HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi & Accredited by NAAC with 'A' Grade)
Coimbatore – 641 032

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

Curriculum & Syllabus

2019-2020

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

IM1: To provide academic excellence in technical education through novel teaching methods.

IM2: To empower students with creative skills and leadership qualities.

IM3: To produce dedicated professionals with social responsibility.

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EIE - HiCET

Dean (Academics)
HiCET

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Chairman
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VISION AND MISSION OF THE DEPARTMENT

VISION

To impart quality technical education in the field of electronics and instrumentation engineering and strive to serve the society.

MISSION

M1. To enrich technical knowledge through effective teaching-learning process.

M2. To inculcate leadership and managerial skills.

M3. To create passion for serving the society with innovation and ethical responsible.

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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PO 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Ability to apply concepts of measurement and sensor to design, calibrate and control various process instruments using industrial automation.

PSO 2. Ability to analyze advanced electronics and instrumentation concepts required for industrial and research pursuits.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1. Graduates would have strong foundation in basic science and mathematics to formulate, analyze and solve electronics and instrumentation problems.

PEO 2. Graduates shall have good knowledge of instrumentation systems and their applications to design control and safety systems for industrial process.

PEO 3. Graduates exhibit professionalism with ethics, communication and team work to satisfy the needs of the society.

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CURRICULUM

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST
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Hindusthan College of Engineering and Technology

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi& Accredited by NAAC with 'A' Grade)
Coimbatore, Tamil Nadu.

TÜVRheinland CERTIFIED

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS
CBCS PATTERN
UNDERGRADUATE PROGRAMMES
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (UG)

REGULATION- 2016 & 2019

REGULATION-2019

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1103	Calculus and Differential Equations	BS	3	1	0	4	25	75	100
THEORY WITH LAB COMPONENT										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	19ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19HE1071	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
			Total :	**12**	**2**	**12**	**20**	**350**	**350**	**700**
As Per AICTE Norms 3 Weeks Induction Programme is Added in the First Semester as an Audit Course										

SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2102	Complex Variables and Transform Calculus	BS	3	1	0	4	25	75	100
THEORY WITH LAB COMPONENT										
3	19PH2151	Material Science	BS	2	0	2	3	50	50	100
4	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
5	19EE2151	Circuit Theory	ES	2	0	2	3	50	50	100
6	19CS2152	Essentials of C and C++ Programming	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
			Total :	**13**	**2**	**14**	**22**	**400**	**400**	**800**

REGULATION-2016

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER - III

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MA3103	Fourier Analysis and Statistics	3	1	0	4	25	75	100
2	16EI3201	Electronic Instrumentation	3	0	0	3	25	75	100
3	16EI3202	Electronic Devices and Circuits	3	0	0	3	25	75	100
4	16EI3203	Measurements and Instrumentation	3	0	0	3	25	75	100
5	16EI3204	Transducer Engineering	3	0	0	3	25	75	100
6	16ME3231	Fundamentals of Thermodynamics and Fluid Dynamics	3	0	0	3	25	75	100

PRACTICAL									
7	16EI3001	Transducer and Measurements Laboratory	0	0	4	2	50	50	100
8	16EI3002	Electronic Devices and Circuits Laboratory	0	0	4	2	50	50	100
		Total Credits:	**18**	**1**	**8**	**23**	**250**	**550**	**800**

SEMESTER – IV

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MA4107	Numerical Methods	3	1	0	4	25	75	100
2	16EI4201	Electrical Machines	3	0	0	3	25	75	100
3	16EI4202	Linear Integrated Circuits and Applications	3	0	0	3	25	75	100
4	16EI4203	Digital Logic Circuits	3	0	0	3	25	75	100
5	16EI4204	Power Plant Instrumentation	3	0	0	3	25	75	100
6	16EI4205	Industrial Instrumentation - I	3	0	0	3	25	75	100
PRACTICAL									
7	16EI4001	Electrical Machines Laboratory	0	0	4	2	50	50	100
8	16EI4002	Linear and Digital Integrated Circuits Laboratory	0	0	4	2	50	50	100
		Total Credits:	**18**	**1**	**8**	**23**	**250**	**550**	**800**

