TOTAL: 60 HOURS

EXTENSIVE READING:

Shiv Khera, *You Can Win*, Milan, Delhi, 2004

NOTE:

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

TEXT BOOK

1. Khaleel Rahuman A., Deepa P., Sheila J., Mathi Vathani J. , *Technical English*, R. K. Publishers, 2023.

REFERENCES:

1. Nagarajan S., Senthil C. S., *Engineering English I & II*, Sri Krishna Publications, 2004.
2. Jewelcy Jawahar , Rathna P., *English Work Book for First Year B.E./ B.Tech.*, VRB Publishers, Chennai, 2008.

MA3101	ENGINEERING MATHEMATICS - I	L	T	P	C
		3	1	0	4

Course Outcome		Cognitive Skill
CO-01	Understand the characteristic equation and find eigen values and Eigen vector of a real matrix. Compute the eigen value and eigen vector using properties.Verify Cayley Hamilton theorem and its applications. Apply orthogonal transformation of a symmetric matrix.	U, A ,E. R
CO-02	Define the definitions and formula for curvature, radius of curvature, circle of curvature. Apply the formula and solve problems using the required formulas also find the evolute of the curves.	U, A ,E, An
CO-03	Know about the differentiation formulae and apply on partial derivatives, total derivatives and Jacobians. Verify the functions be maximum or minimum and Lagrange's multiplier method. Express the Taylor's expansion for two variables.	U, A ,E. R
CO-04	Know the Fundamental concepts of improper integrals, Beta and gamma function and their properties. Develop the skill in the relation between Beta and Gamma Functions. Calculate definite integral values using Beta and Gamma Functions.	U, A , An,E
CO-05	Evaluate the double and multiple integrals and can apply these concepts to find areas of regions on a plane or in space. Graph Cartesian and polar equations. Convert Cartesian coordinates into polar coordinates.	U, A , An,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	M	S	S	S	S	M	S	S	M
CO-02	S	M	M	M	S	S	M	S	M	M	M	M
CO-03	S	M	M	M	S	S	M	M	M	S	S	M
CO-04	S	M	S	M	S	M	S	S	M	S	S	M
CO-05	S	M	S	M	S	M	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT-I MATRICES **9**

Characteristic equation - Eigen values and Eigen vectors of a real matrix - Properties of eigen values and eigen vectors(without proof)- Cayley Hamilton theorem (statement only), verification and its applications - Orthogonal and Symmetric matrices and their properties(excluding proof)- Orthogonal transformation of a symmetric matrix to diagonal form.

UNIT-II DIFFERENTIAL CALCULUS **9**

Curvature - Cartesian co-ordinates and parametric form -Centre and radius of cur- vature, Circle of curvature - Evolutes.

UNIT-III FUNCTIONS OF SEVERAL VARIABLES **9**

Partial derivatives - Total derivatives - Jacobians - Properties - Maxima and minima for functions of two variables - Lagrange Multiplier method- Taylor's expansion.

UNIT-IV IMPROPER INTEGRALS **9**

Evaluation of improper integrals- Beta and Gamma functions - Properties - Relation between Beta and Gamma functions - Evaluation of integrals using Beta and Gamma functions.

UNIT-V MULTIPLE INTEGRALS **9**

Evaluation of double and triple integrals - Area enclosed by plane curves as double integral in cartesian and polar co-ordinates - Change of order of integration- Transformation of Cartesian coordinates into polar coordinates.

L: 45 + T: 15, TOTAL: 60 HOURS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers, Delhi 2007

REFERENCES:

1. M.Immaculate Mary, K.Uma Samundesvari," Engineering Mathematics - I" Revised

Edition, R.K Publishers, 2016.
2. Veerarajan T, "Engineering Mathematics (for first year)", Fourth Edition, Tata McGraw- Hill Publishing Company Ltd.,New Delhi , 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Seventh Edition, Wi- ley India, 2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" Vol,1 ,S.Chand & Company Ltd.2002.
5. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006 .

BS3101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- The course objective is to provide basic ideas about the principles of physics related to properties of matter, wave optics, heat, quantum concepts and materials and engineering problems.

Course Outcome		Cognitive Skill
CO-01	Students will be able to understand and apply knowledge about the properties of materials.	R,U,A
CO-02	Students will be able to understand the types of oscillations and the wave nature of light in interference, diffraction and polarization phenomenon.	R,U,A,E
CO-03	Students will be able to state and explain the various laws of thermodynamics, understand entropy and its application.	R,U,A,An,,E
CO-04	Students gain basic knowledge about quantum mechanics and will be able to solve time dependent and time independent Schrodinger equation for simple potentials.	R,U,A,E,S
CO-05	Students will be able to know the different types of crystal structures and also gain basic knowledge about nanomaterials and biomaterials.	R,U,A,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	S	S	S	S	S	S	M	S	S	M
CO-02	S	S	S	M	S	S	M	S	M	M	M	M

CO-03	S	S	S	S	S	S	M	M	M	S	S	M
CO-04	S	M	S	S	S	M	S	S	M	S	S	M
CO-05	S	S	M	M	S	M	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: PROPERTIES OF MATTER **9**

Elasticity – Poisson's ratio – Stress-strain diagram – factors affecting elasticity – bending of beams – cantilever depression – Young's Modulus- theory and experiment of Young's modulus determination (uniform and non-uniform bending) –Shear Modulus – twisting couple – hollow cylinder – torsion pendulum – determination of rigidity modulus - Bulk Modulus - applications of elastic behaviours of materials.

UNIT II: OSCILLATIONS AND WAVE OPTICS **9**

Oscillations - Rectilinear motion - Oscillations or Vibrations - Simple Harmonic Motion - Damped Harmonic motion - Real oscillatory system - Forced or Driven oscillation.Wave optics - Interference of light – Photons - Young's Double Slit Experiment - Huygens's Principle - Diffraction - Diffraction Grating - Polarization.

UNIT III: THERMAL PHYSICS **9**

Transfer of heat energy (conduction, convection and radiation) - thermal expansion of solids and liquids – expansion joints – bimetallic strips-Thermal conductivity- Forbe's and Lee's disc methods (theory and experiment)- thermal insulation in buildings -Laws of thermodynamics-heat exchanger -solar power- applications of solar power (solar water heater, photo voltaic cell).

UNIT IV: QUANTUM PHYSICS **9**

Matter waves- de-Broglie wavelength - Schrodinger's wave equation-time independent and time dependent equations- physical significance of wave function- uncertainty principle and its application- energy and momentum operators-particle in a one dimensional box- scanning electron microscope- transmission electron microscope-scanning tunnelling microscope.

UNIT V: MATERIAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials- Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, miller indices – inter planar distances. Introduction and applications of Metallic glasses, Shape Memory Alloys (SMA), Nanomaterials, Biomaterials.

TOTAL: 45 HOURS

TEXT BOOKS

1. Engineering Physics I by Bindhu B, Sagi Rani C, Meenadevi V N, Ganapathi Raman R, RK Publishers 2015.
2. Engineering Physics II by Bindhu B, GeethaKumari R, SugirthaSuni N Y, RK Publishers 2016.
3. Engineering Physics by R K Gaur and S L Gupta, Dhanpat Rai Publications 2011.
4. A Text Book Oscillations, Waves & Acoustics by Dr. M. Gosh, Dr. D. Battacharya, S. Chand, Revised Edition.

REFERENCES:

1. Engineering Physics by Rajendran V, McGraw-Hill, New Delhi, 2013
2. Engineering Physics by Arumugam M, Anuradha Publications, 2014.
3. Principles of Physics by Halliday D, Resnick R and Walker J, Wiley 2015.
4. Physics for scientist and Engineers by Serway R A and Jewett J W, Cengage Learning 2010.
5. Engineering Physics by Bhattacharya D K and Poonam T, Oxford University Press 2015
6. Engineering Physics by Pandey B K and Chaturvedi,Cengage Learning India 201

BS3102	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students conversant with the principles of the following topics :(i) Use of free energy in chemical equilibria (ii) Water chemistry (iii) Periodic properties (iv) Spectroscopic techniques and applications and (v) Organic reactions and synthesis of a drug molecule.

Course Outcome		Cognitive Skill
CO-01	Students will be able to understand the estimation of free energy and entropy	U,A,An
CO-02	Students will be able to apply the different techniques in water technology	R,A
CO-03	Students will be able to analyze the properties of periodic tables.	E,A,E
CO-04	Students will be able to describe the different types of spectroscopic techniques.	An,U
CO-05	Students will be able to predict the structure of organic molecules.	S,U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	L	S	S	S	S	S	M	S	S
CO-02	M	S	L	S	S	S	S	M	S	M	M	M

CO-03	S	S	S	M	S	S	S	M	M	M	S	S
CO-04	S	M	S	S	S	S	M	S	S	M	S	S
CO-05	S	L	M	S	S	S	M	S	S	M	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA 9

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

UNIT II: WATER CHEMISTRY 9

Water as a universal solvent – hard and soft water – reasons for hardness – disadvantages of hard water in washing and industrial purposes - estimation of hardness by EDTA method, problems; boiler feed water – characteristics- softening methods - external conditioning – demineralization (ion exchange) process, desalination by reverse osmosis method- internal conditioning (phosphate, calgon and carbonate conditioning methods); stages in domestic water treatment – disinfection by chlorination, ozone and UV treatments.

UNIT III: PERIODIC PROPERTIES 9

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT IV: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 9

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

UNIT V: ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE 9

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 45 HOURS

TEXT BOOKS

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

CS3101	FUNDAMENTALS OF COMPUTING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

Course Outcome		Cognitive Skill
CO-01	Understand the basics of algorithmic problem solving.	R,U
CO-02	Ability to analyze various techniques for read and write simple Python programs.	A
CO-03	Introduce Python programs with conditionals and loops.	An
CO-04	Evaluate and Define Python functions, call them and use Python data structures – lists, tuples, and dictionaries.	E
CO-05	Apply input/output with files in Python.	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	N	M	S	L	M	M	L	S	S	S	S	M
CO-02	N	S	L	L	M	S	S	S	S	M	S	M
CO-03	M	L	S	M	L	L	M	S	S	M	M	M
CO-04	M	L	L	S	M	M	L	S	M	S	S	M
CO-05	M	L	L	L	M	S	L	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation

(pseudo code, flow chart, programming language), algorithmic problem solving, simplestrategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III: CONTROLFLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tupleassignment, tupleasreturnvalue; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V: FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff /O‘Reilly Publishers, 2016
2. (http://greenteapress.com/wp/thinkpython/)
3. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011

REFERENCES:

1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revisedand Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. KennethA.Lambert,―FundamentalsofPython:FirstPrograms‖,CENGAGELearning, 2012. Charles Dierbach, ―Introduction to Computer Science using Python: A

Computational ProblemSolving Focus, Wiley India Edition, 2013.
5. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC,2013

BS3171	PHYSICS & CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

The course objective is to teach students, the importance of physics through involvement in experiments and to have knowledge of the world due to constant interplay between observations and hypothesis.

Course Outcome		Cognitive Skill
CO-01	The students will be able to analyse the physical principle involved in various instruments and also relate the principle to new applications.	R,U,A,An,E
CO-02	Various experiments in the areas of optics, properties of matter and ultrasonics will nurture the students in all branches of engineering.	R ,U,A, An,E
CO-03	The students will be able to think innovatively and also improve the creative skills that are essential for engineering.	R,U,A,An,E
CO-04	The students will be able to gain knowledge of new concept in the solution of practical oriented problems and theoretical problems.	R,U,A,An,E
CO-05	The students will be able to understand measurement technology, usage of new instruments and real time applications in engineering studies.	R,U,A,An,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	S	S	S	S	S	S	M	S	S	M
CO-02	S	S	S	M	S	S	M	S	M	M	M	M
CO-03	S	S	S	S	S	S	M	M	M	S	S	M
CO-04	S	M	S	S	S	M	S	S	M	S	S	M
CO-05	S	S	M	M	S	M	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

List of experiments: Physics Laboratory (Any Five Experiments)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid by Ultrasonic interferometer.(Real and Virtual Lab)
2. Determination of rigidity modulus by Torsional pendulum. (Real and Virtual Lab)
3. Determination of coefficient of viscosity by Poiseulli'smethod.
4. Determination of Youngs modulus by non-uniform bending method.(Real and Virtual Lab)
5. Determination of LASER parameters using LASER diode. (Real and Virtual Lab)
6. Determination of band gap of the semi-conductor.(Real and Virtual Lab)
7. Determination of wavelength of mercury spectrum by diffraction grating.(Real and virtual lab)
8. Determination of wavelength of light by Newton's rings.(Real and Virtual Lab)
9. Determination of angle of the prism using spectrometer. (Real and Virtual Lab)

CHEMISTRY LAB
(Any FIVE experiments)

OBJECTIVES

The objective of the course is to develop the interest among the students regarding chemistry and their applications in engineering.

Course Outcome		Cognitive Skill
CO-01	Learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.	R,U,A,An,E
CO-02	Be able estimate the ions/metal ions present in domestic/industry waste water.	R ,U,A, An,E
CO-03	Utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification and spectroscopy.	R,U,A,An,E
CO-04	Able to analyze and gain experimental skill.	R,U,A,An,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

List of Experiments

1. Determination of conductance of solutions
2. Potentiometry - determination of redox potentials and emfs
3. Synthesis of drug
4. Determination of Chloride content
5. Determination of hardness of water sample
6. Determination of Alkalinity of water sample
7. Virtual lab experiments

TOTAL: 45 HOURS

CS3171	FUNDAMENTALS OF COMPUTING AND PYTHON PROGRAMMING LAB	L	T	P	C
		0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

Course Outcome		Cognitive Skill
CO-01	Understand the basic syntax of python	U
CO-02	Understand the problem solving techniques	An,U
CO-03	Analyze data structure concept in python	U
CO-04	Understand all tools of python	An
CO-05	Understand pygame with simulation	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	S	M	L	L	S	S	S	S	S	M
CO-02	L	L	M	M	S	M	L	S	S	M	S	M
CO-03	M	M	L	L	M	S	L	S	S	M	M	M
CO-04	S	L	L	M	M	M	L	S	M	S	S	M
CO-05	L	L	L	S	L	L	S	S	M	S	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF PROGRAMS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘smethod)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED: Python 3 interpreter for Windows/Linux

TOTAL: 45 HOURS

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

EG3102	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

- To widen and expand students' knowledge of English vocabulary
- To develop skills of students in the areas of vocabulary, grammar, listening, speaking, reading, and writing
- To develop the knowledge, skills and strategies the student must possess to become proficient readers
- To make the students learn the importance and purpose of communication skills and overcome the communication barriers by gaining confidence
- To make the students understand how to apply technical information and knowledge in practical documents

Course Outcome		Cognitive Skill
CO-01	The students will be able to understand the basic vocabulary items, sentence structures and error detection and correction which, in turn, will expand their knowledge of the English language.	R
CO-02	The students will be able to grasp the LSRW Skills and gain exposure to absorb Comprehension and Note-making.	U
CO-03	The students will get real time practice in speaking through Oral Presentation, Small Talk, Role Play, Debate, Group Discussion etc.	A
CO-04	The students will be able to improve their writing skills through exposure to Report Writing and Letter Writing.	U
CO-05	The students will be able to learn the Theory of Communication, the Importance of Communication, and be introduced to the various facets of Verbal and Nonverbal Communication.	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	S	S	M	S	S	S	S	S	S
CO-02	M	S	M	M	S	S	M	S	S	S	M	S
CO-03	S	M	M	S	M	M	S	M	S	S	M	M
CO-04	M	S	M	M	S	M	S	M	S	M	S	S
CO-05	S	M	S	S	M	S	M	S	S	M	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: VOCABULARY AND GRAMMAR 9

Parts of Speech – Sentence Structures – Technical Vocabulary – Synonyms – Antonyms – Homonyms – Homophones – Misspelled Words – One word Substitutes – Odd Words Out – Changing words from one form to another – Common Errors in English – Correction of Errors in Sentences.

UNIT II: LISTENING AND READING 9

Reading Comprehension – Skimming – Scanning – Predicting the Content – Comprehension Questions – Inductive Reading – Close Reading – Note Making – Précis Writing.

UNIT III: SPEAKING 9

Introducing Oneself – Exchanging Personal Information – Small Talk: Family, Friends, Studies, Profession – Speaking: Greeting, Taking Leave – Product Description – Completing information – Gap Exercises – Presentation / Public Speaking Skills – Group Discussion – Debate – Role Play.

UNIT IV: TECHNICAL WRITING 9

Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters) : Job Application Letter with Resume – Letter Seeking Permission – Letter of Invitation – Letter Declining an Invitation – Letter of Complaint – Letter of Requisition.

UNIT V: TECHNICAL COMMUNICATION 9

The Theory of Communication – Definition and Scope – Nature, Importance and Types – Different Communication Models – Barriers to Communication – Effective Communication (Verbal / Non-verbal).).

TOTAL: 45 HOURS

EXTENSIVE READING:

1. CanField Jack, *Chicken Soup for the Soul*, Westland, Chennai, 1999.

NOTE:

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

REFERENCE BOOKS:

1. Communication Skills. Oxford University Press.
2. Wood, F. T. (2007). Remedial English Grammar. Macmillan.
3. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
4. The Four Skills for Communication – Josh Sreedharan – Foundation Books.
5. Communicative English – E. Sureshkumar and P. Sreehari – Orient Blackswan

MA3102	ENGINEERING MATHEMATICS – II	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop basic knowledge to the students in differential equations and vector calculus. This subject is further broadened to the functions of complex variables and complex

integration. A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

Course Outcome		Cognitive Skill
CO-01	The Students will be able to solve ordinary differential equations	An , E , S
CO-02	The Students will be able to solve complex variables	E
CO-03	The Students will be able to synthesize complex integration	S
CO-04	The Students will be able to solve Vector Calculus	E , S
CO-05	The Students will be able to Synthesize Laplace transforms	S

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	S	M	S	S	N	M	M	S	S	M	M
CO-02	S	M	L	N	L	M	S	L	L	S	M	M
CO-03	S	L	S	S	L	L	S	S	M	M	S	S
CO-04	S	L	M	S	N	L	S	S	M	S	S	M
CO-05	S	L	M	M	M	L	N	S	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: ORDINARY DIFFERENTIAL EQUATIONS **9**

Linear differential equations of second order with constant and variable coefficients- Cauchy's and Legendre's linear equations – Method of variation of parameters.

UNIT II: COMPLEX VARIABLES **9**

Functions of a complex variable – Analytic function – Necessary conditions- Cauchy- Riemann equations in cartesian and polar co-ordinates - Sufficient conditions(excluding proof) –Properties of analytic function – Harmonic and its conjugate – Construction of analytic function by Milne Thomson method – Conformal mappings $w = z + c$, cz , $1/z$ and Bilinear transformation.

UNIT III: COMPLEX INTEGRATION **9**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Laurent's expansion – Singular points – Residues – Cauchy's Residue theorem – Evaluation of

real definite integral using contour integration(excluding poles on the real axis) - $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} \frac{f(x)}{g(x)}dx$

UNIT IV: VECTOR CALCULUS **9**

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT V: LAPLACE TRANSFORMS **9**

Laplace transform –Existence condition– Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Transform of Periodic functions. Inverse Laplace transform – Convolution, Initial and Final value theorems (statement only) – Solutions of linear ordinary differential equation of second order with constant coefficients using Laplace transform techniques.

L: 45 + T: 15 = TOTAL 60 HOURS

OUTCOMES:

At the end of the course, the students will be familiar to solve differential equations using Laplace Transform method, which is easier to handle the problems that is being investigated. They'll also become acquainted with the basic ideas of complex variable theory so as to enable the students to apply them with confidence in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition, Khanna Publishers, Delhi 2007.

REFERENCES:

1. M.Immaculate Mary, K.Uma Samundesvari, Engineering Mathematics – II" First Edition, Anuradha Publications, 2013.
2. Erwin Kreyszig, "Advanced engineering Mathematics", Seventh Edition, Wiley India, 2007.
3. Veerarajan T, "Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
4. P.Kandasamy, K.Thilagavathy, K.Gunavathy" Engineering Mathematics" S.Chand & Company Ltd.2002.
5. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd.,New Delhi, 2006.

BE3101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of AC and DC circuits, measuring instruments, electronic devices and Communication system.