For the students admitted during the academic year 2017-2018 and onwards
SEMESTER – V

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16EI5201	Industrial Instrumentation – II	3	0	0	3	25	75	100
2	16EI5202	Analytical Instrumentation	3	0	0	3	25	75	100
3	16EI5203	Microprocessors and Microcontrollers	3	0	0	3	25	75	100
4	16EI5204	Control Systems	3	1	0	4	25	75	100
5	16IT5231	Object Oriented Programming Using Java	3	0	0	3	25	75	100
6	16EI53XX	**Professional Elective – I**	3	0	0	3	25	75	100
PRACTICAL									
7	16EI5001	Microprocessors and Microcontrollers Laboratory	0	0	4	2	50	50	100
8	16EI5002	Industrial Instrumentation Laboratory	0	0	4	2	50	50	100
9	16IT5031	Object Oriented Programming Laboratory	0	0	4	2	50	50	100
		Total Credits:	**18**	**1**	**12**	**25**	**300**	**600**	**900**

SEMESTER – VI

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
		THEORY							
1	16EI6201	Process Control	3	1	0	4	25	75	100
2	16EI6202	Applied VLSI Design	3	0	0	3	25	75	100
3	16EI6203	Discrete Time and Signal Processing	3	0	0	3	25	75	100
4	16EI6204	Embedded Systems	3	0	0	3	25	75	100
5	16EI63XX	**Professional Elective – II**	3	0	0	3	25	75	100
6	16XX64XX	**Open Elective – I**	3	0	0	3	25	75	100
		PRACTICAL							
7	16EI6001	Process Control Laboratory	0	0	4	2	50	50	100
8	16EI6002	Virtual Instrumentation Laboratory	0	0	4	2	50	50	100
9	16EI6701	**Technical Seminar**	0	0	2	1	0	100	100
		Total Credits:	**18**	**1**	**10**	**24**	**250**	**650**	**900**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI5301	Thermal Power Plant Instrumentation	3	0	0	3	25	75	100
2.	16EI5302	Digital System Design	3	0	0	3	25	75	100
3.	16EI5303	Digital Image Processing	3	0	0	3	25	75	100
4.	16EI5304	Communication Engineering	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - II

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI6301	Industrial Electronics	3	0	0	3	25	75	100
2.	16EI6302	Biomedical Instrumentation	3	0	0	3	25	75	100
3.	16EI6303	Advanced Control Theory	3	0	0	3	25	75	100
4.	16EI6304	Instrumentation in Petrochemical Industries	3	0	0	3	25	75	100

OPEN ELECTIVE

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	**16EI6401**	Neural Networks and Fuzzy Systems	3	0	0	3	25	75	100

For the students admitted during the academic year 2016-2017 and onwards

SEMESTER – VII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16EI7201	Computer Control of Process	3	0	0	3	25	75	100
2	16EI7202	Industrial Data Networks	3	0	0	3	25	75	100
3	16EI7203	Programmable Logic and Distributed Control System	3	0	0	3	25	75	100
4	16EI73XX	**Professional Elective - III**	3	0	0	3	25	75	100
5	16EI73XX	**Professional Elective - IV**	3	0	0	3	25	75	100
6	16XX74XX	**Open Elective – II**	3	0	0	3	25	75	100
PRACTICAL									
7	16EI7001	Computer Control of Process and Simulation Laboratory	0	0	4	2	50	50	100
8	16EI7002	Instrumentation System Design Laboratory	0	0	4	2	50	50	100
9	16EI7701	**Internship / Industrial Training**	0	0	0	2	0	100	100
		Total Credits:	**18**	**0**	**8**	**24**	**250**	**650**	**900**

SEMESTER – VIII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16EI83XX	**Professional Elective - V**	3	0	0	3	25	75	100
2	16EI83XX	**Professional Elective - VI**	3	0	0	3	25	75	100
PRACTICAL									
3	16EI8901	Project Work	0	0	20	10	100	100	200
		Total Credits:	**6**	**0**	**20**	**16**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - III

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI7301	Fiber Optics and Laser Instrumentation	3	0	0	3	25	75	100
2.	16EI7302	Adaptive Control and System Identification	3	0	0	3	25	75	100
3.	16EI7303	Instrumentation in Cement and Steel Industries	3	0	0	3	25	75	100
4.	16EI7304	Telemetry and Telecontrol	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE – IV

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI7305	Instrumentation in Paper Industries	3	0	0	3	25	75	100
2.	16EI7306	Micro Electro Mechanical Systems	3	0	0	3	25	75	100
3.	16EI7307	Non-Linear Control System	3	0	0	3	25	75	100
4.	16EI7308	Sensor Technology	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - V

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI8301	Instrumentation System Design	3	0	0	3	25	75	100
2.	16EI8302	Microcontroller Based System Design	3	0	0	3	25	75	100
3.	16EI8303	Robotics and Automation	3	0	0	3	25	75	100
4.	16EI8304	Nuclear Power Plant Instrumentation	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - VI

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	16EI8305	Environmental Instrumentation	3	0	0	3	25	75	100
2.	16EI8306	Safety Instrumentation System	3	0	0	3	25	75	100
3.	16EI8307	Instrumentation Systems for Disaster Management	3	0	0	3	25	75	100
4.	16EI8308	Professional Ethics in Engineering	3	0	0	3	25	75	100

OPEN ELECTIVES

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C	CIA	ESE	TOTAL
1.	**16EI7402**	Electrical Energy Management	3	0	0	3	25	75	100

CREDIT DISTRIBUTION – R2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	23	23	25	24	24	16	**187**

CREDIT DISTRIBUTION – R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	22	22	20	18	**165**

Chairman, Board of Studies

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Principal

PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

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Chairman

SYLLABUS

SEMESTER I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1101	TECHNICAL ENGLISH (COMMON TO ALL BRANCHES)	2	1	0	3

Course Objectives

1. To facilitate students to communicate effectively with coherence.
2. To train the learners in descriptive communication.
3. To introduce professional communication.
4. To enhance knowledge and to provide the information on corporate environment.
5. To equip the trainers with the necessary skills on critical thinking.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) **Reading** –Reading articles from newspaper, Reading comprehension **Writing** Chart analysis, process description, Writing instructions **Grammar and Vocabulary-** Tenses, Regular and irregular verb, technical vocabulary	9
II	**Listening and Speaking-** listening to product description, equipment & work place (purpose, appearance, function) **Reading-** Reading technical articles **Writing-** Letter phrases, writing personal letters, **Grammar and Vocabulary**-articles, Cause & effect, Prepositions..	9
III	**Listening and Speaking-** - listening to announcements **Reading-** Reading about technical inventions, research and development **Writing-** Letter inviting a candidate for interview, Job application and resume preparation **Grammar and Vocabulary-** Homophones and Homonyms.	9
IV	**Listening and Speaking-** - Practice telephone skills and telephone etiquette (listening and responding, asking questions).**Reading-** Reading short texts and memos **Writing-** invitation letters, accepting an invitation and declining an invitation **Grammar and Vocabulary-** Modal verbs, Collocation, Conditionals, Subject verb agreement and Pronoun-Antecedent agreement.	9
V	**Listening and Speaking-** listening to technical group discussions and participating in GDs **Reading-** reading biographical writing **- Writing-** Proposal writing, Writing definitions, **Grammar and Vocabulary**- Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs.	9
	Total Instructional Hours	**45**

Course Outcomes

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016

T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2021.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

R2- Raymond Murphy, "English Grammar in Use"- 4th edition Cambridge University Press, 2004

R3- Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I &II", Orient Blackswan, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA1103	CALCULUS AND DIFFERENTIAL EQUATIONS (COMMON TO EEE, ECE, EIE AND BIO MEDICAL)	3	1	0	4

Course Objective

1. Understand the concept of differentiation.
2. Compute the functions of several variables which are needed in many branches of engineering.
3. Understand the concept of double integrals.
4. Understand the concept of triple integrals.
5. Solve ordinary differential equations of certain types using Wronskian technique.