Course Outcome		Cognitive Skill
CO-01	Understand the basic principle and operation of electrical circuits.	R, U
CO-02	Study the fundamental operations of measuring instruments and the layout of power system.	R, U
CO-03	Understand the fundamental operation and characteristics of semiconductor devices.	R, U
CO-04	Understand the implementation of Boolean expression using logic gates.	R, U
CO-05	Become familiar with basic concepts of Communication system.	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	S	M	S	S	N	M	M	S	S	M	M
CO-02	S	M	L	N	L	M	S	L	L	S	M	M
CO-03	S	L	S	S	L	L	S	S	M	M	S	S
CO-04	S	L	M	S	N	L	S	S	M	S	S	M
CO-05	S	L	M	M	M	L	N	S	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT 1: ELECTRICAL CIRCUITS **9**

Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits.

Introduction to AC Circuits, Faraday's Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power factor, Waveforms and RMS value, Average Value, Peak factor and Form factor, Single phase circuits- Series and Parallel, Three phase balanced circuits. Fundamentals of wiring and earthing.

UNIT II: ELECTRICAL MEASUREMENTS, MACHINES AND POWER SYSTEM **9**

Operating principles of Moving coil and Moving iron instruments (Ammeter and voltmeter), Dynamometer type watt meter and Energy meter, Errors in Measurements.

Construction, Principle of operation and Applications of DC Generators, DC Motors, Single phase transformers. Structure of power system.

UNIT III: SEMICONDUCTOR DEVICES **9**

Introduction to Semiconductors, PN Junction diode-Zener diode and its characteristics-Half wave and Full wave Rectifiers-Bipolar Junction transistor-CB,CE,CC Configuration and characteristics-JFET and MOSFET construction, operation ,characteristics (CS only) and uses.

UNIT IV: DIGITAL ELECTRONICS **9**

Number systems-binary arithmetic--Boolean algebra-laws and theorems-Simplification of Boolean expression- logic gates –Implementation of Boolean expression using logic gates-standard forms of Boolean expression.

UNIT V: COMMUNICATION SYSTEMS **9**

Block diagram of basic communication system-need for modulation-Types of modulation-Principles of Amplitude and Frequency modulation – pulse analog and digital modulation-AM and FM transmitter and receiver (Block diagram description only) –Satellite Communication Radar Systems-Data transmission and MODEM.

TOTAL: 45 HOURS

REFERENCES:

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).
2. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
3. V.K.Mehta "Principles of Power System", S.Chand & Company Ltd, New Delhi, 2001.
4. R.S.Sedha,"Applied electronics"S.Chand&Co., 2006.

BE3102	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to understand the Basic Civil and Mechanical Engineering concepts.

Course Outcome		Cognitive Skill
CO-01	To understand surveying: Objects – types – classification – principles – measurements of distances – angles –levelling–determination	R,U,A
CO-02	To understand the types, bearing capacity– Requirement of good foundation	R,U,A
CO-03	To understand the statics –Basics concepts, Fundamental principles & concepts: Newton's laws, gravitation, force, couple	R,U,A
CO-04	To understand the introduction to IC Engines, working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles	R,U,A,
CO-05	To understand the foundry- Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting.	R,U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	L	M	L	L	L	M	M	L	M
CO-02	M	N	M	L	N	M	L	L	S	M	L	M
CO-03	S	M	L	L	N	M	L	L	L	N	M	L
CO-04	S	L	M	M	N	M	M	L	N	M	M	M
CO-05	S	L	N	M	N	M	L	L	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

A– CIVIL ENGINEERING

UNIT I: SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling–determination of areas–illustrative examples.

Civil Engineering Materials: Bricks–stones–sand–cement–concrete–steel sections.

UNIT II: BUILDING COMPONENTS AND STRUCTURES 9

Foundations: Types, Bearing capacity– Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring –plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams–Basics of Interior Design and Landscaping.

B– MECHANICAL ENGINEERING

UNIT III: FUNDAMENTALS OF ENGINEERING MECHANICS 9

Statics –Basics Concepts, Fundamental principles & concepts: Newton's laws, gravitation, force, couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, 3-D statics.

UNIT IV: BASIC CONCEPTS OF THERMAL ENGINEERING 9

Introduction to IC Engines, Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles, Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants, Principle of vapour compression and absorption system.

UNIT V: BASIC MANUFACTURING PROCESSES 9

Foundry-Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting. Metal fusion welding processes- Oxyfuel gas welding – Arc welding processes. Additive Manufacturing-3D Printing.

TOTAL: 45 HOURS

TEXT BOOKS

1. Shanmugam G and Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham S., "Basic Civil Engineering", DhanpatRai Publishing Co. (P)Ltd. (1999).

REFERENCES:

1. Seetharaman S.,"Basic Civil Engineering", Anuradha Agencies,(2005).
2. Venugopal K. and Prahu Raja V.,"Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,(2000).
3. Shantha KumarSRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai,(2000).

ME3101	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

OBJECTIVES

- To impart the fundamental knowledge of Engineering Graphics to the students in order to achieve a well-founded knowledge about the principles of Engineering Graphics.

Course Outcome		Cognitive Skill
CO-01	Students should able to understand the Use of drafting instruments, BIS conventions and specifications – Size, layout and folding of drawing sheets	U
CO-02	Students should able to learn Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations.	A
CO-03	Students should able to understand the Prisms, pyramids, cylinder and cone, axis perpendicular to any one reference plane. Axis parallel to both the planes	U
CO-04	Students should able to learn about Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view,	E
CO-05	Students should able to understand the Fundamental of projection along with classification, Projections from the pictorial view of the object	R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	M	M	M	M	M	M	M	L	M	S

CO-02	S	S	M	M	M	M	M	M	M	M	L	M	S
CO-03	S	S	M	M	M	M	M	M	M	M	L	M	S
CO-04	S	S	M	M	M	M	M	M	M	M	L	M	S
CO-05	S	M	M	M	M	M	M	M	M	M	L	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: INTRODUCTION **9**

Concepts and conventions: Use of drafting instruments, BIS conventions and specifications – Size, layout and folding of drawing sheets, Lettering and dimensioning. General principles of orthographic projection, First angle projection – Layout of views. **(Not for examination)**

General Plane Curves

Conic sections including the Rectangular Hyperbola (General method); Cycloid, Epicycloid, Hypocycloid and Involute.

Unit II: PROJECTION OF POINTS, LINES & PLANES **9**

Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Projection of planes- parallel to any one reference plane, perpendicular to any one reference plane, inclined to any one reference plane and inclined to both reference planes

Unit III: PROJECTION OF SOLIDS & SECTION OF SOLIDS **9**

Prisms, pyramids, cylinder and cone, axis perpendicular to any one reference plane. Axis parallel to both the planes. Axis inclined to any one reference plane.

Sectioning of solids- Prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane. Obtaining the true shape of section

Unit IV: DEVELOPMENT OF SURFACES & ISOMETRIC PROJECTION **9**

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

Unit V: ORTHOGRAPHIC PROJECTION & PERSPECTIVE PROJECTION **9**

Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view. Perspective Projection of Solids (Any one Method).

L: 45+P: 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, "*Engineering Graphics*", New Age International Publishers, 2007.
2. Luzadder W J, "*Fundamentals of Engineering Drawing*", Prentice Hall Book Co., New York, 1998

3. Bhat, N.D.& M. Panchal , *Engineering Drawing,* Charotar Publishing House,2008

REFERENCES:

1. Kumar M S, "*Engineering Graphics*", Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, "*Engineering Drawing Practices for Schools and Colleges* SP 46-2003", BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , *Engineering Drawing and Computer Graphics*, Pearson *Education,2008*

BE3171	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To make basic electrical connection
- To measure the electrical parameters
- To obtain the characteristics of Electron devices
- To verify the operation of logic gates.

Course Outcome		Cognitive Skill
CO-01	Study of Symbols, Cables and Earthing.	U,An
CO-02	Residential house wiring using switches, fuse, indicator, lamp and energy meter.	U,An
CO-03	Fluorescent lamp wiring.	U,An
CO-04	Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control	A,An
CO-05	Measurement of electrical quantities	A,An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	S	L	L	M	M	M	L	S	S	L
CO-02	S	S	M	L	L	M	S	S	L	S	S	L
CO-03	S	S	S	L	L	M	M	M	L	S	S	L

CO-04	S	S	S	L	L	M	M	S	L	S	S	L
CO-05	S	S	M	L	L	M	S	S	L	S	S	L

S-Strong, M-Medium,L-Low,N-Not relevant

1. **Electrical Engineering Lab**
   1 Study of Symbols, Cables and Earthing.
   2 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
   3 Fluorescent lamp wiring.
   4 Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control
   5 Measurement of electrical quantities – voltage, current, power & computation of power factor in RLC circuit.
   6 Measurement of energy using single phase energy meter.
   7 Fan Wiring.

2. **Electronics Engineering Lab**
   1. Study of Electronic components and equipments – Resistor, colour coding,
   2. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
   3. Characteristics of PN Junction diode.
   4. Characteristics of Zener diode.
   5. Voltage Regulator using Zener diode.
   6. Measurement of ripple factor of HWR and FWR.
   7. Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
   8. Generation of Clock Signal.
   9. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

TOTAL: 30 HOURS

BE3172	**BASIC CIVIL AND MECHANICAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic Engineering practices in Civil & Mechanical Engineering.

Course Outcome		**Cognitive Skill**
CO-01	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings.	U,An
CO-02	Study of pipe connections requirements for pumps and turbines.	U,An

CO-03	Preparation of plumbing line sketches for water supply and sewage works.	U,An
CO-04	Preparation of arc welding of butt joints, lap joints and tee joints.	A,An
CO-05	Demonstration on foundry, fitting and sheet metal exercises.	A,An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	M	L	M	M	M	L	S	S	L
CO-02	S	S	S	L	L	M	S	S	L	S	S	L
CO-03	S	S	S	M	L	S	M	M	L	S	S	L
CO-04	S	S	M	L	S	M	M	S	L	S	S	L
CO-05	S	S	S	L	S	M	S	S	L	S	S	L

S-Strong, M-Medium, L-Low, N-Not relevant

I CIVIL ENGINEERING PRACTICE

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:
    i. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE

Welding:

Preparation of arc welding of butt joints, lap joints and tee joints.

Basic Machining:

Simple Turning and Taperturning

Dynamics:

Experiment using Gyroscope/Four bar link mechanism.

Demonstration on:

(a) Demonstration on foundry, fitting and sheet metal exercises.

(b) Demonstration on the working principle of two stroke and four stroke I.C. engines.

TOTAL: 30 HOURS

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3201	Engineering Mathematics III	3	1	0	4
2.	EE3210	Electrical Machines	3	0	0	3
3.	EI3201	Circuit Theory	3	0	0	3
4.	EI3202	Communication Engineering	3	0	0	3
5.	EI3203	Electronic Devices and Circuits	3	0	0	3
6.	EI3204	Measurements and Instrumentation	3	0	0	3
PRACTICAL						
7.	EE3278	Electrical Machines Laboratory	0	0	2	1
8.	EI3271	Electronic Devices and Circuits Laboratory	0	0	2	1
9.	EI3272	Measurements and Instrumentation Laboratory	0	0	2	1
TOTAL			**18**	**1**	**6**	**22**

MA3201	ENGINEERING MATHEMATICS-III	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop the skill of the students in the areas of boundary value problems and Transform techniques. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies and research.

Course Outcome		Cognitive Skill
CO-01	Recognize a Partial Differential Equation and formulate a Partial Differential Equation from a given equation. Solve linear Partial Differential Equation of both first and second order using various methods.	R, U, A, E
CO-02	Derive a Fourier series expansion for a given periodic function by evaluating Fourier coefficient and expand Fourier cosine and Sine series for given function. Also find the Fourier series expansion for a given set of numerical values by applying harmonic analysis..	R, U, A, E
CO-03	Classify the second order Partial Differential Equation and solve second order Partial Differential Equations such as wave equation, heat equation and Laplace equation with boundary and initial conditions applying Fourier series expansion.	R, U, A, E
CO-04	Know fundamental and mathematical properties of Fourier transform. Calculate the Fourier transform of a given function and inverse Fourier transform of function. Know the applications of Parseval's and convolution theorem.	R, U, A, E
CO-05	Understand the characteristics and properties of Z-transform. Compute Z-transform of simple functions and inverse z transform of given functions and apply Z-transform for solving difference equations.	R, U, A, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	L	M	M	M	M	L	M	M	M	M
CO-02	S	S	L	M	M	M	M	L	M	M	M	M
CO-03	S	S	L	M	M	M	M	L	M	M	M	M
CO-04	S	S	L	M	M	M	M	L	M	M	M	M

CO-05	S	S	L	M	M	M	M	L	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS 9

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of Clairaut's equations – Lagrange's linear equation –Homogeneous linear partial differential equations of second order with constant coefficients.

UNIT II: FOURIER SERIES 9

Dirichlet's conditions – Fourier series – Change of interval - Odd and Even functions – Half range sine and cosine series – Parseval's identity – Harmonic Analysis.

UNIT III: BOUNDARY VALUE PROBLEMS 9

Classification of second order linear partial differential equations – One dimensional wave and heat equations – Assumptions – Fourier series solution – Steady state solution of two dimensional heat equation (insulated edges excluded) – Fourier series solution in Cartesian co-ordinates.

UNIT IV: FOURIER TRANSFORMS 9

Statement and meaning of Fourier integral theorem – Fourier transform — Properties - Inverse Fourier transform – Fourier Sine and Cosine transforms – Inverse sine and cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V: Z-TRANSFORMS 9

Z- transform – Elementary properties – convolution theorem-Inverse Z-transform –Partial fraction Method, Inversion integral method and Convolution – Initial and Final value theorems – Formation of difference equations – Solution of difference equations using Z-transform.

L: 45 + T: 15 = TOTAL 60 HOURS

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 40th Edition, Khanna Publishers, Delhi, 2011.

REFERENCES:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, Inc., USA, 2011.
2. Kandasamy P, Thilagavathy K, and Gunavathy K., "Engineering Mathematics, Volume III", First Edition, S.Chand& Company Ltd., New Delhi.
3. Veerarajan T., "Engineering Mathematics(for Semester III), Third Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi 2007.
4. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Seventh Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2009.

EE3210	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose the students to the concepts of various types of electrical machines.
- To impart knowledge on:
    a. Constructional details, principle of operation, performance, starters and testing of D.C. machines.
    b. Constructional details, principle of operation and performance of transformers.
    c. Constructional details, principle of operation and performance of induction motors and synchronous machines.

Course Outcome		Cognitive Skill
CO-01	Remember the construction and working of any electrical DC machines and transformer under load and unload condition.	R
CO-02	Understand the principle of operation and performance of DC machines and transformer.	U
CO-03	Apply various controls and analyse the responses of DC machine and transformer.	A
CO-04	Troubleshoot the operation of DC machine and transformer.	A
CO-05	Calculate load of DC machine and transformer for a given application and select the suitable DC machine.	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	M	L	L	L	L	N	L	N	L	N
CO-02	M	M	M	L	L	L	L	N	L	N	L	N
CO-03	M	M	M	L	L	L	L	N	L	N	L	N
CO-04	M	M	M	L	L	L	L	N	L	N	L	N
CO-05	M	L	S	M	L	L	L	N	L	N	L	N

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: D.C. GENERATORS **9**

Constructional and working principle -methods of excitation – Separately and Self excited generator-armature winding: lap, wave winding and their uses. EMF generation – emf equation-types-characteristics of DC Generators: critical resistance, critical speed - armature reaction – commutation.

UNIT II: D.C. MOTORS **9**

Constructional and working principle - characteristics of motors –power stage and efficiency– Starting and Speed control.Applications. Testing: Brake test, Swinburne's test, Hopkinson's test.

UNIT III: TRANSFORMERS **9**

Constructional details – Principle of operation – emf equation – Transformation ratio – Transformer on no load – Parameters referred to HV/LV windings – Equivalent circuit – Transformer on load – Regulation - Testing – Load test, open circuit and short circuit tests.

UNIT IV: ASYNCHRONOUS MACHINE **9**

Three-phase induction motors-construction-working principle-classification – Equivalent circuit - Performance calculation – Starting and speed control – Single-phase induction motors (only qualitative treatment).

UNIT V: SYNCHRONOUS MACHINE **9**

Synchronous generator (Alternator)-Construction-working principle –classification-Winding: types – Induced emf – Voltage regulation; Synchronous motor-types-construction-principle of operation-methods of starting.

TOTAL: 45 HOURS

TEXT BOOKS:

1. D.P.Kothari and I.J.Nagrath, 'Basic Electrical Engineering', Tata McGraw Hill Publishingcompany Ltd., second edition, 2017.
2. C.L. Wadhwa, 'Electrical Power Systems', Wiley Eastern Ltd., India, 1985.

REFERENCES:

1. S.K.Bhattacharya, 'Electrical Machines', Tata McGraw Hill Publishing company Ltd, second edition, 1998.
2. V.K.Mehta and Rohit Mehta, 'Principles of Power System', S.Chand and Company Ltd, third edition, 2003.

EI3201	CIRCUIT THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To develop an understanding of the fundamental laws and elements of electrical circuits.
- To impart knowledge on solving circuits using network theorems.
- To develop the ability to apply circuit analysis to DC and AC circuits.
- To understand transient and steady-state response of RLC circuits.
- To introduce the phenomenon of resonance in coupled circuits.

Course Outcome		Cognitive Skill
CO-01	Learn about the basics of electrical circuits, basic laws, analysis of node voltage and mesh currents	R, U
CO-02	Learn about source transformations, various network theorems for circuit analysis	A
CO-03	Gain knowledge about transient responses for DC and AC input and z, y, h parameters	An
CO-04	Develop skills in understanding three phase circuits and power measurements	E
CO-05	Gain knowledge about resonance and tuned coupled circuits.	S

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	M	S	M	M	L	M	S	M	L	L
CO-02	S	M	M	S	L	S	S	M	M	L	S	M
CO-03	M	M	L	M	M	L	M	L	M	M	S	L
CO-04	S	M	M	L	S	M	S	L	M	L	M	S
CO-05	M	S	L	M	M	L	S	M	S	L	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: BASIC CIRCUIT ANALYSIS **9**

Networks: sources, elements, types - Basic principles & laws of circuits: Ohm's law, Kirchoff's laws: KCL, KVL - Source transformation - Mesh & nodal analysis of network containing independent and dependent sources - Super mesh & super nodal analysis.

UNIT II: NETWORK THEOREMS **9**

Network reduction: voltage and current division - Star delta conversions - Thevenins theorem – Norton's theorem – Superposition theorem - Maximum power transfer theorem - Reciprocity theorem - Millman's theorem –Substitution theorem.

UNIT III: TRANSIENT RESPONSE ANALYSIS 9

R, L and C elements – Transformation of basic circuits & signals in S-domain- poles, zeros- Significance of time constant - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input – Characterization of two port networks in terms of Z, Y and h parameters.

UNIT IV: THREE PHASE CIRCUITS 9

A.C. circuits – Average and RMS value - Phasor diagram – Power, Power factor and Energy - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V: RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance–Coefficient of coupling –Tuned circuits – Single and double tuned circuits.

TOTAL: 45 HOURS

TEXT BOOKS:

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill Publishers Edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.

REFERENCES:

1. S. R. Paranjothi, Electric Circuit Analysis, New Age International Publishers, 1996.
2. Joseph A. Edminister, MahmoodNahri, "Electric Circuits", Schaum's Series, McGrawHill, New Delhi, 2010.
3. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

EI3202	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of analog modulation techniques.
- To learn the basics of satellite and optical fiber communication systems.
- To understand the applications of wireless communication systems.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the basic concepts of analog modulation techniques.	R
CO-02	Ability to understand the basic concepts of digital modulation techniques.	R

CO-03	Ability to acquire knowledge about optical fiber communication.	U
CO-04	Ability to describe the importance of satellite communication.	A
CO-05	Ability to know the importance of applications of wireless communication.	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	L	M	M	M	L	M	L	M	M
CO-02	S	S	M	S	M	M	M	L	M	L	S	S
CO-03	S	S	M	S	M	M	M	L	M	L	S	S
CO-04	S	S	M	S	M	M	S	L	M	L	S	S
CO-05	S	S	M	M	M	M	S	L	M	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: ANALOG MODULATION **9**

Introduction to modulation- Need for modulation- Amplitude modulation and demodulation, frequency modulation and demodulation, super heterodyne radio receiver. Frequency division multiplexing- Time division multiplexing.