Unit	Description	Instructional Hours
I	**DIFFERENTIAL CALCULUS** Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
II	**MULTIVARIABLE CALCULUS (DIFFERENTIATION)** Total derivatives - Jacobians – Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	**DOUBLE INTEGRATION** Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parellopiped.	12
IV	**TRIBLE INTEGRATION** Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parellopiped.	12
V	**ORDINARY DIFFERENTIAL EQUATIONS** Ordinary differential equations of second order - Second order linear differential equations with constant coefficients – Cauchy – Euler's Equation - Cauchy – Legendre's Equation - Method of variation of parameters.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Apply the concept of differentiation in any curve.
CO2: Identify the maximum and minimum values of surfaces.
CO3: Apply double integrals to compute the area of plane curves.
CO4: Evaluation of triple integrals to compute volume of solids.
CO5: Develop sound knowledge of techniques in solving ordinary differential equations that model engineering problems.

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.
T2 - Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

R1- Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition,,Narosa Publishing House, New Delhi.
R2 - Weir,M.D and Joel Hass, ' Thomas Calculus" 12th Edition,Pearson India 2016.
R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH1151	APPLIED PHYSICS (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. Enhance the fundamental knowledge in properties of matter
2. Analysis the oscillatory motions of particles
3. Extend the knowledge about wave optics
4. Gain knowledge about laser and their applications
5. Conversant with principles of optical fiber, types and applications of optical fiber

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER** Elasticity – Hooke's law – Stress-strain diagram - Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment-**Determination of Young's modulus by uniform B.E.nding method.**	6+3
II	**OSCILLATONS** Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution – Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment. **Determination of Rigidity modulus – Torsion pendulum.**	6+3
III	**WAVE OPTICS** Conditions for sustained Interference – air wedge and it's applications - Diffraction of light – Fresnel and Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating. **Determination of wavelength of mercury spectrum – spectrometer grating. Determination of thickness of a thin wire – Air wedge method**.	6+6
IV	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Type of lasers – Nd:YAG laser and CO2 laser- Laser Applications – Holography – Construction and reconstruction of images. **Determination of Wavelength and particle size using Laser.**	6+3
V	**FIB.E.R OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors.	6
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate the fundamental properties of matter
CO2: Discuss the Oscillatory motions of particles
CO3: Analyze the wavelength of different colors
CO4: Understand the advanced technology of LASER in the field of Engineering
CO5: Develop the technology of fiber optical communication in engineering field

TEXT BOOKS:

T1 - Rajendran V, "Applied Physics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Con ltd., New Delhi, 2016
R3 - Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY1151	CHEMISTRY FOR ENGINEERS (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. The boiler feed water requirements, related problems and water treatment techniques.
2. The principles of polymer chemistry and engineering applications of polymers and composites.
3. The principles of electrochemistry and with the mechanism of corrosion and its control.
4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
5. The important concepts of spectroscopy and its applications

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination-**Estimation of total, permanent and temporary hardness of water by EDTA.**	6+3
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP.	6
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types –galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions- **Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric titration (Mixture of strong acid and base). Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4**	6+9
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy- **Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).**	6+3
	Total Instructional Hours	**45**

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Course Outcome	CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance. CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design. CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities. CO5: Identify the structure and characteristics of unknown/new compound with the help of spectroscopy.

TEXT BOOKS:

T1 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi,2018.
T2 - Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004.

REFERENCES:

R1 - B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi,2012.
R2 - S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi ,2017

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CS1151	PYTHON PROGRAMMING AND PRACTICES (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

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

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert acard in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** 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 B.E.tween two points.**	7+2(P)
III	**CONTROL FLOW, FUNCTIONS** 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 numB.E.rs, linear search, binary search.**	5+4(P)
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; **Illustrative programs: selection sort, insertion sort, merge sort, histogram.**	3+6(P)
V	**FILES, MODULES, PACKAGES** 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, copying file contents.**	5+4(P)
	Total Instructional Hours	**45 (29+16)**

Course Outcome

- CO1: Develop algorithmic solutions to simple computational problems
- CO2: Read, write, execute by hand simple Python programs
- CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions
- CO4: Represent compound data using Python lists, tuples, dictionaries
- CO5: Read and write data from/to files in Python Programs.