UNIT II: DIGITAL MODULATION **9**

Pulse modulation- PAM, PCM, Digital modulation: digital T-carrier system, digital radio system Amplitude, frequency and phase shift keying, Quadrature Phase Shift Key - Modulator and demodulator, bit error rate calculation.

UNIT III: OPTICAL FIBER COMMUNICATION **9**

Introduction to Optical fiber communication -Ray theory - Principles of light propagation through fiber- Different types of fibers- Optical sources- Optical detectors. Optical Networks- SONET/SDH- Optical CDMA.

UNIT IV: SATELLITE COMMUNICATION **9**

Introduction to satellite Communication- Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Spread Spectrum communication- Satellite applications.

UNIT V: APPLICATIONS OF WIRELESS COMMUNICATION 9

Wireless Networking, Wi MAX, Wireless devices, ZigBee, Examples of air Interface standard: GSM, IS-95 CDMA, Bluetooth Technology, Types of Wireless Data Transmission: Wireless Router, Wireless adapters, Microwave, Infrared. Types of Wireless Devices: Radio, Wireless Phones.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Wayne Tomasi, Electronic Communication Systems, Pearson Education, 5th Edition, 2008.
2. Roy Blake, Electronic Communication Systems, Thomson Delmar, 2nd Edition, 2002.
3. K. Daniel Wong, Fundamentals of Wireless Communication Engineering Technologies, John Wiley, 2012.

REFERENCES:

1. William Schweber, Electronic Communication Systems, Prentice Hall of India, 2002.
2. G. Kennedy, Electronic Communication Systems, McGraw Hill, 6th edition, 2017.
3. Miller, Modern Electronic Communication, Prentice Hall of India, 2003.
4. Simon Haykins, Communication systems, John Wiley, 5thEdition, 2009
5. J.M.Senior, Optical Fibre Communication-Principles and Practice, PHI, 3rd edition, 2009.
6. Dennis Roddy, Satellite Communication, McGraw Hill International, 4th Edition, 2017.

EI3203	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students to:

- Be familiar with the structure of semiconductor devices.
- Be exposed to the operation and applications of electronic devices.
- Explore the applications of wave shaping circuits, oscillators and rectifiers.

Course Outcome		Cognitive Skill
CO-01	Explore the characteristics of semiconductor devices.	R
CO-02	Train the students to work with transistors.	U
CO-03	To impart knowledge about the function of amplifiers.	A
CO-04	Acquire knowledge on wave shaping circuits and oscillators.	A
CO-05	Understand the concepts of rectifiers and power supplies.	An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	L	M	N	S	L	M	N	S	N	M	L	N
CO-03	N	S	L	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: SEMICONDUCTOR DEVICES 9

Semiconductors- Working and description of PN diode– Varactor Diode –Avalanche and Zener Breakdown – Zener diode –Photo diode – Photo voltaic cell – Light emitting diode – Liquid crystal display – Light dependant resistor.

UNIT II: TRANSISTORS 9

Principle of transistor action – Cut off, Active and saturation regions of a transistor – CE,CB,CC Configurations –Transistor as a switch – Use of a heat sink – Field effect transistor – theory of operation–MOSFET –Working and V-I Characteristics – Depletion and enhancement types – Working and V-I characteristics of UJT – SCR.

UNIT III: AMPLIFIERS 9

Classification of amplifiers– Distortion in amplifiers– frequency response of an amplifier– operation of class A Power amplifier– push-pull amplifier–Class B amplifier, class C amplifiers –single tuned and double tuned amplifier - stagger tuned amplifier.

UNIT IV: WAVE SHAPING CIRCUITS & OSCILLATORS 9

Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits; Clipping circuits- Positive, negative and biased clipper; Clamping circuits - Positive, negative and biased clamper.

Classification of oscillators – Barkhausen criterion - Advantages of negative feedback– voltage/current, series, Shunt feedback– positive feedback operation and analysis of RC phase shift, Wien bridge, Hartley and colpitts oscillators.

UNIT V: RECTIFIERS & POWER SUPPLIES 9

Single –phase, half-wave and full-wave rectifiers – Bridge rectifiers – Ripple factor, rectification efficiency, Transformer utilisation factor and regulation – Performance characteristics of rectifiers with filters – Regulated power supply– switched mode power supplies.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson, 2015.
2. David A. Bell,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
3. K.Gopakumar, Design and Analysis of Electronic Circuits, Phasor Books, Kollam, 2013.
4. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
5. Thomas L.Floyd, "Electronic Devices" Conventional current version, Pearson Prentice Hall, 10th Edition, 2017.

REFERENCES:

1. Millman and Halkias, Electronic devices and Circuits, Tata McGraw Hill International, 4thEdition 1994.
2. G.K.Mithal, Electronic Devices and Circuits, Khanna Publishers, 1999.
3. Rashid, "Micro Electronic Circuits" Thomson Publications, 1999.
4. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
5. Salivahanan Electronic devices and Circuits, second edition, Tata McGraw Hill International, 2011.

EI3204	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To understand and learn the different principles and instruments adopted for measurement of current, voltage, power, energy etc.
- To acquire knowledge on measurement of resistance, inductance & capacitance using AC and DC bridges.
- To solve problems in the various electrical parameter measurements.
- To study the storage of digital signal and analyzers for analyzing digital signal to provide with meaningful information.

Course Outcome		Cognitive Skill
CO-01	Identify various types of electrical instruments suitable for measurement of current and voltage.	R
CO-02	Identify various types of electrical instruments suitable for measuring power and energy.	R
CO-03	Understand the types of DC and AC bridges and their applications.	U

CO-04	Understand the construction, working principle and types of oscilloscopes and signal generators.	U, A
CO-05	Comprehend different types of recording devices and analyzers, their construction and operation.	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	L	L	M	L	M	N	N	N
CO-02	M	S	L	M	S	L	L	N	L	N	N	L
CO-03	L	S	M	S	M	L	N	M	N	M	L	N
CO-04	S	M	L	S	N	S	S	L	N	N	N	M
CO-05	S	M	L	N	S	N	S	M	L	M	N	N

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: MEASUREMENT OF CURRENT AND VOLTAGE 9

Introduction to measurements- Electrical measurements– Classification of analog instruments– Galvanometers– vibration, tangent and d'Arsonval type. Principle of operation, construction, sources of errors and compensations in PMMC– Moving iron– Dynamometer and induction type instruments. Extension of ranges and calibration of ammeters & voltmeters.

UNIT II: MEASUREMENT OF POWER AND ENERGY 9

Power measurement – Voltmeter ammeter method, Electrodynamic wattmeter – Theory, errors and compensation methods – Low power factor wattmeter – Power measurement in poly-phase systems-Energy measurement – Single phase and poly phase induction type energy meter – theory and adjustments –DC energy meter – Testing of energy meters – Calibration of wattmeter and energy meter.

UNIT III: DC & AC BRIDGES 9

Low Resistance: Kelvin's double bridge and Ductor Ohmmeter method - Medium Resistance: Voltmeter Ammeter method – Substitution method – Wheatstone bridge method -High Resistance: Megger.

Introduction to A.C. bridges Sources and Detectors in A.C. bridges. Measurement of Self Inductance: Maxwell's bridge, Hay’s bridge and Anderson's bridge. Measurement of Mutual Inductance: Heaviside M.I. bridge – Measurement of Capacitance: Schering's bridge, Wien's bridge.

UNIT IV: OSCILLOSCOPES & SIGNAL GENERATORS 9

CRO – General purpose and advanced type – Sampling and storage scopes- Principle, measurements & operation of digital storage oscilloscope – Signal and function generators – Noise generators – Pulse and square wave generator –Sweep generator.

UNIT V: RECORDING DEVICES AND WAVE ANALYSERS 9

Signal recorders – X-Y recorder – Magnetic tape recorders – Digital recording and data loggers – Basic wave analyzer – Frequency selective and heterodyne spectrum analyzer – Fundamental type harmonic distortion analyzers – Distortion factor meter – Q meter.

TOTAL: 45 HOURS

TEXT BOOKS:

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, DhanpatRai and Co, New Delhi, 19th edition, 2016.
2. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K.Kataria& Sons, Delhi, 14th edition, 2014, Reprint 2020.
3. Golding. E. W, and Widdis F.C, "Electrical Measurements and Measuring" Instruments", 5th Edition, A. H. Wheeler & Company, 2011.

REFERENCES:

1. Kalsi H.S, Electronic Instrumentation and Measurements, McGraw-Hill Education, New Delhi, 4th edition, 2019.
2. Copper. W.D and Helfrick.. A.D, "Modern Electronic Instrumentation and Measurement Techniques", 5th Edition, Prentice Hall of India, 2003.

EE3278	ELECTRICAL MACHINES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To enable the students to understand the behaviour of semiconductor devices based on experimentation.

Course Outcome		Cognitive Skill
CO-01	Analyze the Efficiency of DC generator by different methodologies	An
CO-02	Analyze performance the DC Motor	An
CO-03	Apply the different method to control the speed of DC motor	A
CO-04	Understand the various transformer connection	U
CO-05	Analyze performance of transformer by different method	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	M	L	L	L	N	N	L	N	L	N
CO-02	M	L	M	L	L	L	N	N	L	N	L	N
CO-03	M	L	M	L	L	L	N	N	L	N	L	N
CO-04	M	L	M	L	L	L	N	N	L	N	L	N
CO-05	M	L	S	M	L	L	N	N	L	N	L	N

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS: (any 10)

1. Open circuit and load characteristics of separately excited D.C. generator.
2. Open circuit and load characteristics of self-excited D.C. generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Speed control of D.C. shunt motor.
6. Load test on single phase transformer.
7. Open circuit and short circuit test on single phase transformer
8. Load test on single-phase induction motor.
9. No load and blocked rotor tests on single phase induction motor.
10. Load test on three phase induction motor.
11. Study of D.C. motor and induction motor starters.

TOTAL: 30 HOURS

EI3271	**ELECTRONIC DEVICES AND CIRCUITS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To enable the students to understand the behaviour of semiconductor devices based on experimentation.

Course Outcome		**Cognitive Skill**
CO-01	To train the students with digital electronics diodes, transistors.	U
CO-02	To work with the characteristics circuits of PN junction diode and zener diode.	U

CO-03	To train the students to know the CB, CE, CC configurations.	A
CO-04	To train the students with the implementation of rectifiers.	An
CO-05	Ability to gain knowledge about the purpose of transducers.	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	L	M	N	S	L	M	N	S	N	M	L	N
CO-03	N	S	L	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Characteristics of Zener diode and study of simple voltage regulator circuits.
2. Characteristics of a NPN Transistor under common emitter, common collector and common base configurations.
3. Characteristics of JFET (Draw the equivalent circuit)
4. Characteristics of UJT and generation of saw tooth waveforms.
5. Characteristics and application of SCR.
6. Design and Frequency response characteristics of a Common Emitter amplifier.
7. Single Phase half-wave rectifier with and without inductive and capacitive filters
8. Single Phase full wave rectifier with and without inductive and capacitive filters
9. Design of low pass and high pass filters.
10. Design and testing of RC phase shift, LC oscillators

TOTAL: 30 HOURS

EI3272	**MEASUREMENTS AND INSTRUMENTATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types bridges.
- To make the students to calibrate the electrical instruments.

Course Outcome		Cognitive Skill
CO-01	Understand the concepts of transient analysis.	U
CO-02	Acquire practical skills on analyzing random errors.	A
CO-03	Gain knowledge about the principle of operation and measurement of different parameters using of different types of bridges.	An
CO-04	Acquire knowledge of analyzing different signal conditioning units.	E
CO-05	Ability to calibrate different measuring instruments.	S

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	S	M	S	S	S	S	L	L	S
CO-02	S	M	S	S	M	S	S	S	S	L	L	S
CO-03	S	M	S	S	M	S	S	S	S	L	L	S
CO-04	S	M	S	S	M	S	S	S	S	L	L	S
CO-05	S	M	S	S	M	S	S	S	S	L	L	S

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Study of RL, RC and RLC transients.
2. Statistical analysis of random errors.
3. Measurement of frequency and phase using CRO
4. Measurement of low resistance using Kelvin's Double Bridge.
5. Measurement of medium resistance using Wheatstone's bridge.
6. Measurement of Capacitance using Schering's Bridge.
7. Measurement of Inductance using Anderson's Bridge.
8. Calibration of ammeter using potentiometer
9. Calibration of voltmeter using potentiometer
10. Calibration of wattmeter.
11. Calibration of single-phase energy meter.
12. Design of V/I, I/V converters.

TOTAL: 30 HOURS

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3203	Numerical Methods	2	1	0	3
2.	BS3201	Environmental Studies	2	0	0	2
3.	EI3205	Digital Logic Circuits	3	0	0	3
4.	EI3206	Linear Integrated Circuits	3	0	0	3
5.	EI3207	Transducer Engineering	3	0	0	3
6.	ME3210	Thermodynamics and Fluid Mechanics	3	0	0	3
PRACTICAL						
7.	EI3273	Transducer Engineering Laboratory	0	0	2	1
8.	EI3274	Linear and Digital Integrated Circuits Laboratory	0	0	2	1
9.	ME3278	Thermodynamics and Fluid Mechanics Laboratory	0	0	2	1
10.	EI32P1	Summer Internship-I	0	0	0	2
TOTAL			**16**	**1**	**6**	**22**

MA3203	**NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

OBJECTIVES

The course should enable the students:

- To have the basic concepts in numerical methods and find the solutions of large system of linear equations where analytical methods fail to give solution. To gain the ability to solve engineering problems characterized in the form of non- linear ordinary differential equation or partial differential equation.

Course Outcome		Cognitive Skill
CO-01	Understand the fundamental theorem and compute the solution of non linear equations using Newton's method and fixed point iteration method. To solve the linear equations using direct and indirect methods.	R, U, A, E
CO-02	Apply interpolation for equal intervals using Newton's forward and backward formula and using Newton's divided difference formula for unequal intervals and Lagrange's formula.	R, U, A, E
CO-03	Discuss about numerical differentiation and integration. Apply Newton's forward and backward formula, Lagrange's formula and divided difference formula. To evaluate the integrals by using Trapezoidal rule and Simpson's rule.	R, U, A, E
CO-04	Understand the first order differential equation. Solve the first order differential equation by using single step method. Apply multi step method to find the solution of first order differential equation.	R, U, A, E
CO-05	Study about classification of partial differential equations. Find the finite difference solution of one dimensional heat equation and wave equation. To solve two dimensional Laplace and poisson equations.	R, U, A, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	M	M	M	L	M	S	M	S	M
CO-02	S	M	S	M	S	M	M	M	M	S	S	L
CO-03	S	S	M	S	M	M	M	S	L	M	M	M
CO-04	S	M	S	M	S	L	M	M	M	L	S	L
CO-05	S	M	M	M	M	M	L	L	M	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: SOLUTION OF EQUATIONS **9**

Solution of non-linear equations– Newton Raphsonmethod, Fixed point iteration method– Solution of linear system of Equations-Direct methods: Gaussian elimination and Gauss-Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods.

UNIT II: INTERPOLATION **9**

Forward and Backward Differences – Interpolation for equal intervals- Newton's forward and Backward formula- Interpolation for unequal intervals-Newton's divided difference and Lagrange's formula.

UNIT III: NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Numerical differentiation using Newton's Forward, Backward, Newton's divided difference and Lagrange's formula – Numerical integration by Trapezoidal, Simpson's 1/3 and 3/8 rules– Gaussian Quadrature -Two and three point formulae.

UNIT IV: INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION 9

Solution of first order differential equations -Single step Methods: Taylor Series, Euler, Modified Euler methods and Fourth order Runge-Kutta method. Multi-step methods: Milne's and Adam's Predictor and Corrector methods.

UNIT V: NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEMS 9

Classification of partial differential equation- Finite difference solution of one dimensional heat equation by implicit and explicit methods– One dimensional wave equation and two dimensional Laplace and Poisson equations.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Venkatraman M.K, "Numerical Methods" Fifth Edition, National Pub.Company, Chennai 2005.

REFERENCES:

1. Kandasamy, P.Thilakavathy, K and Gunavathy, K. "Numerical Methods" Second Edition, 2008 S.Chand and Co. New Delhi.
2. Scarborough, James B, "Numerical Mathematical Analysis"Oxford Book Company 1930
3. Balagurusamy, E., "Numerical Methods", First Edition, Tata McGraw-Hill Pub. Co. Ltd., New Delhi. 2009
4. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.

BS3201	ENVIRONMENTAL STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES

- To understand the basic concepts in environmental science
- To gain the knowledge about structure and natural cycles of environment.
- To get an idea about control methods of pollution.
- To know the information about conservation methods of forest and wild life.

Course Outcome		Cognitive Skill
CO-01	Student will be able to demonstrate a general understanding of interdisciplinary nature of environmental uses and able to characterize natural resources.	U, A, An
CO-02	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to	R, E ,A

	reduce them.	
CO-03	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, U, A
CO-04	Students will be able to understand the effects of human population and know about the awareness programme.	R, A, E
CO-05	Students apply systems concept and methodologies to analyse and understand interaction between social and environmental process.	R, A, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	M	M	S	S	S	M	S	S	M
CO-02	M	M	S	M	S	S	S	S	M	S	S	M
CO-03	M	M	S	M	S	S	S	S	M	S	S	M
CO-04	M	M	S	S	M	S	S	S	M	S	S	M
CO-05	M	M	S	S	L	S	M	S	M	S	S	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: NATURE OF ENVIRONMENT STUDIES AND NATURAL RESOURCES 9

Environment studies- definition – scope and importance- need for public awareness-Methods to create environmental awareness- Natural resources- Forest resources- energy resources- food resources- water resources – land resources - mineral resources.

UNIT II: ECO SYSTEMS AND BIO-DIVERSITY 9

Concept and component of eco systems- producer, consumer, decomposer- structure and function of eco system- food chain and food web- energy flow model- aquatic eco systemforest eco system- desert eco system- pyramid of biomass- ocean eco system- grass land eco system-Bio diversity in India- value of bio diversity- biodiversity threatens- biodiversity protection- In-situ and Ex-situ conservation.

UNIT III: ENVIRONMENTAL POLLUTION 9

Meaning of environmental pollution- air pollution- acid rain – global warming- water pollution-water pollution control- soil pollution- urban waste and soil pollution- marine pollution- noise

pollution- thermal pollution- solid and hazardous waste management- waste disposal methods- solid waste and India- natural disaster and disaster management.

UNIT IV: HUMAN POPULATION AND ENVIRONMENT 9

Population growth- distribution of population- factors affecting variation in population theories of population- future of human population- family welfare programme- HIV and AIDS- environment and human health- human rights- value education- women and child welfare.

UNIT V: SOCIAL ISSUES AND THE ENVIRONMENT 9

Unsustainable to sustainable development- sustainable development in India- water conservation, watershed management and water harvesting- environmental ethics- role of engineer in environmental protection.

TOTAL: 30 HOURS

TEXT BOOKS

1. Cunnigham & Saigo: 'Environmental science: A global concern' 4th Ed.W.c. Brown Publishers. USA. 1997
2. Chauhan A.S, 'Environmental studies' 2nd revised ed.2004, Jain Brother Publishers, New Delhi

REFERENCES:

1. Benny Joseph: 'Environmental Science and Engineering', 2006, Tata McGraw- Hill Publication.
2. Siddique K.A.: Elements of Ecology and Environmental Pollution, 1st Ed. 2002, Kushal Publication, Varanasi. M

EI3205	DIGITAL LOGIC CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To study various number systems and simplify the logical expressions using Boolean functions.
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs.

Course Outcome		Cognitive Skill
CO-01	Explain the elements of digital system abstractions such as digital representations of information, digital logic and codes.	R, U
CO-02	Ability to understand and simplify combinational circuits	R, U
CO-03	Design synchronous sequential logic circuits using the basic building blocks like flip-flops	A

CO-04	Design asynchronous sequential logic circuits using the basic building blocks and PLDs.	A
CO-05	Ability to understand various logic families and its characteristics.	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	N	N	L	M	L	L	L	S	L	L	M
CO-02	N	S	N	L	L	M	L	L	L	S	L	S
CO-03	L	L	N	S	L	L	M	L	L	L	M	S
CO-04	S	L	S	N	L	L	L	S	M	M	S	S
CO-05	S	L	L	M	L	L	L	L	M	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: NUMBER SYSTEMS AND CODES 9

Binary and hexadecimal number systems; Methods of base conversions; Binary and hexadecimal arithmetic; Representation of signed numbers; Fixed and floating point numbers; Binary coded decimal codes; Gray codes; Excess 3 code. Alphanumeric codes: ASCII.

UNIT II: COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms – K-map representations – minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers – code converters, adders, subtractors, encoders and decoders.

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops – level triggering and edge triggering – counters – asynchronous and synchronous type – modulo counters – shift registers – design of synchronous sequential circuits – Moore and Melay models – counters – state diagram, state reduction, state assignment.

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES 9

Asynchronous sequential logic circuits –Transition table, flow table – race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits – introduction to Programmable Logic Devices: PROM – PLA –PAL, CPLD – FPGA.

UNIT V: LOGIC FAMILIES AND ITS CHARACTERISTICS 9

TTL, ECL, CMOS - Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation; Structure and operations of TTL and CMOS gates; NAND in TTL and CMOS, NAND and NOR in CMOS.

TOTAL: 45 HOURS

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.
4. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.

REFERENCES:

1. W.H. Gothmann, "Digital Electronics – An introduction to theory and practice", PHI, 2nd edition, 2006.
2. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
3. Thomas L. Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. D. P. Kothari, J. S. Dhillon, 'Digital Circuits and Design',Pearson Education, 2016.

EI3206	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To study the IC fabrication procedure.
- To study the characteristics; realize circuits; design for signal analysis using Op-amp ICs.
- To understand the basic concepts of operational amplifier and its various applications.

Course Outcome		Cognitive Skill
CO-01	Understand manufacturing process of ICs and analyze how monolithic components are being developed.	R, U
CO-02	Identify different configurations, analyze the parameters and observe the frequency response of operational amplifiers.	U
CO-03	Understand & demonstrate different applications of operational amplifiers.	A
CO-04	Comprehend & differentiate the working principle of various data converters.	An

CO-05	Demonstrate the applications of waveform generators, timers and voltage regulators.	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	L	L	M	L	M	N	N	N
CO-02	M	S	L	M	S	L	L	N	L	N	N	L
CO-03	L	S	M	S	M	L	N	M	N	M	L	N
CO-04	S	M	L	S	N	S	S	L	N	N	N	M
CO-05	S	M	L	N	S	N	S	M	L	M	N	N

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: IC FABRICATION **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities – Realisation of monolithic ICs and packaging – Fabrication of diodes, capacitance, resistance.

UNIT II: CHARACTERISTICS OF OPAMP **9**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics – differential amplifier – frequency response of OP-AMP – Basic applications of op-amp – Inverting and Non-Inverting Amplifiers – V/I & I/V converters – summer, differentiator and integrator.

UNIT III: APPLICATIONS OF OPAMP **9**

Instrumentation amplifier – Log and Antilog Amplifiers – first and second order active filters – comparators – multivibrators – waveform generators – clippers – clampers – peak detector – S/H circuit.

UNIT IV: DATA CONVERTERS **9**

Digital to analog converters – basic concepts –analog switches – types – Weighted resistor – R-2R ladder DAC –Analog to Digital converter – basic concepts – Types – Flash – Counter – Successive approximation – Dual slope – ADC and DAC specifications.

UNIT V: VOLTAGE REGULATORS AND TIMERS **9**

Voltage regulators – Fixed voltage regulators – Adjustable voltage regulators – switching regulator – 723 general purpose voltage regulator – IC555 Timer – Timer functional diagram – Monostable and Astable operation – Schmitt trigger – Voltage Controlled Oscillator- Phase locked loop - applications.

TOTAL: 45 HOURS

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, SheilB.Jani, 'Linear Integrated Circuits', II Edition, New Age, 2018.
3. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', IV Edition, Pearson Education, 2021.

REFERENCES:

1. Fiore,"Opamps& Linear Integrated Circuits Concepts & Applications", Cengage, 2010.
2. Floyd, Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C. Halkias, 'Integrated Electronics - Analog and Digital Circuits System', Tata McGraw Hill, 2nd edition, 2017.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', PHI Learning, 6th edition, 2012.

EI3207	TRANSDUCERS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To know the methods of measurement, classification of transducers and to analyze error.
- To understand the behaviour of transducers under static and dynamic conditions and hence to model the transducer.
- To get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

Course Outcome		Cognitive Skill
CO-01	Ability to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.	R, U
CO-02	Ability to model and analyze transducers.	R, U
CO-03	Ability to choose the appropriate sensor/transducer for a given application.	U
CO-04	Ability to gain knowledge about the static and dynamic characteristics of transducers.	U, A
CO-05	Ability to understand fiber optic sensor and applications.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	L	M	N	S	L	M	N	S	N	M	L	N
CO-03	N	S	L	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers– Introduction to Signal Conditioning Circuits.

UNIT II: CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range – Dynamic characteristics: Mathematical model of transducer, zero,first and second order transducers; Impulse, step, ramp and sinusoidal responses.

UNIT III: VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor, signal conditioning circuit, applications of RTD.

UNIT IV: VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:-Capacitive pressure sensor.

UNIT V: OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Introduction to smart sensors.

. **TOTAL: 45 HOURS**

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. A.K. Sawhney, 'A course in Electrical & Electronic Measurement and Instrumentation', DhanpatRai and Co (P) Ltd., 2004.
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.

REFERENCES:

1. Bela G. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
3. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
4. W. Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
5. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.

ME3210	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES

The course should enable the students:

- To expose the fundamentals of thermodynamics and to be able to use it in accounting for the bulk behaviour of the sample physical systems.
- To integrate the basic concepts into various thermal applications like IC engines, gas turbines, steam boiler, steam turbine, compressors, refrigeration and air conditioning.
- The applications of the conservation laws to flow through pipes are studied.

Course Outcome		Cognitive Skill
CO-01	Understanding the concepts such as conservation of mass, conservation of energy, work interaction, heat transfer and first law of thermodynamics.	U
CO-02	Identify closed and open systems and analyze related problems.	U
CO-03	Analyze the performance of gas and vapor power cycles and identify methods to improve thermodynamic performance.	U
CO-04	Understanding the concepts of conservation of mass, conservation of energy, basic hydrostatics, laws of Fluid mechanics.	R

CO-05	Find the dependent and independent parameters for a model of fluid flow.	R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	L	L	L	M	M	L	S	S	M
CO-02	L	S	M	L	M	L	L	M	L	M	L	S
CO-03	M	M	L	M	S	L	M	L	M	M	M	M
CO-04	S	M	L	L	M	M	L	M	L	M	S	M
CO-05	S	L	M	M	L	M	M	L	M	S	S	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Classical approach: Thermodynamic systems – Boundary - Control volume - System and surroundings – Universe – Properties - State-process – Cycle – Equilibrium - Work and heat transfer – Point and path functions - First law of thermodynamics for open and closed systems - First law applied to a control volume - SFEE equations [steady flow energy equation] - Second law of thermodynamics - Heat engines - Refrigerators and heat pumps - Carnot cycle - Carnot theorem - Clausius inequality - Concept of entropy - Principle of increase of entropy - Basic thermodynamic relations.

UNIT II: IC ENGINES AND GAS TURBINES 9

Air standard cycles: Otto, diesel and dual cycles and comparison of efficiency - Working Principle of four stroke and two stroke engines - Working principle of spark ignition and compression ignition engines - Applications of IC engines - Normal and abnormal combustion - Working principle of four stroke and two stroke engines - Working principle of spark ignition and compression ignition engines - Applications of IC engines. Open and closed cycle gas turbines – Ideal and actual cycles - Brayton cycle - Cycle with reheat, intercooling and regeneration – Applications of gas turbines for aviation and power generation.

UNIT III: STEAM BOILERS AND STEAM TURBINES 9

Formation of steam - Properties of steam – Use of steam tables and charts – Steam power cycle (Rankine) - Modern features of high-pressure boilers – Mountings and accessories – Testing of boilers. Steam turbines: Impulse and reaction principle – Velocity diagrams – Compounding and governing methods of steam turbines (qualitative treatment only) - Layout diagram and working principle of a steam power plant.

UNIT IV: BASIC CONCEPTS AND PROPERTIES OF FLUIDS: 9

Fluid – definition, distinction between solid and fluid - units and dimensions, properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - fluid statics - concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers.

UNIT V:FLUID KINEMATICS AND DYNAMICS 9

Fluid kinematics - flow visualization, lines of flow, types of flow, velocity field and acceleration, continuity equation (one and three dimensional differential forms) - equation of streamline, stream function, velocity potential function, circulation, flow net, fluid dynamics - equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube - dimensional analysis - Buckingham's theorem applications - similarity laws and models.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers , 2000
2. P.K. Nag, 'Basic and Applied Engineering Thermodynamics', Tata McGraw Hill, New Delhi, 2002.
3. B.K. Sachdeva, 'Fundamentals of Engineering Heat and Mass Transfer (SI Units)', New Age International (P) Limited, Chennai, 2003.
4. Streeter, V.L., and Wylie, E.B., Fluid Mechanics, McGraw-Hill, 2010.

REFERENCES:

1. Rudramoorthy, R., Thermal Engineering, Tata McGraw-Hill, New Delhi, 2003.
2. Kothandaraman, C.P., Domkundwar, S., and Domkundwar, A.V., A course in Thermal Engineering, DhanpatRai and Sons, Fifth edition, 2002.
3. Holman, J.P., Thermodynamics, McGraw-Hill, 1985.
4. Rogers, Engineering Thermodynamics, ELBS, 1992.
5. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw-Hill, New Delhi, 1994.
6. Sarkar, B.K., Thermal Engineering, Tata McGraw-Hill, New Delhi, 1998.1997.
7. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd, New Delhi, 7th edition, 2002.
8. Vasandani, V.P., Hydraulic Machines - Theory and Design, Khanna Publishers, 11th Edition 2010.
9. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi publications (P) Ltd, New Delhi, 9th edition,2010.

EI3273	TRANSDUCER ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students to analyze step response of RTD.

Course Outcome		Cognitive Skill
CO-01	Gain knowledge about the principle of operation and characteristics of different types of transducers.	A
CO-02	Acquire knowledge of analyzing different stages of signal conditioning units.	A
CO-03	Ability to interpret the results and draw meaningful conclusions.	A, An
CO-04	Ability to gain knowledge about the purpose of transducers.	E
CO-05	Ability to understand about the basics of pressure, temperature, flow and level measurement.	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	S	M	N	S	S	M	S	S	N	M	L	N
CO-03	S	S	S	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Signal conditioning characteristics of Strain gauge
2. Signal conditioning characteristics of Load cell
3. Characteristics of LVDT
4. Characteristics of Temperature Sensor (Thermistor/Thermocouple/RTD)
5. Step response of RTD and Thermocouple.
6. Characteristics of P/I and I/P converters.
7. Characteristics Hall effect transducer
8. Loading effect of Potentiometer
9. Characteristics of LDR
10. Photodiode, Phototransistor characteristics and study of light activated relay circuit.
11. Study of smart transducers

TOTAL: 30 HOURS

EI3274	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- Experiment test bench to learn design, testing and characterizing of circuit behaviour with digital and analog ICs.

Course Outcome		Cognitive Skill
CO-01	To understand and analyze, linear and digital electronic circuits.	U, An
CO-02	To design code converters and parity generators	A
CO-03	To design mux and demux circuits, counters, shift registers	A
CO-04	To design Application of Op-Amps	A
CO-05	To design and verification of ADC & DAC	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	S	M	N	S	S	M	S	S	N	M	L	N
CO-03	S	S	S	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Application of Op-Amp (Inverting and Non-inverting amplifier, Adder, Subtractor, Voltage follower, Comparator, Integrator and Differentiator).
2. Design of Schmitt Trigger using Op-amp.
3. Design of oscillator circuits (RC phase Shift/Weinbridge Oscillator).

4. Implementation of Adder and Subtractor circuits.
5. Design of Parity generator and parity checker circuits
6. Design of Code converters/ Encoders and Decoders
7. Implementation of Multiplexer and De-multiplexer circuits (Study of 4:1; 8:1 multiplexer and Study of 1:4; 1:8 Demultiplexer)
8. Design and implementation of synchronous and asynchronous counter ICs
9. Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's
10. Design and Verification of RS, JK, D and T flip flops using logic gates.
11. Timer IC application (Study of NE/SE 555 timer in Astable, Monostable operation)
12. Design and Verification of ADC & DAC.

TOTAL: 30 HOURS

ME3278	THERMODYNAMICS AND FLUID MECHANICS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.
  (Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted).
- Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

Course Outcome		Cognitive Skill
CO-01	Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.	U, An
CO-02	Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.	U, An
CO-03	Understand the Properties of Pure Substance and Psychometric.	U, An
CO-04	To conduct experiments in centrifugal pump and reciprocating pump	U, An
CO-05	To conduct experiments in gear pump pelton wheel francis turbine Kaplan turbine.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	M	L	L	M	S	M	S	S	S	L
CO-02	S	S	S	M	L	M	S	M	S	S	S	L
CO-03	S	S	S	L	L	M	S	M	S	S	S	L
CO-04	S	S	S	L	L	M	S	M	S	S	S	L
CO-05	S	S	S	L	L	M	S	M	S	S	S	L

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

THERMODYNAMICS LAB

1. Valve timing and port timing diagrams for IC Engines.
2. Performance test on a Petrol Engine / Diesel Engine
3. Heat Balance test on an IC Engine.
4. Boiler – performance and Heat Balance Test.
5. Performance test on a Refrigerator (Determination of COP)
6. Determination of heat transfer Coefficient (Free and forced convection)

List of Equipments

1. Engine – cut section models.
2. Single cylinder petrol engine with Mechanical dynamometer.
3. Multi cylinder petrol engine with hydraulic dynamometer.
4. Multi cylinder diesel engine with Electrical dynamometer.
5. Steam boilers with suitable mountings and accessories.
6. Refrigeration Test Rig.
7. Forced convection Heat transfer Test set up.
8. Free convection Heat transfer test set up.

FLUID MECHANICS LABORATORY

1. Flow measurements using venturi meter.
2. Test to estimate frictional losses in pipe flow.
3. Test on centrifugal pump for obtaining its characteristics curves and design flowParameters.
4. Test on jet pump for obtaining its characteristics curves and design flow parameters.
5. Test on reaction turbine for obtaining the characteristics curves and to design values of specific speed, discharge, output and efficiency.
6. Test on impulse turbine to obtain its characteristics curves and hydraulic design values.

TOTAL: 30 HOURS

SEMESTER V

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EI3208	Industrial Instrumentation	3	0	0	3
3.	EI3209	Control Engineering	3	1	0	4
4.	EI3210	Analytical Instrumentation	3	0	0	3
5.	EI3211	Embedded Instrumentation Systems and IoT	3	0	0	3
6.	EI32**	Programme Elective - I	3	0	0	3
PRACTICAL						
7.	EI3275	Industrial Instrumentation Laboratory	0	0	2	1
8.	EI3276	Embedded Instrumentation Systems and IoT Laboratory	0	0	2	1
9.	EE3280	Control Systems Laboratory	0	0	2	1
TOTAL			**17**	**1**	**6**	**21**

MS3201	**PROFESSIONAL AND BUSINESS ETHICS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

OBJECTIVES

1. To recognize legal and ethical issues in business decision-making.
2. To Understand and apply ethical rules and constraints.
3. To enhance analytical problem-solving skills and ethical decision-making abilities.

Course Outcome		**Cognitive Skill**
CO-01	Explain the connection between ethics, morals, and values in the workplace.	R
CO-02	Allow engineers to better understand the kind of behavior expected from them and their duties towards their profession and the society for	U

	maintaining public safety.	
CO-03	Critically analyze engineering as a social experiment applying scientific and technological principles to the design, fabrication, operation of machines and systems for the benefit of society.	U, An
CO-04	Appraise some of the competing demands on business when scrutinizing the ethics of safety, responsibilities and rights.	U, A
CO-05	Critically apply understanding the ethics of real world contexts and analyze information relevant to global issues.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	N	M	L	S
CO-02	S	M	N	S	S	M	S	S	N	M	L	N
CO-03	S	S	S	L	N	M	S	S	M	N	L	S
CO-04	M	N	S	S	M	L	S	S	M	N	L	N
CO-05	S	N	M	S	L	M	N	N	M	L	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: HUMAN VALUES **6**

Morals, Values, and Ethics - Integrity and Work Ethic - Caring, Sharing, and Honesty - Commitment, Empathy, and Self-Confidence.

UNIT II: ENGINEERING ETHICS **6**

Senses of 'Engineering Ethics' and Moral Issues -Moral Autonomy and Ethical Theories - Models of Professional Roles.

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION **6**

Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics and Legal Perspectives.

UNIT IV: SAFETY, RESPONSIBILITIES, AND RIGHTS **6**

Safety, Risk, and Risk Assessment - Collegiality, Loyalty, and Respect for Authority - Professional and Employee Rights.

UNIT V: GLOBAL ISSUES **6**

Multinational Corporations and Environmental Ethics - Engineers as Managers, Consultants, and Expert Witnesses.

TOTAL: 30 HOURS

TEXTBOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering," McGraw-Hill, New York, Latest edition: 4th edition (2022).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics," Prentice Hall of India, New Delhi, Latest edition: 2nd edition (2021).

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics," Pearson Education/Prentice Hall, New Jersey, Latest edition: 4th edition (2022).
2. Charles E Harris, Michael S. Protchard, and Michael J Rabins, "Engineering Ethics - Concepts and Cases," Wadsworth Thompson Learning, United States, Latest edition: 2nd edition (2023).
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, New Delhi, Latest edition: 8th edition (2021).
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers," Oxford University Press, Oxford, Latest edition: 2nd edition (2022).

EI3208	**INDUSTRIAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To provide sound knowledge about various techniques used for the measurement of industrial parameters.
- To have an adequate knowledge about viscosity and moisture transducers.

Course Outcome		**Cognitive Skill**
CO-01	Understand the working of different types of temperature sensors.	R, U
CO-02	Familiarize with the various types of pressure measurement techniques	R, U
CO-03	Ability to understand the construction and working of different flowsensors used in industries.	R, U
CO-04	Understand the various level measurement technique	R, U
CO-05	Introduce the measurement techniques of viscosity and humidity	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	L	M	M	M	S	M	M	M	M
CO-02	L	L	S	M	L	S	L	L	S	M	M	M
CO-03	L	S	L	M	M	L	M	M	M	L	S	M
CO-04	M	M	M	S	M	L	M	L	M	S	L	M
CO-05	L	M	L	M	S	M	M	L	M	L	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: TEMPERATURE MEASUREMENT 9

Resistance Temperature Detectors – Applications, Industrial RTD construction requirement, RTD Transmitters. Thermistors – Principle of Operation, Sensor types, Temperature measurement using Thermistors. Thermocouples – Theory of Operation, Thermocouple types. Diode – Type Temperature Sensors, Fluidic Sensors, Johnson noise thermometer, Electronic Temperature Switches.

UNIT II: PRESSURE MEASUREMENT 9

Manometers, Bourdon Tubes, Diaphragm Elements. Electronic Pressure Sensors – Strain Gauge Transducers, Capacitance Transducer, Potentiometric Transducer, Resonant Wire Transducer, Piezoelectric Pressure Sensors, Linear Variable Differential Transformer, Optical Transducers. Differential Pressure Transmitters – Pneumatic transmitter.

UNIT III: FLOW MEASUREMENT 9

Introduction, Orifice Plates, Venturi Tubes and Nozzles, Pitot Tubes. Positive Displacement Flow meters - Nutating disc flow meter, Sliding vane flow meter, Lobed impeller flow meter, Reciprocating piston flow meter. Mass Flow meters – Radiation type, Angular – Momentum type, Impeller-Turbine Flow meter, Constant torque - Hysteresis Clutch, Twin-Turbine.

UNIT IV: LEVEL MEASUREMENT 9

Float Type level indicator, Displacer Type – Torque tube assembly. Electrical Methods – Resistance, Conductance, Inductive and Capacitive level gauging. Ultrasonic Method, Microwave Level Switches, Noncontacting optical level sensor, Rotating Paddle Switches.

UNIT V: MEASUREMENT OF VISCOSITY AND HUMIDITY 9

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers. Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter.

TOTAL: 45 HOURS

TEXT BOOKS:

1. D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill Publishing Company Ltd,1996.
2. S. K. Singh, 'Industrial Instrumentation and Control', Tata McGraw Hill,2003.
3. R. K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, New
4. Delhi, 1999.