TEXT BOOKS:

T1 - Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.6.2", Shroff Publishers, First edition (2017).

T2 - S.Annadurai, S.Shankar, I.Jasmine Selvakumari Jeya, M.Revathi, "Fundamentals of Python Programming", McGraw Hill Publications, 2019.

REFERENCE BOOKS:

R1 - Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley India Edition, 2013.

R2 - Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015

R3 - Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME1152	ENGINEERING DRAWING	1	0	4	3

Course Objective

1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves.
2. To learn about the orthogonal projections of straight lines and planes.
3. To acquire the knowledge of projections of simple solid objects in plan and elevation.
4. To learn about the projection of sections of solids and development of surfaces.
5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing; drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections – Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane by rotating object method.	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves.
CO2: Draw the orthogonal projections of straight lines and planes.
CO3: Interpret the projections of simple solid objects in plan and elevation.
CO4: Draw the projections of section of solids and development of surfaces of solids.
CO5: Draw the isometric projections and the perspective views of different objects.

TEXT BOOK:

T1 - K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5th Edition New Age International Publishers, New Delhi 2016.

T2- K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai 2016.

REFERENCES:

R1 - 1. Basant Agrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited,New Delhi 2013.

R2. N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	19HE1071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. To enhance student language competency
2. To train the students in LSRW skills
3. To develop student communication skills
4. To empower the trainee in business writing skills.
5. To train the students to react to different professional situations

Unit	Description	Instructional Hours
I	**Listening** Listening to technical group discussions and participating in GDs. listening to TED talks. Listen to Interviews & mock interview. Listening short texts and memos.	3
III	**Reading** Reading articles from newspaper, magazine. Reading comprehension. Reading about technical inventions, research and development. Reading short texts and memos.	3
III	**Writing** E-mail writing: Create and send email writing (to enquire about some details, to convey important message to all, to place an order, to share your joy and sad moment). Reply for an email writing.	3
IV	**Speaking** To present a seminar in a specific topic (what is important while choosing or deciding something to do). To respond or answer for general questions (answer for your personal details, about your family, education, your hobbies, your aim etc.,).	3
V	**Speaking** Participate in discussion or interactions (agree or disagree express your statement with a valid reason, involve in discussion to express your perspective on a particular topics).	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016.

T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCE BOOKS :

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.

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Semester II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2101	BUSINESS ENGLISH FOR ENGINEERS (COMMON TO ALL BRANCHES)	2	1	0	3

Course Objective

1. To introduce to business communication.
2. To train the students to react to different professional situations.
3. To make the learner familiar with the managerial skills
4. To empower the trainee in business writing skills.
5. To learn to interpret and expertise different content.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs	9
II	**Listening and Speaking-** listening to TED talks **Reading-**Making and interpretation of posters**Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary**- Active & passive voice, Spotting errors (Tenses, Preposition, Articles)	9
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary**- Direct and Indirect speech.	9
IV	**Listening and Speaking-** Role play- **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive	9
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company **- Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary**- Editing a passage(punctuation, spelling & number rules)	9
	Total Instructional Hours	**45**

Course Outcome

CO1- To know different modes of business communication.
CO2- To understand managerial techniques.
CO3- To apply the rules of grammar and vocabulary in effective business communication.
CO4- To analyse and interpret business documents.
CO5- To draft business reports

TEXT BOOKS:

T1 - Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press, 2016.
T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2015.

REFERENCE BOOKS :

R1 - Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009
R2- Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.
R3-Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 2001.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA2102	COMPLEX VARIABLES AND TRANSFORM CALCULUS (COMMON TO EEE, EIE AND BIOMED)	3	1	0	4

Course Objective

1. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2. Identify effective mathematical tools for the solutions of partial differential equations.
3. Describe the construction of analytic functions and conformal mapping.
4. Illustrate Cauchy's integral theorem and calculus of residues.
5. Analyze the techniques of Laplace and Inverse laplace transform.