REFERENCES:

1. E. O. Doebelin, 'Measurement Systems - Application and Design', Tata McGraw Hill publishing company, 2003.
2. A. K. Sawhney and P. Sawhney, 'A Course on Mechanical Measurements, Instrumentation and Control', DhanpathRai and Co, 2004.
3. B. C. Nakra& K. K. Chaudary, 'Instrumentation Measurement & Analysis', Tata McGraw Hill Publishing Ltd, 2004.
4. D. P. Eckman', Industrial Instrumentation', Wiley Eastern Ltd.

EI3209	**CONTROL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

- To introduce the components and their representation of control systems
- To learn various methods for analysing time response of systems
- To understand the concept of system stability
- To learn various methods for analysing frequency response of systems
- To know about the state variable methods of control system analysis

Course Outcome		**Cognitive Skill**
CO-01	Understand the various control terminologies and system modelling.	U
CO-02	Perform time domain analysis of various models of linear systems.	An
CO-03	Analyse the concepts of stability of systems through various methods.	An
CO-04	Perform frequency domain analysis of various models of linear systems.	An
CO-05	Develop and analyse state space model of systems.	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	M	M	L	M	M	S
CO-02	S	S	S	M	M	L	M	M	M	M	M	M
CO-03	M	M	M	M	M	L	S	M	M	M	S	S
CO-04	M	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: SYSTEMS AND REPRESENTATION 9

Introduction to control systems- classification of control systems- basic elements. Introduction to linear and non-linear systems - open and closed loop systems- advantages of closed loop operation. Modelling of system-Electrical analogy of mechanical and thermal systems - Transfer function - Block diagram reduction techniques - Signal flow graphs.

UNIT II: TIME DOMAIN ANALYSIS 9

Standard test signals- Response of systems to standard test signals- Time response - First order system - Second order system – Step response- Time domain specifications - Types of test input - I and II order system response – Type and order- Error analysis- Static and dynamic error- Error coefficients - Generalized error series –Steady state analysis.

UNIT III: STABILITY OF CONTROL SYSTEM 9

Characteristic equation - Location of roots in S plane for stability - Routh Hurwitz criterion - Root locus construction - Effect of pole, zero addition - Gain margin and phase margin - Nyquist stability criterion.

UNIT IV: FREQUENCY DOMAIN ANALYSIS 9

Frequency response - Bode plot - Polar plot - Nichols chart - Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT V: STATE VARIABLE ANALYSIS 9

State space representation of Continuous Time systems. Transfer function from State Variable Representation, Solution of state equations, state transition matrix, Concepts of Controllability and Observability, Kalman’s Test.

TOTAL: 60 HOURS

TEXT BOOK:

1. Nagarath, I. J. and Gopal, M.,"Control Systems Engineering", New Age International Publishers, 2017.
2. Katsuhiko Ogata,"Modern Control Engineering", Pearson, 2015.
3. Norman S Nise, Control System Engineering, Sixth Edition.

REFERENCES:

1. B. C. Kuo,"Automatic Control Systems", Prentice Hall of India Ltd., New Delhi, 2014.
2. M. Gopal,"Control Systems, Principles & Design", Tata McGraw Hill, New Delhi, 2012.
3. M. N. Bandyopadhyay,"Control Engineering Theory and Practice", Prentice Hall of India, 2003.
4. NPTEL Video Lecture Notes on Control Engineering by Prof. S. D. Agashe, IIT, Bombay.

EI3210	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy and chromatography.
- To understand the working principle of industrial gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.

Course Outcome		Cognitive Skill
CO-01	Ability to acquire knowledge about the widely used analytical Instruments.	R
CO-02	Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.	U
CO-03	Ability to critically evaluate the strengths and limitations of the various instrumental methods.	A
CO-04	Able to design various types of electrodes, analyzer and spectrometers.	A
CO-05	Ability to develop critical thinking for interpreting analyticaldata.	U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	N	M	L	N	M	S	M	L	S
CO-02	L	S	N	S	L	M	N	S	N	M	L	N
CO-03	N	S	L	S	N	S	S	S	S	N	L	S
CO-04	M	N	S	S	l	L	S	S	S	N	L	N
CO-05	S	N	M	M	L	M	N	N	M	L	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: SPECTROPHOTOMETR 9

Introduction to Analytical Instrumentation- Elements of an analytical instrument – PC based analytical instruments –Classification of instrumental techniques.

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

UNIT II: CHROMATOGRAPHY 9

Chromatography: Chromatographic process – Classification- Terms in Chromatography- Gas chromatography: Block diagram- Principle –Constructional details – Column details- Gas chromatography detectors. Liquid Chromatography: Types of liquid chromatography- High pressure Liquid Chromatography (HPLC): Principle- Constructional details.

UNIT III: INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers - Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements, Predicative emission monitoring system (PEMS)

UNIT IV: pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurements - Dissolved oxygen analyzer - Sodium analyzer - Silicon analyzer - Water quality Analyzer. Bio sensors- Principle and working of biosensors.

UNIT V: NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

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

TOTAL: 45 HOURS

TEXT BOOK:

1. Willard, H. H., Merritt, L. L., Dean, J. A., Settle, F. A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R. D, "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.
3. Robert E. Sherman, "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCES:

1. Khandpur, R. S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.
2. Ewing, G. W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007)
3. Liptak, B. G., Process, Measurement and Analysis, CRC Press, 5th Edition, 2015.
4. NPTEL lecture notes on, Modern Instrumental methods of Analysis, by Dr.J.R. Mudakavi, IISC, Bangalore.

EI3211	EMBEDDED INSTRUMENTATION SYSTEMS AND IOT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To get familiarized with the embedded hardware architecture.
- To understand the basics of ARM processor and embedded software development tools.
- To obtain good knowledge afbout RTOS and the attributes of various communication protocols.
- To get introduced with the concept of IoT and architecture of IoT systems.
- To acquire knowledge over IoTapplications in embedded system.

Course Outcome		Cognitive Skill
CO-01	Understand the concept of embedded system and its architectural features.	R, U
CO-02	Understand the basics of ARM processor and embedded software development tools.	R, U
CO-03	Understand the concepts of RTOS and the attributes of various communication protocols.	R, U
CO-04	Understand the basic concepts of IoT and architecture of IoT systems.	R, U
CO-05	Apply and develop IoT applications in embedded systems.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	M	M	L	M	M	S
CO-02	S	S	S	M	M	L	M	M	M	M	M	M
CO-03	M	M	M	M	M	L	S	M	M	M	S	S
CO-04	M	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: EMBEDDED HARDWARE ARCHITECTURE 9

CISC Architecture:- Introduction to MCS51 Family - 8051 Microcontroller - Architecture - Timers - Interrupts - Serial Data Communication - RISC Architecture:- overview of PIC 16F487x family - PIC16F877A - Architecture - Timers - Interrupts - Serial ports.

UNIT II: ARM & EMBEDDED SOFTWARE DEVELOPMENT TOOLS 9

Introduction to ARM - LPC4088 Architecture - Software Development Tools: - IDE Tools - ISP Tools - ARM Development Tools.

UNIT III: REAL TIME OPERATING SYSTEM 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication - synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT IV: INTRODUCTION TO INTERNET OF THINGS 9

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

UNIT V: IOT APPLICATIONS ` 9

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

TOTAL: 45 HOURS

TEXT BOOKS:

1. Rajkamal, ‘Embedded system-Architecture, Programming, Design’, TataMcgraw Hill, 2011.

2. Peckol, “Embedded System Design”, John Wiley, 2010.
3. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun(editor)
4. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press).

REFERENCES:

1. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
2. Han-Way Huang, ”Embedded system Design using C8051”, Cengage Learning, 2009.
3. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.
4. Shibu.K V, “Introduction to Embedded Systems”, TataMcgraw Hill, 2009.

EI3275	INDUSTRIAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To make the students aware about calibration of meters, sensors and transmitters.
- To make the students conscious about the working and operation of different types of industrial instruments.

Course Outcome		Cognitive Skill
CO-01	Ability to learn about the benefits of industrial instruments.	A, An
CO-02	Ability to know about calibration of meters.	A, An
CO-03	Ability to experimentally measure industrial process parameters such as flow, level, pressure torque and viscosity.	A, An
CO-04	Ability to measure and analyze pH, conductivity, UV/ IR absorbance and transmittance.	A, An
CO-05	Ability to measure and analyze physiological parameters such as ECG respiration and pulse rate.	A, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	M	L	M	L	M	M	M	L	M	M

CO-02	M	M	L	S	L	S	L	L	L	M	M	L
CO-03	M	L	S	L	M	M	L	M	L	M	L	M
CO-04	L	M	M	L	S	L	S	L	L	S	S	L
CO-05	S	M	L	S	L	M	L	M	L	M	L	S

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Measurement of flow using discharge coefficient of orifice plate.
2. Calibration of pressure gauge using dead weight tester.
3. Measurement of torque.
4. Measurement of conductivity of test solutions.
5. Measurement of viscosity of test solutions.
6. Measurement of temperature using IC sensor.
7. Vacuum pressure measurement.
8. Level measurement using DPT.
9. Measurement of absorption and transmittance using UV spectrophotometer.
10. Study of IR spectrophotometer.
11. Standardization and measurement of pH values of different solutions
12. Measurements of conductivity of test solutions.
13. Measurement and analysis of ECG and pulse rate.

TOTAL: 30 HOURS

EI3276	**EMBEDDED INSTRUMENTATIONSYSTEMS AND IOT LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To gain practical knowledge on programming using 8051 microcontroller.
- To gain experience in implementation of IoT enabled embedded applications.

Course Outcome		**Cognitive Skill**
CO-01	Ability to gain practical exposure on programming using 8051 microcontroller.	A, An
CO-02	Ability to do interfacing of embedded systems.	A, An
CO-03	Ability to experimentally measure industrial process parameters using NodeMCU.	A, An
CO-04	Ability to implement IoT for various embedded applications.	A, An
CO-05	Ability to implement IoT to analyze real time industrial applications.	A, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	M	M	L	M	M	S
CO-02	S	S	S	M	M	L	M	M	M	M	M	M
CO-03	M	M	M	M	M	L	S	M	M	M	S	S
CO-04	M	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Arithmetic and logic operations using 8051
2. Implementation & interfacing of LED using 8051
3. Implementation & interfacing of seven segment display using 8051
4. Interface temperature sensor to microcontroller 8051
5. Stepper motor control using 8051 microcontroller
6. Implement LED and LED pattern with Arduino
7. Display “Hello World” in LCD 16x2 display with Arduino
8. Implement Servo Motor Control with Arduino
9. Interface Arduino with ultrasonic sensor to measure distance
10. Interface Arduino with Temperature sensor/ Proximity sensor
11. IOT enabled temperature monitoring with NodeMCU/Raspberry Pi
12. IOT enabled distance measurement with NodeMCU/Raspberry Pi

TOTAL: 30 HOURS

EE3280	**CONTROL SYSTEM LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

Course Outcome		**Cognitive Skill**
CO-01	Ability to understand control theory and apply them to electrical engineering problems.	R, U, A,

CO-02	Ability to analyze the various types of controllers	U, An
CO-03	Ability to design compensators	R, S
CO-04	Ability to study the simulation package	R, U
CO-05	Ability to analyse the stability of system	An, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	N	N	M	N	N	N	L	N	N	N	N
CO-02	S	M	M	N	N	N	N	M	N	N	N	N
CO-03	S	S	S	S	N	M	N	M	N	N	N	N
CO-04	S	N	M	N	N	N	N	N	N	N	N	N
CO-05	S	M	S	M	N	N	N	N	N	N	N	N

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS

1. Determination of transfer function parameters of a DC servo motor.
2. Determination of transfer function parameters of AC servo motor.
3. Analog simulation of type-0 and type-1 system.
4. Digital simulation of linear systems.
5. Digital simulation of non-linear systems.
6. Design and implementation of compensators.
7. Design of P, PI and PID controllers.
8. Stability analysis of linear systems.
9. Closed loop control system.
10. Study of synchros.
11. Study of stepper motor.
12. Study of speed control system.

TOTAL: 30 HOURS

SEMESTER VI

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EI3212	Virtual Instrumentation	3	0	0	3
2.	EI3213	Process Control	3	0	0	3
3.	EI3214	Digital Signal Processing Techniques	3	0	0	3
4.	EI32**	Programme Elective-II	3	0	0	3
5.	EI32**	Programme Elective-III	3	0	0	3
6.	XXXXXX	Open Elective - I	3	0	0	3
PRACTICAL						
7.	EI3277	Virtual Instrumentation Laboratory	0	0	2	1
8.	EI3278	Process Control Laboratory	0	0	2	1
9.	EI32P2	Summer Internship-II	0	0	0	2
TOTAL			**18**	**0**	**4**	**22**

EI3212	**VIRTUAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

To introduce virtual instrumentation concepts and applications.

- To train to program virtual instrumentation software for biomedical application.
- To understand the data acquisition and control in VI.
- To obtain the knowledge in instrument interfaces.
- To analyze the applications of VI in instrumentation engineering.

Course Outcome		**Cognitive Skill**
CO-01	To comprehend and appreciate the significance and role of this course in the present contemporary world.	R

CO-02	Identify salient traits of a virtual instrument.	U
CO-03	Understand the use of VI for data acquisition.	U, A
CO-04	Experiment, analyze and document different types of interfaces.	U, A
CO-05	Apply the virtual instrumentation technologies for instrumentation applications.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	S	S	S	M	S	M	M	L	M	M
CO-02	S	L	N	L	S	M	L	M	M	M	M	M
CO-03	M	M	S	S	L	M	L	S	M	M	M	S
CO-04	M	L	N	M	M	M	M	M	M	S	M	M
CO-05	S	M	N	N	L	M	S	L	S	S	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNITI: INTRODUCTION **9**

History of Virtual Instrumentation (VI), Need of VI, Advantages of VI, block diagram and architecture of a virtual instrument, Programming paradigms – comparison with conventional programming.

UNITII: VI USING LABVIEW **9**

Lab VIEW software – Lab VIEW basics – Lab VIEW environment, creating, editing and debugging a VI in Lab VIEW – Creating a sub VI – Loops and charts –Case and sequence structures – File I/O – VI customization.

UNIT III: DATA ACQUISITION AND CONTROL IN VI **9**

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/Os – Buffered data acquisition – Simple problems

UNIT IV: INSTRUMENT INTERFACES **9**

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

UNIT V: APPLICATION OF VI **9**

Application of Virtual Instrumentation: Instrument Control using RS-232C and IEEE488, Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, Active X programming, publishing measurement data in the web.

TOTAL: 45 HOURS

TEXT BOOK:

1. Sanjay Gupta,"Virtual Instrumentation using Lab View", Tata McGraw Hill Publishing, First reprint, 2006.
2. S. Gupta and J.P Gupta,"PC Interfacing for Data Acquisition and Process Control", Instrument Society of America, 1994.
3. Peter W. Gofton,"Understanding Serial Communications", Sybex International.
4. Robert H. Bishop,"Learning with Lab View", Prentice Hall, 2003.
5. Jovitha Jerome, "Virtual Instrumentation using Lab View", PHI Learning Pvt. Ltd., 2010

REFERENCES:

1. Gary W. Johnson, Richard Jennings,"Lab View Graphical Programming", McGraw Hill Professional Publishing, 2001.
2. William Buchanan,"Computer Buses Design and Application", CRC Press, 2000.

EI3213	PROCESS CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce technical terms and nomenclature associated with process control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features of industrial controllers and various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed forward control and model based control schemes.

Course Outcome		Cognitive Skill
CO-01	Ability to design, the fundamentals of mathematical modeling of processes.	R, An
CO-02	Familiarize the students with the characteristics, selection, and sizing of control valves	U, An

CO-03	Ability to understand the construction, design, and working of different of various control actions	U, E
CO-04	Ability to identify, formulate and solve various PID tuning methods	R, U
CO-05	Ability to learn to tune and implement different control schemes for various processes	R, U

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	L	M	S	L	S	M	L	L	L
CO-02	L	L	S	M	L	L	M	L	L	M	S	M
CO-03	M	L	M	L	S	M	S	M	S	L	L	S
CO-04	L	S	L	S	L	L	M	L	L	S	M	M
CO-05	M	L	M	L	M	L	S	L	L	M	L	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: PROCESS MODELLING AND DYNAMICS **9**

Components of process control- Variable of process control- Mathematical Modeling of Processes: Level, Flow, Pressure and thermal processes – Interacting and non-interacting processes- Continuous and batch processes - Self regulation - Servo and regulatory operations - Linearization of nonlinear systems.

UNIT II: FINAL CONTROL ELEMENTS **9**

I/P and P/I Converters- Actuators: Pneumatic and electric actuators - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Linearization of equal percentage control valve- Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves - Cavitation and flashing - Control Valve selection.

UNIT III: CONTROL ACTIONS **9**

Discrete and Continuous mode, Composite control action, Proportional, Single speed floating, Integral and Derivative controllers P+I, P+D and P+I+D control modes - Practical forms of PID Controller - PID Implementation. Issues: Bumpless transfer, Anti-reset windup Techniques - Direct/reverse action.

UNIT IV: PID CONTROLLER TUNING **9**

PID Controller Design Specifications: Evaluation criteria- Steady state and dynamic response performance criteria - Time Integral performance criteria- Selection of feedback controller for a

process. PID Controller Tuning: Z-N and Cohen-Coon methods, Water decay ratio and Frequency response methods. Auto tuning - Cascade control - Feed-forward control.

UNIT V: MODEL BASED CONTROL SCHEMES 9

Introduction to multivariable/multi loop control schemes - Smith Predictor Control Scheme - Internal Model Controller - IMC PID controller - Dynamic matrix controller (DMC), Self-Tuning Controller. Three element Boiler drum level control- Control Schemes for CSTR, and Heat Exchanger.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Seborg, D. E., Edgar, T. F. and Mellichamp, D. A., Process Dynamics and Control, Wiley John and Sons, 2nd Edition, 2003.
2. Bequette, B. W., Process Control Modeling, Design and Simulation, Prentice Hall of India, 2004.
3. Stephanopoulos, G., Chemical Process Control - An Introduction to Theory and Practice, Prentice Hall of India, 2005.

REFERENCES:

1. Coughanowr, D. R., Process Systems Analysis and Control, McGraw - Hill International Edition, 2004.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2006.
3. Considine, D. M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.
4. Bela. G. Liptak., Process Control and Optimization, Instrument Engineers Handbook, Volume 2, CRC press and ISA, 2005.
5. Ramesh C. Panda., T.Thyagarajan., An Introduction to Process Modelling Identification and Control for Engineers, Narosa Publishing house Pvt. Ltd, 2017.
6. Krishnaswamy. K., ”Process Control”, New Age International Pvt. Ltd., Publishers, 2nd edition, 2009.

EI3214	DIGITAL SIGNAL PROCESSING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

To study the properties and representation of discrete and continuous signals.

- To study the sampling process and analysis of discrete systems using z- transforms
- To study and analyze characteristics of continuous, discrete signals and systems, DFT and FFT, IIR & FIR filters.

Course Outcome		Cognitive Skill
CO-01	Ability to acquire knowledge on classification of signals and AtoD conversion procedure.	R, A

CO-02	Ability to understand the importance of Fourier,Laplace and Z-transforms in digital signal processing.	U, A
CO-03	Ability to learn about digital filters and DSProcessors.	U, An
CO-04	Ability to analyze the transformation techniques & their computation.	U, E
CO-05	Ability to learn about the applications of digital signal processors.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	M	L	M	S	L	L	L	L	L
CO-02	S	M	L	M	L	M	L	L	L	L	L	L
CO-03	S	M	L	M	L	M	S	L	L	L	L	L
CO-04	S	M	M	S	M	S	L	M	M	L	L	L
CO-05	S	M	M	S	M	S	S	M	M	L	L	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION **9**

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

UNIT II: CONTINUOUS & DISCRETE TIME SYSTEM ANALYSIS **9**

Continuous time Fourier Transform and Laplace Transform analysis with examples - properties of the Continuous time Fourier Transform and Laplace Transform basic properties.

Z-transform and its properties- ROC, inverse z-transforms; difference equation - Solution by Z-transform, application to discrete systems - Stability analysis - Convolution using Z-transform.

UNIT III: DISCRETE FOURIER TRANSFORM & COMPUTATION **9**

Discrete Fourier Transform- properties, magnitude and phase representation Computation of DFT using FFT algorithm - DIT & DIF using radix 2 FFT- Use of FFT algorithms in linear filtering and correlation.

UNIT IV: DESIGN OF DIGITAL FILTERS **9**

FIR & IIR filter realization - Direct form I, Direct form II, Linear phase FIR realizations - Parallel & cascade forms. FIR design: Windowing Techniques - Rectangular, Kaiser Windows, LPF, HPF, BPF, BRF; IIR Filters- digital design using impulse invariant and bilinear transformation warping,

UNIT V: DIGITAL SIGNAL PROCESSORS **9**

Introduction –DSP Processor Architecture, Types- Features - Addressing Formats - TMS320C64x DSP Architecture - First Commercial DSP: Texas Instruments TMS32010, Conventional Von Neumann memory and Harvard Memory Architecture

TOTAL: 45 HOURS

TEXT BOOK:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, Pearson Education, New Delhi, PHI. 2003.
2. S. K. Mitra, 'Digital Signal Processing - A Computer Based Approach', McGraw Hill Edu, 2013.
3. Alan V. Oppenheim, Alan S. Willsky with S. Hamid Nawab, Signals & Systems, 2nd edn. Pearson Education, 1997.
4. Peckol, Embedded system Design", John Wiley & Sons, 2010.
5. Lyla B Das, Embedded Systems- An Integrated Approach, Pearson, 2013.

REFERENCES:

1. Ashok Amhardar,"Analog and Digital Signal Processing", 2nd Edition Thomson 2002.
2. Alan V Oppenheim, Ronald W Schafer and John R Buck, "Discrete Time Signal Processing", 2nd Edition, PHI/ Pearson Education, 2000.
3. Johny R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall of India, Pearson Education, 2002.
4. Sanjit K. Mitra,"Digital Signal Processing: A Computer - Based Approach", Tata McGraw-Hill, 2nd Edition, 2001.
5. Simon Haykin and Barry Van Veen, Signals and Systems, John Wiley, 1999
6. K. Lindner,"Signals and Systems", McGraw Hill International, 1999.

EI3277	VIRTUAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- Able to create simple virtual instrumentation programs using: for loops, charts, clusters, graphs, case and sequence structures.
- Able to simulate some real time control systems using Labview.

Course Outcome		Cognitive Skill
CO-01	Ability to learn on Labview software.	U, A

CO-02	Ability to create virtual instrumentation for simple applications.	U, A
CO-03	Ability to create communication with field instruments by developing data acquisition systems.	U, An
CO-04	Ability to learn on graphical programming environment in VI.	U, A
CO-05	Ability to work on real time control applications.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	S	S	S	M	S	S	S	S	S	S
CO-02	S	L	S	S	S	M	S	S	S	S	S	S
CO-03	S	L	S	S	S	M	S	S	S	S	S	S
CO-04	S	L	S	S	S	M	S	S	S	S	S	S
CO-05	S	L	S	S	S	M	S	S	S	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Creating Virtual Instrumentation for simple applications.
2. Programming exercises for loops and charts.
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time humidity control using Virtual Instrumentation.
11. Developing a Simulation of Level Measurement in a Tank using Labview.
12. Developing a PID Simulator using Labview.
13. Image acquisition and processing using Labview.

TOTAL: 30 HOURS

EI3278	PROCESS CONTROL LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- To impart theoretical, practical skills in process identification and PID controller tuning.
- To strengthen the knowledge of feedback controllers.

Course Outcome		Cognitive Skill
CO-01	Ability to understand and analyze process control engineering problems.	U, A
CO-02	Be able to build dynamic models using input-output data of a process.	U, A
CO-03	Ability to work with real time control loops (flow/level/temperature/pressure).	U, An
CO-04	Ability to get practical knowledge on characteristics of control valve.	U, A
CO-05	Ability to work PID controllers using cascade and feed-forward control schemes.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	S	S	M	M	L	L	S	S	M	M
CO-02	L	M	M	M	L	S	S	M	L	L	S	M
CO-03	M	M	L	M	M	L	M	L	M	M	S	M
CO-04	L	M	M	M	S	M	S	L	M	L	M	L
CO-05	M	M	L	M	M	M	S	M	M	L	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Design and Implementation of interacting systems.
2. Design and Implementation of non-interacting systems.
3. Design and implementation of ON/OFF Controller for the Temperature Process.
4. Response of different order processes with and without transportation lag.
5. Response of PID controller.

6. Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner)
7. Closed loop response of flow and level control system.
8. Closed loop response of temperature control system.
9. Closed loop response of pressure control system.
10. Tuning of PID Controller for mathematically described processes
11. PID Enhancements (Cascade and Feed-forward Control Schemes).
12. Study of AC and DC drives and Multi-input Multi-output system (MIMO system).

TOTAL: 30 HOURS

SEMESTER VII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EI3215	Industrial Automation	3	0	0	3
3.	EI3216	Computer Control of Processes	3	0	0	3
4.	EI32**	Programme Elective-IV	3	0	0	3
5.	XXXXXX	Open Elective - II	3	0	0	3
PRACTICAL						
6.	EI3279	Industrial Automation Laboratory	0	0	2	1
7.	EI3280	Computer Control of Process Laboratory	0	0	2	1
8.	EI32P3	Mini Project	0	0	6	3
TOTAL			**14**	**0**	**10**	**19**

MS3202	PRINCIPLES OF MANAGEMENT	L	T	P	C
		2	0	0	2

OBJECTIVES

- To introduce students to the basic concepts and functions of management.
- To understand the role and responsibilities of managers in various organizational

settings.

- To develop an understanding of the planning, organizing, leading, and controlling functions of management.
- To examine the impact of management theories and practices on organizational performance.
- To equip students with the skills necessary to manage people and processes effectively in a technical environment.

Course Outcome		Cognitive Skill
CO-01	By the end of this course, students will be able to: Define and explain the key concepts and functions of management.	R, U
CO-02	Analyze the roles and responsibilities of managers in different organizational contexts.	U, A
CO-03	Apply planning, organizing, leading, and controlling principles to real-world scenarios.	U, A, An
CO-04	Evaluate the effectiveness of different management theories and practices.	U, A
CO-05	Demonstrate management skills necessary for leading teams and projects in a technical environment.	U, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	S	S	N	M	M	M	L	S	S	N
CO-02	M	N	N	L	N	N	L	M	N	N	L	N
CO-03	S	L	L	N	M	L	N	S	L	L	N	M
CO-04	N	S	M	M	S	S	S	N	S	M	M	S
CO-05	L	M	M	N	L	M	M	L	M	M	N	L

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: INTRODUCTION TO MANAGEMENT 7

Definition, nature, and importance of management - Functions of management: Planning, Organizing, Leading, Controlling - Roles and skills of managers - Evolution of management thought: Classical, Behavioral, and Modern theories - Scientific Management (Taylor) -

Administrative Theory (Fayol) - Human Relations Movement (Mayo) - Contemporary approaches (Systems Theory, Contingency Theory).

UNIT II: PLANNING **5**

Nature and purpose of planning - Types of plans: Strategic, Tactical, Operational - Planning process and techniques - SWOT Analysis, SMART Goals , Scenario Planning - Decision making: Process, types, and tools- Rational Decision-Making Model - Bounded Rationality - Group Decision-Making Techniques (Brainstorming, Delphi Technique).

UNIT III: ORGANISING **5**

Organizational structure and design - Types of organizational structures: Functional, Divisional, Matrix, Network - Authority, responsibility, and delegation - Coordination and communication within organizations - Formal and Informal Communication Channels - Role of Technology in Organizational Communication (Emails, Video Conferencing, Collaborative Tools).

UNIT IV: LEADING **7**

Leadership theories and styles - Trait Theory - Behavioral Theories (Ohio State Studies, Michigan Studies) - Contingency Theories (Fiedler's Model, Path-Goal Theory) - Transformational vs. Transactional Leadership - Motivation theories and practices, Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McClelland's Theory of Needs, Modern Approaches (Self-Determination Theory) -Group dynamics and team management - Stages of Team Development (Forming, Storming, Norming, Performing) - Managing Virtual Teams.

UNIT V: CONTROLLING **6**

Nature and purpose of control - Control process and techniques, Establishing Standards, Measuring Performance, Correcting Deviations - Types of control: Feed forward, Concurrent, Feedback - Quality control and management, Total Quality Management (TQM), Six Sigma, Lean Management, Use of Data Analytics in Quality Control.

TOTAL: 30 HOURS

TEXT BOOKS

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). Fundamentals of Management (11th ed.). Pearson.
2. Griffin, R. W. (2022). Management: Principles and Practices (12th ed.). Cengage Learning.
3. Jones, G. R., & George, J. M. (2021). Essentials of Contemporary Management (9th ed.). McGraw-Hill Education.

REFERENCES

1. Daft, R. L. (2021). Management (14th ed.). Cengage Learning.
2. Bateman, T. S., & Snell, S. A. (2020). Management: Leading & Collaborating in a Competitive World (14th ed.). McGraw-Hill Education.
3. Schermerhorn, J. R. (2021). Management (14th ed.). Wiley.
4. Hill, C. W. L., Schilling, M. A., & Jones, G. R. (2020). Strategic Management: Theory & Cases (13th ed.). Cengage Learning.
5. Kinicki, A., & Williams, B. K. (2021). Management: A Practical Introduction (10th ed.). McGraw-Hill Education.

EI3215	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the construction, operation and installation of PLCs.
- To provide the knowledge on interfacing the PLCs and field devices with communication protocols.
- To understand the concepts of DCS and SCADA systems.
- To provide insight into some of the advanced principles those are evolving for present and future automation.

Course Outcome		Cognitive Skill
CO-01	Ability to choose appropriate PLC and explain the architecture, installation procedures and trouble shooting.	R, U
CO-02	Ability to develop PLC programs using various functions of PLCs for a given application.	A, An, E
CO-03	Ability to explain the application development procedures in SCADA and manage data, alarm and storage.	A, An
CO-04	To understand interfacing of field devices with DCS controller and the communication modules used.	U, A
CO-05	Ability to gain comparative knowledge between conventional automation and Industrial 4.0.	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	S	L	S	M	M	L	L	S	S	M	M
CO-02	M	M	M	M	L	S	S	M	L	M	S	M
CO-03	M	S	L	M	M	L	M	L	M	M	S	M
CO-04	L	M	M	M	S	M	M	L	S	L	M	L
CO-05	M	M	L	M	M	M	S	M	M	L	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT-I: PROGRAMMABLE LOGIC CONTROLLER **9**

Introduction - Principles of operation - PLC Architecture and specifications - PLC hardware components Analog & digital I/O modules, CPU & memory module - Programming devices- PLC ladder diagram, Converting simple relay ladder diagram into ladder diagram. PLC programming Simple instructions - Manually operated switches - Mechanically operated switches - Latching relays.

UNIT-II: APPLICATIONS OF PLC **9**

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions - Data manipulating instructions, math instructions; Applications of PLC- Motor start and stop, Simple materials handling applications, Automatic water level controller, Automatic lubrication of supplier Conveyor belt, Automatic car washing machine, Bottle label detection and process control application.

UNIT-III: SCADA SYSTEM & ARCHITECTURE **9**

Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries - SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA/HMI Systems Various SCADA architectures, advantages and disadvantages of each system.

UNIT-IV: DISTRIBUTED CONTROL SYSTEM **9**

Introduction to DCS - Various Architectures - Comparison - Local control unit - Process interfacing issues - Communication facilities Operator interfaces - Low level and high level operator interfaces - Displays - Engineering interfaces - Low level and high level engineering interfaces - Factors to be considered in selecting DCS - Case studies - Sugar industry and Power plant.

UNIT-V: INDUSTRY 4.0 **9**

Introduction to Industry 4.0 - Difference between conventional automation and Industry 4.0- Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Internet of Services-Big Data - Cyber-Physical Systems - Next Generation Sensors- Value chains in manufacturing companies - Customization of products - Digital Twins - Trends of Industrial Big Data. -Cloud Computing / Cloud Manufacturing

TOTAL: 45 HOURS

TEXT BOOKS:

1. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.
2. Gary Dunning, “Introduction to Programmable Logic Controllers”, 3rd India edition, Cengage Learning, 2007.
3. John Webb, “Programmable Logic Controllers: Principles and Applications”, 5th edition Prentice Hall of India, 2012.
4. Krishna Kant, “Computer Based Process Control”, Prentice Hall of India, 2004.
5. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986.

REFERENCES:

1. B. G. Liptak, Instrument Engineer's Handbook - Process Software and Digital Network, 3rd edition, CRC Press,2002.
2. Jose A. Romagnoli, Ahmet Palazoglu, Introduction to Process Control, CRC Taylor and Francis Group, 2005.
3. Richard Zurawski, Industrial Communication Technology Handbook, 2nd edition, CRC Press, 2015
4. William T. Shaw, Cybersecurity for SCADA systems, Penn Well Books, 2006.
5. Advances in Computers | The Digital Twin Paradigm for Smarter Systems and Environments: The Industry Use Cases | ScienceDirect.com by Elsevier

EI3216	COMPUTER CONTROL OF PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the importance of state-space representation and stability analysis of discrete data system.
- To identify non parametric and parametric input-output models.
- To provide adequate knowledge in digital controller design.
- To learn about design of multi-loop regulatory control.
- To design multivariable controllers for multivariable systems.

Course Outcome		Cognitive Skill
CO-01	Able to understand the analysis of discrete data system.	R, U
CO-02	Able to design various digital control algorithms.	U, A
CO-03	Able to learn the techniques of DAS, DDC and AI.	R, U, A
CO-04	Ability to build multi-loop regulatory control from input-output data.	U, A
CO-05	Ability to design multivariable controllers for multivariable systems.	U, A, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L

CO-01	S	L	M	S	M	L	N	M	S	M	L	S
CO-02	L	S	N	S	L	M	N	S	s	M	L	N
CO-03	N	S	L	S	N	S	S	S	S	N	L	S
CO-04	M	N	S	S	l	L	S	S	S	N	L	S
CO-05	S	N	M	M	L	M	N	N	M	L	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT-I: DISCRETE STATE-VARIABLE TECHNIQUE **9**

State equation of discrete data system with sample and hold– State transition equation - Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability–Stability tests of discrete-data system.

UNIT-II: DIGITAL CONTROLLER DESIGN **9**

Review of z-transform – Selection of sampling process – Pulse transfer function - Digital PID controller– Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.

UNIT-III: COMPUTER AS A CONTROLLER **9**

Basic building blocks of computer control system – Data acquisition systems – Direct digital control – Introduction to AI and expert control system – Case study - Design of computerized multi loop controller.

UNIT-IV: MULTI-LOOP REGULATORY CONTROL **9**

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.

UNIT-V: MULTIVARIABLE REGULATORY CONTROL **9**

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005.
3. Katsuhiko Ogata, Modern Control Engineering, Fifth Edition, Prentice Hall,2020
4. M. Chidambaram, Computer Control of Processes CRC Press, 2002

REFERENCES:

1. Gopal, M., "Digital Control and State Variable Methods", Tata McGraw Hill, 2003.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Wiley John and Sons, 3rd Edition, 2010.
3. P. Albertos and A. Sala, "Multivariable Control Systems an Engineering Approach", Springer Verlag, 2006.
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.
5. Thomas E. Marlin, Process Control- Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill, 2000.

EI3279	INDUSTRIAL AUTOMATION LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES

- This lab imparts skills and knowledge on industrial automation to automate industrial and commercial applications using PLC/ DCS/ SCADA.

Course Outcome		Cognitive Skill
CO-01	Programming and implementing the control schemes using PLC, DCS and SCADA to work with industrial automation system.	U, A
CO-02	Understanding field device interface modules of PLC.	U, A
CO-03	Programming and implementing mathematical and logical operations in PLC.	U, A, An
CO-04	Programming and implementing various control schemes using SCADA.	U, A, An
CO-05	Monitoring and controlling various processes using DCS.	U, A, An, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	S	S	M	S	S	S	S	L	S	S
CO-02	M	M	S	S	M	S	S	S	S	L	S	S

CO-03	M	M	S	S	M	S	S	S	S	L	S	S
CO-04	M	M	S	S	M	S	S	S	S	L	S	S
CO-05	M	M	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS:

1. Study of PLC field device interface modules (AI, AO, DI, DO modules)
2. Programming logic gate functions in PLC
3. Implementing mathematical operations in PLC
4. Programming jump-to-subroutine & return operations in PLC
5. Programming to operate seven segment display using ladder logic
6. Simulation of traffic light control using ladder logic
7. PLC based control of level process
8. Control of bottle filling system using PLC
9. Control of level/temperature process using SCADA
10. Monitoring and control of flow process using DCS
11. Monitoring and control of level process using DCS
12. Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

TOTAL: 30 HOURS

EI3280	**COMPUTER CONTROL OF PROCESSES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

To experimentally verify the simulation of controlling the different discrete processes.

Course Outcome		**Cognitive Skill**
CO-01	To understand the mathematical analysis and simulation of different control algorithms for efficient control of processes.	U, A
CO-02	To acquire knowledge of basic control processes and verify using MATLAB software.	U, A
CO-03	To acquire practical knowledge in Controller tunings	U, A, An
CO-04	To acquire practical knowledge in deadbeat, dahlin and kalman controllers	U, A, An

CO-05	To acquire skills in simulation of real time control applications.	U, A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	L	L	S	S	M	S	S	S	S	L	S	S
CO-02	L	L	S	S	M	S	S	S	S	L	S	S
CO-03	L	L	S	S	M	S	S	S	S	L	S	S
CO-04	L	L	S	S	M	S	S	S	S	L	S	S
CO-05	L	L	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

LIST OF EXPERIMENTS:

1. Simulation of continuous-time state-space model from the state equation.
2. Simulation of complex control systems.
3. Study of controllability and observability of different processes.
4. Simulation of first order system and second order system with and without dead time using Runge – Kutta method
5. Simulation of first order system and second orders system with and without dead time using discretization method
6. Transient stability analysis of a system.
7. Analysis of frequency domain specifications of a system.
8. Simulation of Discrete P+I+D controller for a first order system.
9. Simulation of deadbeat Controller.
10. Simulation of Dahlin's controller.
11. Relative gain array matrix calculations.
12. Simulation of Fuzzy Inference Systems.

TOTAL: 30 HOURS

SEMESTER VIII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EI32**	Programme Elective-V	3	0	0	3
2.	EI32**	Programme Elective - VI	3	0	0	3
PRACTICAL						
3.	EI32P5	Project Work	0	0	20	10
TOTAL			**6**	**0**	**20**	**16**

ELECTIVES

SI. NO	COURSE CODE	COURSE TITLE	L	T	P	C
List of Programme Electives						
1.	EI32A1	Biomedical Instrumentation and Measurements	3	0	0	3
2.	EI32A2	Robotics and Automation	3	0	0	3
3.	EI32A3	Instrumentation System Design	3	0	0	3
4.	EI32A4	Thermal Power Plant Instrumentation	3	0	0	3
5.	EI32A5	Applied Soft Computing	3	0	0	3
6.	EI32A6	Industrial Data Networks	3	0	0	3
7.	EI32A7	Instrumentation in Petrochemical Industries	3	0	0	3
8.	EI32A8	Field and Service Robotics	3	0	0	3
9.	EI32A9	Artificial Intelligence for Robotics	3	0	0	3
10.	EI32B1	Digital Twin and Industry 5.0	3	0	0	3
11.	EI32B2	Electric and Hybrid Vehicle Technology	3	0	0	3
12.	EI32B3	SCADA System and Applications	3	0	0	3
13.	EI32B4	Fibre Optics & Laser Instrumentation	3	0	0	3
14.	EI32B5	Nuclear Instrumentation	3	0	0	3
15.	EI32B6	Machine Vision	3	0	0	3
16.	EI32B7	Introduction to Autonomous Mobile Robots	3	0	0	3

EI32A1	BIOMEDICAL INSTRUMENTATION AND MEASUREMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of biomedical instrumentation.
- To study the measurement of certain electrical and non-electrical physiological parameters.
- To understand the principle of various imaging modalities analysis involved in medical field. basic principles in imaging techniques.
- To have a basic knowledge in life assisting and therapeutic devices.