Unit	Description	Instructional Hours
I	**MATRICES** Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) Cayley - Hamilton Theorem (excluding proof) - Orthogonal matrices – Definition – Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by the elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form f(p,q)=0, Clairaut's type : z = px+qy +f(p,q) – Lagrange's linear equation.	12
III	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann's equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne –Thomson's method – Conformal mapping w = A+z , Az, 1/z and bilinear transformations.	12
IV	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) – Residues - Cauchy's Residue theorem.	12
V	**TRANSFORM CALCULUS** Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transform of periodic functions - Inverse Laplace transform - Convolution theorem (without proof) – Solution of linear ODE of second order with constant coefficients using Laplace transforms.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies.
CO2: Solve Partial Differential Equations using various methods.
CO3: Infer the knowledge of construction of analytic functions and conformal mapping.
CO4: Evaluate real and complex integrals over suitable closed paths or contours.
CO5: Apply Laplace transform and its properties to solve certain linear differential equations.

TEXT BOOKS:

T1 -Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.
T2 -Erwin Kreyszig, "Advanced Engineering Mathematics",10thEdition, Wiley India Private Ltd., New Delhi, 2018

REFERENCE BOOKS :

R1-Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.
R2- Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
R3- Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH2151	MATERIAL SCIENCE (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. Acquire fundamental knowledge of semiconducting materials related to the Engineering program.
2. Extend the knowledge about the magnetic materials.
3. Explore the behavior of super conducting materials.
4. Gain knowledge about Crystal systems.
5. Understand the importance of ultrasonic waves.

Unit	Description	Instructional Hours
I	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative)-**Determination of band gap of a semiconductor- Determination of acceptance angle and numerical aperature in an optical fiB.E.r**.	6+6
II	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications-**B – H curve by Magnetic hysteresis experiment.**	6+3
III	**SUPERCONDUCTING MATERIALS** Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors –High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation.	6
IV	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	6
V	**ULTRASONICS** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echo system-**Determination of velocity of sound and compressibility of liquid – Ultrasonic wave-Determination of Coefficient of viscosity of a liquid –Poiseuille's method.**	6+6
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor

CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday

CO3: Discuss the behavior of super conducting materials

CO4: Illustrate the types and importance of crystal systems

CO5: Evaluate the production of ultrasonics and its applications in NDT

TEXT BOOKS:

T1 - Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1 - Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2 - M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016
R3 - Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY2151	ENVIRONMENTAL STUDIES (COMMON TO ALL BRANCHES)	2	0	2	3

Course Objective

1. The natural resources, exploitation and its conservation
2. The importance of environmental education, ecosystem and biodiversity.
3. The knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
4. Scientific, technological, economic and political solutions to environmental problems.
5. An awareness of the national and international concern for environment and its protection

Unit	Description	Instructional Hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	6
II	**NATURAL RESOURCES** Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources– Solar energy and wind energy - role of an individual in conservation of natural resources.	6+9
III	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution-**Determination of Dissolved Oxygen in sewage water by Winkler's method-Estimation of alkalinity of water sample by indicator method- Determination of chloride content of water sample by argentometric method.**	6
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones**- Determination of pH in B.E.verages**.	6+3
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health- **Estimation of heavy metal ion (copper) in effluents by EDTA.**	6+3
	Total Instructional Hours	**45**

Course Outcome

CO1: Realize the importance of ecosystem and biodiversity for maintaining ecological balance.
CO2: Understand the causes of environmental pollution and hazards due to manmade activities.
CO3: Develop an understanding of different natural resources including renewable resources.
CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
CO5: Gain knowledge about the importance of women and child education and know about the existing technology to protect environment

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TEXT BOOKS:

T1 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018.
T2 - Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

REFERENCES:

R1 - Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015.
R2 - G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.
R3 - Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CS2152	ESSENTIALS OF C AND C++PROGRAMMING (COMMON TO CSE/EEE/EIE/ECE/BIO MED)	2	0	2	3

Course Objective

1. To Learn and develop basics of C programming.
2. To understand Object Oriented Programming concepts and basic characteristics of C++.
3. Be familiar with the constructors and operator overloading.
4. To understand the concepts of inheritance, polymorphism and virtual function.
5. To learn and define concept of templates and exception handling.