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Course Outcome		Cognitive Skill
CO-01	To understand the origin of biological signals and electrode configurations for bio-potential measurements.	R, U
CO-02	To learn the measurement of certain electrical physiological parameters, acquisition and analysis.	R, U
CO-03	To explain the different techniques used for measurement of non-electrical parameters.	R, U
CO-04	Ability to get enough knowledge on various imaging modalities analysis involved in medical field.	U, An
CO-05	Ability to work using life assisting and therapeutic devices.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	L	L	S	S	M	S	S	S	S	L	S	S
CO-02	L	L	S	S	M	S	S	S	S	L	S	S
CO-03	L	L	S	S	M	S	S	S	S	L	S	S
CO-04	L	L	S	S	M	S	S	S	S	L	S	S
CO-05	L	L	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: FUNDAMENTALS OF BIOMEDICAL INSTRUMENTATION 9

Cell and its structure – Bio signals characteristics – Origin of bio potential and its propagation. Frequency and amplitude ranges. Resting and Action Potential – Nervous system and its fundamentals Basic components of a biomedical system- Physiological signals and transducers – Classification – selection criteria.

Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

UNIT II: ELECTRICAL PARAMETERS, ACQUISITION AND ANALYSIS 9

Bio signals characteristics- ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current- Instruments for checking safety parameters of biomedical equipment.

Need for bio-amplifier – Preamplifier- differential bio-amplifier- isolation amplifier -chopper amplifier.

UNIT III: NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Temperature, respiration rate and pulse rate measurements: Blood pressure- Measurement of blood pressure – Direct and indirect methods, Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography. Blood flow and cardiac output measurements: Electromagnetic and ultrasound blood flow measurements- Cardiac output - Heart rate - Heart sound - ESR, GSR measurements.

UNIT IV: IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques– Computer tomography– MRI– Ultrasonography– Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.

UNIT V: LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

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

TOTAL: 45 HOURS

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2nd edition, 2003.
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.

3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

EI32A2	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study control of robots and to educate various path planning techniques for specific applications.
- To introduce the dynamics and control of manipulators.

Course Outcome		Cognitive Skill
CO-01	Ability to understand the evolution of robot technology and basic terminology of Robotics.	U
CO-02	Familiarize various control schemes of Robotics control.	U
CO-03	Ability to model the motion of robots and analyze the workspace and trajectory planning of robots.	A
CO-04	Ability to understand the control of robot manipulators.	A
CO-05	Ability to understand the dynamic modelling of the robot.	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	L	L	S	S	M	S	S	S	S	L	S	S
CO-02	L	L	S	S	M	S	S	S	S	L	S	S
CO-03	L	L	S	S	M	S	S	S	S	L	S	S

CO-04	L	L	S	S	M	S	S	S	S	L	S	S
CO-05	L	L	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT-I: BASIC CONCEPTS **9**

Definition and origin of robotics - different types of robotics - various generations of robots- degrees of freedom - Robot classifications and specifications- Asimov's laws of robotics - dynamic stabilization of robots.

UNIT-II: POWER SOURCES, ACTUATORS AND SENSORS **9**

Hydraulic, pneumatic and electric drives: Design and control issues - Selection criterion for actuators, direct drives, non-traditional actuators- path determination - machine vision - ranging - laser - acoustic - magnetic, fiber optic and tactile sensors.

UNIT-III: MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION **9**

Construction of manipulators - manipulator dynamics and force control - electronic and pneumatic manipulator control circuits - end effectors - U various types of grippers - design considerations.

UNIT-IV: KINEMATICS AND PATH PLANNING **9**

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints - Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem - robot programming languages.

UNIT-V: DYNAMICS AND CONTROL AND APPLICATIONS **9**

Lagrangian mechanics- 2DOF Manipulator- Lagrange Euler formulation- Dynamic model - Manipulator control problem- Linear control schemes- PID control scheme-Force control of robotic manipulator. Robots in manufacturing and non- manufacturing applications. Micro &Nanorobots, Unmanned vehicles, Humanoids.

TOTAL: 45 HOURS

TEXT BOOK:

1. Mikell P. Weiss G. M., Nagel R. N., Odraj N. G., Industrial Robotics, McGraw-Hill, Singapore, 2015.
2. Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications Prentice Hall, 3rd Edition 2104.
3. Asfahl C. R., Robots and Manufacturing Automation, John Wiley, USA 1992.

REFERENCES:

1. Deb. S. R., Robotics Technology and Flexible Automation, John Wiley, USA 1992.
2. Klafter R. D., Chimielewski T. A., Negin M., Robotic Engineering - An integrated approach, Prentice Hall of India, New Delhi, 1994.
3. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
4. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

EI32A3	INSTRUMENTATION SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on the design of signal conditioning circuits for the measurement of level, temperature and pH.
- To develop the skills needed to design, fabricate and test analog/ digital PID controller, data loggers and alarm annunciator.
- To make the students familiarize design orifice and control valve sizing.

Course Outcome		Cognitive Skill
CO-01	Ability to acquire the knowledge of purpose and scope of instrumentation in industrial processes.	R, U
CO-02	Ability to design signal conditioning circuits for transmitters.	U, An
CO-03	Ability to design controller in continuous and discontinuous mode.	U, An
CO-04	Ability to design, flow meter and control valve.	U, An
CO-05	Ability to design Alarm and Annunciation circuits	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	L	M	L	M	L	S	M	M	L	M
CO-02	L	S	S	L	M	S	M	L	L	L	S	M
CO-03	M	S	L	S	L	L	S	M	S	M	L	L
CO-04	L	L	M	S	M	M	L	M	L	S	M	M
CO-05	M	M	L	L	S	M	M	L	M	L	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: DESIGN OF SIGNAL CONDITIONING CIRCUITS 9

Analog and Digital filter design and Adaptive filter design - Op-Amp circuits in instrumentation-design specifications of ADC, DAC – sample and hold circuit.- Signal conditioning circuit for

pH measurement, Air-purge Level Measurement - Signal conditioning circuit for Temperature measurement: Thermocouple, RTD and Thermistor -Cold Junction Compensation and Linearization

UNIT II: DESIGN OF TRANSMITTERS 9

Study of 2 wire and 4 wire transmitters - Design of RTD based Temperature Transmitter, design of cold junction compensation circuit for thermocouple based temperature transmitter- Capacitance based Level Transmitter and Smart Flow Transmitters.

UNIT III: DESIGN OF DATA LOGGER AND PID CONTROLLER 9

Design of ON / OFF Controller, PID Controller using Linear Integrated Circuits – Microcontroller Based Digital Two - degree of freedom PID Controller -Micro -controller based Data Logger -Design of PC based Data Acquisition Cards.

UNIT IV: ORIFICE AND CONTROL VALVE SIZING 9

Flow measurement: Design of Orifice meter, design of rotameter, Electromagnetic flow meter, Ultrasonic flow meter, Coriolis flow meter- Venturi and flow nozzle Valves: Control valves - design of actuators and positioners - Control valve sizing

UNIT V: DESIGN OF ALARM AND ANNUNCIATION CIRCUIT 9

Alarm and Annunciation circuits using Analog and Digital Circuits - Design of Programmable Logic Controller - Design of configurable sequential controller using PLDs.

TOTAL: 45 HOURS

TEXT BOOK:

1. C. D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Prentice Hall, 2006.
2. Patranabis, ’Principles of Industrial Instrumentation’, Tata McGraw Hill Publishing Company Ltd, 1996.

REFERENCES:

1. Control Valve Handbook, 4th Edition, Emerson Process Management, Fisher Controls International, 2005.
2. R.W. Miller, Flow Measurement Engineering Handbook, Mc-Graw Hill, New York 1996.
3. Bela G. Liptak, Instrument Engineers Handbook - Process Control and Optimization”, 4th edition, Vol.2, CRC Press.

EI32A4	THERMAL POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students familiarize about various power generation methods.
- To identify various parameters to be measured in thermal power plant.
- To impart knowledge about various instruments involved in furnace control processes.
- To understand about various instruments involved in boiler control processes

- To familiarize the student learn about monitoring and control techniques of turbine in power plants.

Course Outcome		Cognitive Skill
CO-01	Understanding various power generation processes	U
CO-02	Identify important parameters to be monitored and controlled in power plants	U
CO-03	Understanding the purpose of various instruments involved in furnace control processes	U
CO-04	Knowledge about various instruments involved in boiler control processes	U
CO-05	Knowledge about various control parameters in turbine monitoring and control	An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	M	M	S	S	M	M	S	M	L	S
CO-02	M	S	S	M	M	L	M	S	M	M	M	L
CO-03	M	L	M	M	S	L	S	L	M	M	M	S
CO-04	M	S	L	S	M	S	M	M	S	M	M	M
CO-05	S	M	S	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: POWER GENERATION METHODS **9**

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power - importance of instrumentation in power generation - thermal power plants: building blocks, details of boiler processes P&I diagram of boiler - cogeneration.

UNIT II: MEASUREMENTS IN POWER PLANTS **9**

Electrical measurements: current, voltage, power, frequency, power factor - non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature - smoke density measurement - Flue gas oxygen analyzer - Turbine speed and vibration measurement-

UNITIII: FURNACE CONTROL **9**

Coal handling: Pulverizers - Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.

UNITIV: BOILER CONTROL **9**

Boiler metal temperature measurement, pressure measuring devices - Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control - distributed control system inpower plants - interlocks in boiler operation.

UNIT V: TURBINE MONITORING AND CONTROL **9**

Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system

TOTAL: 45 HOURS

TEXT BOOK:

1. Sam G. Dukelow, The control of Boilers, Instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES:

1. Krishnaswamy K M, Bala P, Bala M P, ”Power Plant Instrumentation,” Prentice Hall, 2013.
2. Elonka. S. M.andKohal A. L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
3. Jain R. K., Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 2008.

EI32A5	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

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

Course Outcome		Cognitive Skill
CO-01	Ability to familiarize about the concepts of feedback and feed forward neural networks.	R, U

CO-02	Ability to provide adequate knowledge about fuzzy and neuro-fuzzy systems	U
CO-03	Able to cater the knowledge of Neural Networks, Fuzzy Logic Control and Genetic Algorithm and their applications for controlling real time systems.	An
CO-04	Able to understand the fundamentals of artificial intelligent and expert systems.	U
CO-05	Able to understand and apply computing platform and software for engineering problems	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	M	M	S	S	M	M	S	M	L	S
CO-02	M	S	S	M	M	L	M	S	M	M	M	L
CO-03	M	L	M	M	S	L	S	L	M	M	M	S
CO-04	M	S	L	S	M	S	M	M	S	M	M	M
CO-05	S	M	S	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: NEURAL NETWORKS **9**

Artificial neural networks - biological neurons, Basic models of artificial neural networks – McCulloch and Pitts Neuron, Perceptron networks Learning rule –Training and testing algorithm, Activation Functions – Multi-layer perceptron, Back propagation Network – Architecture, Learning algorithm

UNITII: STATISTICAL LEARNING MODELS **9**

Bayesian decision theory- Bayes classifier, Decision regions, significance of covariance matrix. Introduction to GMM. Support vector machines- introduction concept of maximum margin- Multi-class classifiers using SVM

UNIT-III: FUZZY SYSTEMS **9**

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

UNIT-IV: GENETIC ALGORITHMS **9**

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

UNIT V: SOFT COMPUTING FOR CONTROL APPLICATIONS **9**

Process modeling using ANN- Neuro controller for inverted pendulum. Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum - fuzzy PID control, Fuzzy based motor control.

TOTAL: 45 HOURS

TEXT BOOK:

1. LauranceFausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 3rd Edition, 2010.
3. S. N. Sivanandam and S. N. Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic - Intelligence Control & Information', Pearson Education, New Delhi, 2003.
3. M. Gen and R. Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design andAutomation, 2000.
4. Hagan, Demuth, Beale,"Neural Network Design", Cengage Learning, 2012
5. P. Padhy,"Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S. Levine,"Control System Advanced Methods," The Control Handbook CRC Press 2011.

EI32A6	INDUSTRIAL DATA NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

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

Course Outcome		Cognitive Skill
CO-01	Ability to define basic concepts of data communication and its importance.	R, U

CO-02	Ability to explain the various serial communication used in process industries.	R, U
CO-03	Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.	An
CO-04	Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.	An
CO-05	Apply and implement wireless technologies tor industrial applications.	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	S	S	M	M	S	M	L	S
CO-02	S	S	S	M	M	L	M	S	M	M	M	L
CO-03	S	L	M	M	S	L	S	L	M	M	M	S
CO-04	S	S	L	S	M	S	M	M	S	M	M	M
CO-05	S	M	S	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNITI: DATA NETWORK FUNDAMENTALS 9

Network Types -Network Topologies– OSI Model –protocol- TCP/IP Model –Token passing-Network Devices - Ethernet Standards.

UNIT II: SERIAL COMMUNICATION INTERFACES 9

RS232, RS422, and RS485:- Features - Signal levels - USB: - Types - Features - Signal levels - Data encoding - Packet types -Transfer types - CAN: - - Features - Signal levels – Message types - Message frames

UNITIII: HART AND FIELD BUS 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks, HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Fieldbus topology - Interoperability, Interchangeability-

UNITIV: MODBUS AND PROFIBUS ` 9

MODBUS protocol structure - function codes - Message format, PROFIBUS: - Introduction - Types - Operational Characteristics - Transmission technology - Introduction to PROFINET

UNITV: WIRELESS TECHNOLOGIES FOR INDUSTRIAL APPLICATIONS 9

Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation, Wireless sensor networks: - Hardware components –Network architecture - ISA100 - Wireless HART - IEEE 802.11 - IEEE 802.15.4

TOTAL: 45 HOURS

TEXT BOOK:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004.
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. BehrouzForouzan, Data Communications & Networking, 3rd edition, Tata McGrawhill, 2006.

REFERENCES:

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of IndiaPvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2ndEdition, 2005.

EI32A7	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES

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

Course Outcome		Cognitive Skill
CO-01	Gain knowledge on oil gas production process and important unit operations in a refinery.	U
CO-02	Ability to have gained the process knowledge, ability to develop and analyze mathematical model of selective processes.	U

CO-03	Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.	An
CO-04	Gain knowledge on the most important chemical derivatives obtained from petroleum products.	An
CO-05	Understand safety instrumentation followed in process industries.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	S	L	M	S	M	M	L	M	M	S
CO-02	S	S	S	M	M	L	M	S	M	M	L	M
CO-03	S	M	M	M	M	L	S	L	M	M	L	L
CO-04	M	S	S	S	M	M	M	M	S	L	S	M
CO-05	M	M	S	M	M	S	L	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: FORMATION OF CRUDE OIL AND GAS PRODUCTION 9

Origin, formation and evaluation of crude Oil. Techniques used for oil discovery - Oil recovery methods - oil rig system. Testing of petroleum Products. Refining of Petroleum - Overview of oil gas production - oil gas separation.

UNIT II: IMPORTANT UNIT OPERATIONS IN REFINERY 9

Distillation Column - Cracking - Thermal cracking - Catalytic Cracking - Hydro Cracking - Coking and Air Blowing of Bitumen. Catalytic reforming - Alkylation - Isomerization.

UNIT III: INTRODUCTION TO PETROCHEMICALS 9

Petrochemicals - Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Derivatives from methane - Methanol Production - Production of Acetylene from Methane, and Extraction of Aromatics.

UNIT IV: IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9

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

UNIT V: SAFETY IN INSTRUMENTATION SYSTEMS 9

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

TOTAL: 45 HOURS

TEXT BOOK:

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

REFERENCES:

1. Liptak, B.G., "Instrumentation in Process Industries", Chilton Book Company, 2005. (Digitized in 2008).
2. Austin, G.T. and Shreeves, A.G.T., "Chemical Process industries", McGraw-Hill, 2012.
3. HavardDevold,"Oil and Gas Production Handbook", ABB, 2006.
4. R Paul Gruhn and Harry Cheddie,"Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA Press, 2006.

EI32A8	FIELD AND SERVICE ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

Course Outcome		Cognitive Skill
CO-01	To remember the basic concepts of robot.	R
CO-02	To analyze the function of sensors in the robot.	U
CO-03	To acquire knowledge path planning of service robot.	An
CO-04	To use robots in different field applications.	A
CO-05	To learn the different use a humanoids robot for a typical application.	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	S	M	S	S	N	S	L	S	S
CO-02	M	M	M	S	S	S	L	S	N	L	S	S
CO-03	S	L	S	M	S	S	S	N	L	S	S	N
CO-04	S	M	L	S	S	S	L	S	S	L	S	S
CO-05	M	M	L	S	M	S	S	S	N	L	N	S

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: INTRODUCTION **9**

History of service robotics - Present status and future trends - Need for service robots - applications examples and Specifications of service and field Robots. Non-conventional Industrial robots.

UNIT II: LOCALIZATION **9**

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization Monte carlo localization- Landmark based navigation-Globally unique localization-Positioning beacon systems- Route based localization. Metrical maps - Grid maps - Sector maps – Hybrid Maps – SLAM.

UNITIII: PLANNING AND NAVIGATION **9**

Introduction-Path planning overview- Global path planning – A* Algorithm - local path planning Road map path planning- Cell decomposition path planning Potential field path planning - Obstacle avoidance

UNIT IV: FIELD ROBOTS **9**

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNITV: HUMANOIDS **9**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Human activity recognition using vision, touch, sound, Safety and robustness, Applications.

TOTAL: 45 HOURS

TEXT BOOK:

1. Roland Siegwart, Illah Reza Nourbakhsh, DavideScaramuzza, Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004.

2. RiadhSiaer, The future of Humanoid Robots- Research and applications, Intech Publications, 2012.

REFERENCES:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering - An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics", Springer, 2011.

EI32A9	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.

Course Outcome		Cognitive Skill
CO-01	To remember the problems are amenable to solution by AI methods.	R
CO-02	To understanding appropriate AI methods for problem solving.	U
CO-03	To formalize a given reasoning in the language/framework of different methods.	An
CO-04	To acquire knowledge on Implement basic learning methods for robot	A
CO-05	To learn the different ethics and design of AI with robot.	E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S

CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	S	L	M	S	L	L	M	L	M	L	N	N
CO-05	S	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTELLIGENT AGENT **9**

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Structure of Agent - Constraint satisfaction problems - knowledge and reasoning - knowledge representation.

UNIT II: PROBLEM SOLVING **9**

State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction

UNIT III: REASONING **9**

Uncertainity - Non-monotonic reasoning -Probabilistic reasoning - Filtering and prediction - Hidden Markov models - Kalman filters - Dynamic Bayesian Networks, genetic algorithm, making decisions.

UNIT IV: LEARNING **9**

Forms of learning - Knowledge in learning - Statistical learning methods - reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNITV: AI IN ROBOTICS **9**

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

TOTAL: 45 HOURS

TEXT BOOK:

1. Stuart Russell, Peter Norvig,"Artificial Intelligence: A modern approch", Pearson education, India, 2020.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems", Harlow: Addison Wesley, 2017.
3. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3rd edition, 2019

REFERENCES:

1. David Jefferis,"Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 2012.
2. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 2010.

3. Bratko, "Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
4. C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning MIT press, 2020.

EI32B1	DIGITAL TWIN AND INDUSTRY 5.0	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics concepts in digital twin.
- To introduce the concepts in digital twin in a discrete Industry.
- To introduce the concepts in digital twin in a process Industry.
- To obtain the knowledge in industry 5.0.
- To know about the advantages in industry 5.0.

Course Outcome		Cognitive Skill
CO-01	To describe the transition to digital twin, its challenges and opportunities.	R, U
CO-02	To understand the importance of digital twin and its requirements in discrete industries.	R, U
CO-03	To understand the importance of digital twin and its requirements in process industries.	U, An
CO-04	To acquire knowledge in transition of industry 4.0 to industry 5.0 era, its scope and opportunities.	R, U
CO-05	To describe the applications in digital twins in industries.	An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S
CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	S	L	M	S	L	L	M	L	M	L	N	N

CO-05	S	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION **9**

Digital twin – Definition, types of Industry and its key requirements, Importance, Application of Digital Twin in process, product, service industries, History of Digital Twin, DTT role in industry innovation, Technologies/tools enabling Digital Twin – Virtual CAD Models – control Parameters-Real time systems – control Parameters – Handshaking Through Internet – cyber physical systems

UNIT II: DIGITAL TWIN IN A DISCRETE INDUSTRY **9**

Basics of Discrete Industry, Trends in the discrete industry, control system requirements in a discrete industry, Digital Twin of a Product, Digital Thread in Discrete Industry, Data collection &analysis for product & production improvements, Automation simulation, Digital Enterprise.

UNIT III: DIGITAL TWIN IN A PROCESS INDUSTRY **9**

Basics of Process Industry, Trends in the process industry, control system requirements in a process industry, Digital Twin of a plant, Digital Thread in process Industry, Data collection and analysis for process improvements, process safety, Automation simulation, Digital Enterprise.