Unit	Description	Instructional Hours
I	**BASICS OF 'C' PROGRAMMING** Fundamentals of ' C' programming – Structure of a 'C' program – Constants - Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations- Branching and Looping - Arrays – One dimensional and Two dimensional arrays. **Programs: 1. Write a C program to calculate sum of individual digits of a given numB.E.r. 2. Write a C program to count no. of positive numB.E.rs, negative numB.E.rs and zeros in the array. 3. Write a C program to find sum of two numB.E.rs using functions with arguments and without return type**.	3+6(P)
II	**BASICS OF 'C++' PROGRAMMING** Introduction to C++ – structures and unions- Object oriented programming concepts–Defining a Class – creating objects - access specifiers – Function in C++ - function and data members default arguments – function overloading – Inline functions - friend functions – constant with class – static member of a class – nested classes – local classes. **Program: Write a C++ program to accept the student detail such as name and 3 differentmarks by get_data() method and display the name and average of marks using display() method. Define a friend class for calculating the average of marks using the method mark_avg().**	6+3(P)
III	**CONSTRUCTOR AND OPERATOR OVERLOADING** Constructors - Default, Copy, Parameterized, Dynamic constructors, Default argument – Destructor. - Function overloading- Operator overloading-Unary, Binary - Binary operators using friend function. **Program: Write a C++ program to calculate the volume of different geometric shapes like cuB.E., cylinder and sphere and hence implement the concept of Function Overloading.**	7+2(P)
IV	**INHERITANCE AND POLYMORPHISM** Inheritance – Public, Private and Protected derivations– Single– Multiple– Multilevel– Hybrid– Hierarchical - Virtual base class – abstract class – composite objects- Runtime polymorphism – virtual functions – pure virtual functions. **Program: Demonstrate Simple Inheritance concept by creating a base class FATHER with data memB.E.rs SurName and BankBalance and creating a derived class SON, which inherits SurName and BankBalance feature from base class but provides its own feature FirstName and DOB. Create and initialize F1 andS1 objects with appropriate constructors and display the Father & Son details. (Hint : While creating S1 object, call Father base class parameterized constructor through derived class by sending values).**	7+2(P)
V	**TEMPLATES AND EXCEPTION HANDLING** Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and Unexpected functions – Uncaught exception. **Program: Write a C++ program to create a template function for Bubble Sort and demonstrate sorting of integers and doubles.**	7+2(P)
	Total Instructional Hours	**45(30+15)**

Course Outcome

CO1:Able to develop simple applications in C using basic constructs.
CO2:Able to apply solutions to real world problems using basic characteristics of C++.
CO3:Able to write object-oriented programs using operator overloading, constructors and destructors.
CO4:Able to develop programs with the concepts of inheritance and polymorphism.
CO5:Able to understand and define with C++ advanced features such as templates and exception handling.

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TEXT BOOKS:

T1 - E.Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2016.

T2 - E.Balagurusamy, "Object Oriented Programming with C++", 7th Edition, McGraw Hill Publication, 2017.

REFERENCE BOOKS:

R1 - Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

R2 - RohitKhurana, "Object Oriented Programming with C++",Vikas Publishing, 2nd Edition, 2016.

R3 - B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI2151	CIRCUIT THEORY (COMMON TO EIE AND EEE)	2	0	2	3

Course Objective

1. Analyze electric circuits and solve complex circuits
2. Impart knowledge on various network theorems in AC and DC circuits
3. Provide knowledge on resonance phenomenon and analyze coupled circuits
4. Analyze transient response of AC and DC inputs to RL.RC and RLC circuits
5. Draw phasor diagrams of voltage and current for three phase circuits and measure power and power factor