UNIT IV: INDUSTRY 5.0 **9**

Industrial Revolutions, Industry 5.0 – Definition, principles, Application of Industry 5.0 in process& discrete industries, Benefits of Industry 5.0, challenges in Industry 5.0, Smart manufacturing, Internet of Things 5.0, Industrial Gateways, Basics of Communication requirements – cognitive systems 5.0.

UNIT V: ADVANTAGES OF DIGITAL TWIN **9**

Improvement in product quality, production process, process Safety, identify bottlenecks and improve efficiency, achieve flexibility in production, continuous prediction and tuning of production process through Simulation, reducing the time to market.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2018.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven Smart Manufacturing”, Elsevier Science., United States, 2019

REFERENCES:

1. Uthayan Elangovan, Industry 5.0: The Future of the Industrial Economy, CRC Press, 2022.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress., United States, 2015.
3. Christoph Jan Bartodziej, “The Concept Industry 4.0 an Empirical Analysis of Technologies and Applications in Production Logistics”, Springer Gambler., Germany,

2017.
4. Ibrahim Garbie, “Sustainability in Manufacturing Enterprises, Concepts, analyses and assessments for Industry 4.0”, Springer., Switzerland, 2016.
5. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018
6. Ulrich Sendler, “The Internet of Things, Industries 4.0 Unleashed”, Springer., Germany, 2018.

EI32B2	ELECTRIC AND HYBRID VEHICLE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide knowledge about electric vehicle architecture
- To understand the mechanics of hybrid electric vehicles
- To know the concepts of energy storage for EV and HEV
- To understand electric propulsion
- To impart knowledge on power electronic converter for battery charging

Course Outcome		Cognitive Skill
CO-01	Able to understand the principles of hybrid electric vehicles	U
CO-02	Acquire the concepts of control of vehicles	U
CO-03	Able to understand the energy storage principle in vehicles	A
CO-04	Learn the electric vehicle drives	A
CO-05	Acquire the knowledge on converters.	U,R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S

CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	S	L	M	S	L	L	M	L	M	L	N	N
CO-05	S	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAINCOMPONENTS 9

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT II: MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OFVEHICLES 9

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode – regeneration mode - series parallel mode

UNIT III: ENERGY STORAGE FOR EV AND HEV 9

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, Super capacitors.

UNIT IV: ELECTRIC VEHICLE DRIVES 9

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT V: POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING 9

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z- converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology.

TOTAL: 45 HOURS

TEXTBOOKS

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S. Gay and Ali Emadi CRC Press 2005
2. Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press 2003

REFERENCES:

1. Iqbal Husain, ‘Electric and Hybrid Electric Vehicles’, CRC Press, 2021.
2. Wei Liu, ‘Hybrid Electric Vehicle System Modeling and Control’, Second Edition, WILEY, 2017

3. James Larminie and John Lowry, 'Electric Vehicle Technology Explained', Second Edition, Wiley, 2012
4. Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles Sheldon S. Williamson Springer 2013
5. Modern Electric Vehicle Technology C.C. Chan and K.T. Chau Oxford University 2001

EI32B3	SCADA SYSTEM AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applications in power system.

Course Outcome		Cognitive Skill
CO-01	Able to understand the basics of SCADA	U
CO-02	Acquire the concepts of SCADA components	U
CO-03	Able to understand about theSCADA communication	A
CO-04	Learn the monitoring and control of plant using SCADA	A
CO-05	Acquire the knowledge about applications of SCADA	U,R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	L	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S
CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	M	L	M	S	L	L	M	L	M	L	N	N
CO-05	M	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION TO SCADA **9**

Evolution of SCADA - SCADA definitions - SCADA Functional requirements and Components - SCADA Hierarchical concept - SCADA architecture -General features -SCADA Applications

UNIT II: SCADA SYSTEM COMPONENTS **9**

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), SCADA Server, SCADA Control systems and Control panels

UNIT III: SCADA COMMUNICATION **9**

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fibre optic, PLCC etc. Interface provisions and communication extensions.

UNIT IV: SCADA MONITORING AND CONTROL **9**

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V: SCADA APPLICATIONS **9**

Utility applications -Transmission and Distribution sector operations, monitoring, analysis and improvement- Industries - oil, gas and water.

TOTAL: 45 HOURS

TEXTBOOKS:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications, USA, 2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

REFERENCES:

1. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
2. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, Penn Well 1999
3. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001

EI32B4	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose the students with basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the industrial applications of optical fibres.

- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about industrial application of lasers.
- To provide adequate knowledge about holography and medical applications of Lasers..

Course Outcome		Cognitive Skill
CO-01	Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers.	U
CO-02	Apply the gained knowledge on optical fibers for its use as communication medium.	A
CO-03	Apply the gained knowledge on optical fibers as sensor.	A
CO-04	Understand laser theory and laser generationsystem.	U, A
CO-05	Ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	L	L	S	S	M	S	S	S	S	L	S	S
CO-02	L	L	S	S	M	S	S	S	S	L	S	S
CO-03	L	L	S	S	M	S	S	S	S	L	S	S
CO-04	L	L	S	S	M	S	S	S	S	L	S	S
CO-05	L	L	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: OPTICAL FIBER AND THEIR PROPERTIES 9

Principles of light propagation through a fiber – laws related to light propagation through fiber– Different types of fibers and their properties, Fiber manufacturing – mechanical and transmission characteristics – Connectors & splicers – Fiber termination – Optical sources – Optical detectors. Optical filters – Prism and Monochromators, Polarizers, Optical detectors – Single Channel and Multichannel detectors, Time resolved and phase resolved detection methods, Optical fibers – Total Internal Reflection

UNIT II: INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor)

Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) - Interferometric method of measurement of length - Moire fringes - Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III: LASER FUNDAMENTALS 9

Fundamental characteristics of lasers - Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers - Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness - Laser modes - Resonator configuration - Q-switching and modelocking - Cavity damping.

UNITIV: INDUSTRIAL APPLICATION OF LASERS 9

Types of LIDAR, construction and working, and LIDAR applications. Material processing: Laser instrumentation for material processing, Powder feeder, Laser heating, Laser welding, Laser melting, and Conduction limited melting and Key Hole melting. Laser trimming of material: Process of Laser trimming.

UNITV: MEDICAL APPLICATIONS 9

Medical applications of lasers, laser- tissue Interactions - Photochemical reactions, Thermalisation, Collisional relaxation, - Laser instruments for surgery, Removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology, Lasers in Ophthalmology - Dermatology and Dentistry – Cosmetic Surgery, Phototherapy, Photodynamic therapy (PDT)- Laser Safety Procedures.

TOTAL: 45 HOURS

TEXT BOOK:

1. J. M. Senior, 'Optical Fibre Communication - Principles and Practice', Prentice Hall of India, 1985.
2. J. Wilson and J. F. B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr.,"Fiber Optic Sensors: An Introduction for Engineers and Scientists", John Wiley & Sons, 2011.

REFERENCES:

1. Keiser, G.,"OpticalFiber Communication", McGraw-Hill, 3rd Edition, 2000.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.

EI32B5	NUCLEAR INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students familiarize about radioactive properties.
- To learn about different types of radiation detectors and counting systems.
- To learn about the applications of nuclear instrumentation in medical and industrial field.

Course Outcome		Cognitive Skill
CO-01	To acquire knowledge about radiation and its types.	R, U, A
CO-02	To get knowledge about different types of radiation detectors.	U, A
CO-03	To learn about Pre-amp, amplifiers and counting systems.	U, A
CO-04	To know about applications in medicines.	U, A
CO-05	To know about applications in industry.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	S	M	S	S	N	S	L	S	S
CO-02	M	M	M	S	S	S	L	S	N	L	S	S
CO-03	S	L	S	M	S	S	S	N	L	S	S	N
CO-04	S	M	L	S	S	S	L	S	S	L	S	S
CO-05	M	M	L	S	M	S	S	S	N	L	N	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: RADIOACTIVITY **9**

General properties of Nucleus, Radioactivity, Nature of Nuclear Radiations, Characteristic and Properties of Alpha, Beta, and Gamma rays, Natural and artificial radio-activity. Radioactivity

decay, Radioactivity Laws, Half-life period, radioactive decay series, Isotopes and Isobars, Various effects- photoelectric, Compton scattering and pair production, stopping power and range of charged nuclear particles.

UNIT II: RADIATION DETECTORS 9

Techniques for weak signal detection, Detectors for alpha, beta and gamma rays, Detector classification- Ionization chamber, Regions of multiplicative operation, Proportional counter, Geiger Muller counter-volt ampere characteristics, Designing features, Scintillation counter detectors, Types of Scintillation counter, efficiency of detection, Solid state detectors .

UNITIII: ELECTRONICS AND COUNTING SYSTEMS 9

Pre-amp., Main amplifiers, Discriminators, Scalars and count rate meters, Pulse shaping, pulse stretchers, Coincidence circuits, Radiation counting system block diagram, factors influencing resolution of gamma energy spectrum, Energy resolution in radiation detectors, single and multichannel analyzers (MCA), pulse height analyzers (PHA).

UNITIV: APPLICATION IN MEDICINES 9

Gamma camera- design, block diagram, medical usage. Nuclear Medical Imaging block diagram, Nuclear Instrumentation for health care, Radiation Personnel Health Monitors like neutron monitors, Gamma Monitors, Tritium monitors, Iodine monitors and PARA (particulate activity radiation alarms).

UNITV: APPLICATIONS IN INDUSTRY 9

Basic Nuclear Instrumentation system- Nuclear Instrumentation for laboratory. Industrial uses of radioactive materials - Personal monitors like Thermo Luminescence Detectors (TLD), Dosimeters, Tele-detectors. Nuclear Instrumentation for power reactor - Nuclear Instrumentation for Toxic fluid tank level measurement, Underground Piping Leak detection, weighing, Ultrasonic thickness gauges, water content measurement - Industrial Uses of Nuclear Materials - Agriculture applications like food irradiation.

TOTAL: 45 HOURS

TEXT BOOK:

1. G. F. Knoll, Radiation Detection & Measurement, 2nd edition, John Wiley & Sons, 1998.
2. P. W. NICHOLSON, Nuclear Electronics, John Wiley, 1998.
3. S. S. Kapoor& V. S. Ramamurthy, Nuclear Radiation Detectors, Wiley Eastern Limited, 1986.

REFERENCES:

1. Gaur & Gupta, Engineering Physics, DanpatRai& Sons, 2001.
2. Irvin Kaplan, Nuclear Physics, Narosa, 1987.
3. M. N. Avdhamule& P. G. Kshirsagar, Engineering Physics, S.Chand& Co., 2001.
4. R. M. Singru, Introduction to Experimental Nuclear Physics", Wiley Eastern Pvt. Ltd., 1974.
5. Hand Book of Nuclear Medical Instruments, TMH Publishing New Delhi, 1974.

EI32B6	MACHINE VISION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students familiarize about the fundamentals of machine vision.
- To provide adequate knowledge about image acquisition, conversion and decision making.
- To familiarize the students the use of machine vision techniques in pattern recognition.
- To provide adequate knowledge about applications of machine vision.

Course Outcome		Cognitive Skill
CO-01	Ability to familiarize about the fundamentals of machine vision.	R, U
CO-02	Ability to provide adequate knowledge about image acquisition, conversion and decision making.	U
CO-03	Ability to provide adequate knowledge about image processing decision making.	An
CO-04	Ability to familiarize the use of machine vision techniques to pattern recognition.	An
CO-05	Able to provide adequate knowledge about applications of machine vision.	U, An

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	L	S	M	L	L	S	L	L	L	L
CO-02	M	S	S	M	M	S	M	M	M	N	S	L
CO-03	S	S	L	S	M	L	S	L	S	N	M	L
CO-04	L	M	L	S	L	N	L	M	N	S	L	L
CO-05	M	M	L	M	S	L	L	M	M	M	L	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION TO MACHINE VISION **9**

Human Vision – Machine vision and Computer Vision – Benefits of Machine Vision – Block Diagram and Function of Machine Vision System, Machine Vision use of machine vision - tasks for a vision system - relation to other fields - place of vision in CIM.

UNITII: IMAGE ACQUISITION AND CONVERSION **9**

Colour systems - light sources - lighting techniques - image formation by lensing - image scanning - television cameras - sensors, charge coupled devices - camera and system interface - frame buffers and frame grabbers - digital and smart cameras.

UNIT III: IMAGE PROCESSING DECISION MAKING **9**

Processing of binary images - thresholding, geometrical properties, topological properties - processing of gray scale images statistical operations, spatial operations, segmentation edge detection, morphological operations - image analysis - factors extraction - decision making.

UNIT IV: PATTERN RECOGNITION **9**

Fundamentals - parametric classifiers - non parametric, classifiers nearest neighbour CART, neural networks, optimization, generic classifiers.

UNIT V: MACHINE VISION APPLICATIONS **9**

Applications in user industries automotive, semiconductor, electronic manufacturing, printing industries etc. - generic applications founding manufacturing metrology, inspection assembly verification - application analysis and implementation.

TOTAL: 45 HOURS

TEXT BOOK:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision" Cengage Learning India Pvt Ltd (2008).

REFERENCES:

1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis Publisher, 1973.
2. Rafael C. Gonzaies, Richard E. Woods, Digital Image processing publisher, 1992.
3. Nellazuech, 'Understanding & applying machine vision Marceldekker Inc. 2000.

EI32B7	INTRODUCTION TO AUTONOMOUS MOBILE ROBOTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce mobile robotic technology and its types in detail.
- To learn the kinematics of wheeled and legged robot.
- To familiarize the intelligence into the mobile robots using various sensors.
- To acquaint the localization strategies and mapping technique for mobile robot.
- To aware the collaborative mobile robotics in task planning, navigation and intelligence.

Course Outcome		Cognitive Skill
CO-01	Able to evaluate the appropriate mobile robots for the desired application.	U
CO-02	Able to analyze the sensors for the intelligence of mobile robotics	U, An
CO-03	Ability to evaluate the kinematics for given wheeled and legged robot.	R, U, E
CO-04	Ability to create the localization strategies and mapping technique for mobile robot.	U, A, An
CO-05	Ability to create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.	U, A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	L	S	S	M	S	S	S	S	L	S	S
CO-02	S	L	S	S	M	S	S	S	S	L	S	S
CO-03	S	L	S	S	M	S	S	S	S	L	S	S
CO-04	S	L	S	S	M	S	S	S	S	L	S	S
CO-05	S	L	S	S	M	S	S	S	S	L	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT-I: INTRODUCTION TO MOBILE ROBOTICS **9**

Introduction to Mobile robots - Locomotion, Classification - Legged, Wheeled, Aerial. Key issues in locomotion.

UNIT-II: MOBILE ROBOT KINEMATICS **9**

Kinematic models and constraints- Forward Kinematic model, Representing robot position, Wheel kinematic constraints, Motion control.

UNIT-III: PERCEPTION **9**

Sensors for mobile robots - Classification, performance, uncertainty in sensors, wheel/motor sensors, heading sensor, accelerometers, inertial measurement, motion sensor, range sensors. Vision sensor- Basics of computer vision, image processing techniques, feature extraction - image, range data location recognition.

UNIT-IV: LOCALIZATION **9**

Major challenges, localization based navigation. Belief representation, map representation, probabilistic map based localization, Autonomous map building.

UNIT-V: PLANNING AND NAVIGATION **9**

Planning - graph search, potential field path planning. Obstacle avoidance - bug algorithm, histogram, curvature velocity, nearness techniques. Navigation architecture. Case studies.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", second edition, MIT Press, Cambridge, 2011.

REFERENCES:

1. Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, "Humanoid Robots: Modelling and Control", Butterworth-Heinemann, 2018
2. Mohanta Jagadish Chandra, "Introduction to Mobile Robots Navigation", LAP Lambert Academic Publishing, 2015.
3. Peter Corke, "Robotics, Vision and Control", Springer, 2017.
4. Ulrich Nehmzow, "Mobile Robotics: A Practical Introduction", Springer, 2003.
5. Xiao Qi Chen, Y.Q. Chen and J.G. Chase, "Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions", Intec Press, 2009.
6. Alonzo Kelly, Mobile Robotics: Mathematics, Models, and Methods, Cambridge University Press, 2013, ISBN: 978-1107031159.

OPEN ELECTIVES

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
1.	EI32D1	Introduction to PLC Programming	3	0	0	3
2.	EI32D2	Introduction to Industrial Automation Systems	3	0	0	3

EI32D1	INTRODUCTION TO PLC PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand basic PLC terminologies digital principles, PLC architecture and operation.
- Familiarize different programming language of PLC.
- Develop PLC logic for simple applications using ladder logic.
- Understand the hardware and software behind PLC and SCADA.
- Exposures about communication architecture of PLC/SCADA.

Course Outcome		Cognitive Skill
CO-01	Know the basic requirement of a PLC input/output devices and architecture	R
CO-02	Ability to apply Basics Instruction Sets used for PLC Programming	R, U
CO-03	Ability to design PLC Program using Ladder Logic.	U
CO-04	Ability to design PLC Program using other languages	U
CO-05	Ability to apply programming for different applications	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L

CO-01	S	L	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S
CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	S	L	M	S	L	L	M	L	M	L	N	N
CO-05	S	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION TO PLC **9**

Introduction to PLC: Microprocessor - I/O Ports - Isolation – Filters - Drivers, PLC Construction: What is a PLC - PLC Memories -PLC I/O - PLC Special I/O - PLC Types.

UNIT II: PLC INSTRUCTIONS **9**

PLC Basic Instructions: PLC Ladder Language- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters, Examples.

UNIT III: PLC PROGRAMMING **9**

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions

UNIT IV: PLC PROGRAMMING (OTHER LANGUAGES) **9**

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT V: CASE STUDIES **9**

Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems

TOTAL: 45 HOURS

TEXT BOOKS:

1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication

REFERENCES:

1. MadhuchanndMitra and SamerjitSengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd.
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

EI32D2	INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To educate on design of signal conditioning circuits for various applications.
- To Introduce signal transmission techniques and their design.
- Study of components used in data acquisition systems interface techniques
- To educate on the components used in distributed control systems
- To introduce the communication buses used in automation industries.

Course Outcome		Cognitive Skill
CO-01	Ability get an overview of industrial automation	R
CO-02	Ability to learn about the different automation components	R, U
CO-03	Know about SCADA systems	U
CO-04	Understand about PLC systems	U
CO-05	Ability to know about DCS	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	L	M	S	N	S	M	L	M	N	N
CO-02	M	M	M	S	S	S	L	S	S	L	S	S
CO-03	S	M	M	S	S	S	L	S	S	L	S	S
CO-04	S	L	M	S	L	L	M	L	M	L	N	N
CO-05	S	S	L	M	S	L	L	N	L	N	N	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: INTRODUCTION **9**

Automation overview- Requirement of automation systems - Architecture of Industrial Automation system - Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: Modbus &Profibus

UNIT II: AUTOMATION COMPONENTS **9**

Sensors for temperature – pressure – force – displacement – speed – flow – level - humidity and pH measurement. Actuators - process control valves - Introduction of DC and AC servo drives for motion control.

UNIT III: SCADA **9**

Evolution of SCADA - SCADA definitions - SCADA Functional requirements and Components - SCADA Hierarchical concept - SCADA architecture -General features -SCADA Applications

UNIT IV: PROGRAMMABLE LOGIC CONTROLLERS **9**

Programmable controllers, Programmable logic controllers -Analog digital input and output modules - PLC programming - Ladder diagram, PLC Communication and networking, Application of PLC to process control industries.

UNIT V: DISTRIBUTED CONTROL SYSTEM **9**

Overview of DCS - DCS architecture - DCS communication - DCS interfaces - Features of DCS - Advantages of DCS - DCS applications.

TOTAL: 45 HOURS

TEXT BOOKS:

1. S.K.Singh, “Industrial Instrumentation”, Tata Mcgraw Hill, 2nd edition companies, 2003.
2. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall India, 8th Edition, 2006.
3. E.A.Parr, Newnes, New Delhi,“Industrial Control Handbook”,3rd Edition, 2000.
4. Clarke, G., Reynders, D. and Wright, E., “Practical Modern SCADA Protocols: DNP3, 4. 60870.5 and Related Systems”, Newnes, 1 st Edition, 2004.

REFERENCES:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003.
2. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill, New York, 2016.