Unit	Description	Instructional Hours
I	**BASIC CIRCUITS ANALYSIS** Ohm's Law Kirchoff's laws – Resistors in series and parallel circuits- Source transformation– Voltage and current division- DC and AC Circuits –Power and Power factor- Mesh current and Node voltage method –Super Mesh-Super Node Analysis - **Experimental verification of Kirchoff's Laws**	6+3
II	**NETWORK REDUCTION AND NETWORK THEOREMS FOR DC CIRCUITS** Star delta conversion- Superposition Theorem – Thevenin's and Norton & Theorem –Maximum power transfer theorem –Reciprocity Theorem - Millman's Theorem - **Experimental verification of Network Theorems**	6+3
III	**RESONANCE AND COUPLED CIRCUITS** Series and Parallel resonance – frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Dot rule for coupled circuits - Tuned circuits – Single tuned circuits - **Simulation of resonance circuits.**	6+3
IV	**TRANSIENT RESPONSE** Transient response of RL, RC and RLC Circuits using Laplace transform for DC input - Time constants for RL,RC and RLC circuits - **Simulation of transient circuits.**	6+3
V	**THREE PHASE CIRCUITS** Three phase balanced / unbalanced voltage sources – analysis of three phase circuit with balanced supply and balanced load – phasor diagram of voltages and currents – power measurements using two wattmeter method – **Implementation of power measurement using two wattmeter method.**	6+3
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply basic laws to electrical circuits.
CO2: Solve electrical circuits using network theorems
CO3: Explain the concept of resonance and solve coupled circuit problems
CO4: Carryout problems in DC and AC transients
CO5: Analyse and calculate three phase AC circuit parameters

TEXT BOOKS:

T1 -William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 8th edition, 2012.

T2 – A.Sudhakar , Shyammohan S Palli, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill publishers, 8th edition, 2015.

REFERENCE BOOKS:

R1-Joseph A. Edminister, Mahmood Nahri, "Electric Circuits", Schaum'sseries, TataMcGraw-Hill, 2013.

R2-Chakrabarti A, "Circuit Theory - Analysis and SynthesisDhanpat Rai & Co,7th Revised Edition,2018.

R3-T.Nageswara Rao "Circuit Theory" AR Publication,Chennai,2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME2001	ENGINEERING PRACTICES LABORATORY (COMMON TO ALL BRANCHES)	0	0	4	2

Course Objective

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

S.No	Description of the Experiments
	CIVIL AND MECHANICAL ENGINEERING PRACTICES
1	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2	Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for right angle corner junction.
3	Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for T junction.
4	Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5	Practice on sheet metal Models– Trays and funnels
6	Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7	Practice on simple step turning, taper turning and drilling.
8	Demonstration on Smithy operation.
9	Demonstration on Foundry operation.
10	Demonstration on Power tools.

Total Practical Hours 45

GROUP B (ELECTRICAL)

S.No	Description of the Experiments
	ELECTRICAL ENGINEERING PRACTICES
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring
3	Stair case wiring.
4	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5	Measurement of energy using single phase energy meter.
6	Soldering practice using general purpose PCB.
7	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8	Study of Energy Efficient Equipment's and Measuring Instruments.

Total Practical Hours 45

Course Outcome

CO1: Fabricate wooden components and pipe connections including plumbing works.
CO2: Fabricate simple weld joints.
CO3: Fabricate different electrical wiring circuits and understand the AC Circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. To improve communication skills and Professional Grooming.
2. To impart deeper knowledge of English Language and its practical application in different facets of life.
3. To equip the techniques of GD, Public Speaking, debate etc.

Unit	Description	Instructional Hours
I	**Listening** Listening for gist and respond – Listen for detail using key words to extract specific meaning – listen for phonological detail – Listen and identify the main points for short explanations and presentation.	3
II	**Reading** Strategies for effective reading – read and recognize different text types – Genre and Organization of Ideas – Quantifying reading – reading to comprehend – Interpreting sentences – contrasting, summarizing or approximating	3
III	**Speaking** Speak to communicate – Make requests and ask questions to obtain personal information – use stress and intonation – articulate the sounds of English to make the meaning understood – speaking to present & Interact – opening and closing of speech.	3
IV	**Writing** Plan before writing – develop a paragraph: topic sentences, supporting sentences – write a descriptive paragraph – elements of good essay – descriptive, narrative, argumentative – writing emails – drafting resumes – project writing – convincing proposals.	3
V	**Language Development** Demonstration at level understanding of application of grammar rules – revision of common errors : preposition, tenses, conditional sentences –reference words – pronouns and conjunctions.	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Introduced to different modes and types of communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to writing.
CO5- Trained to analyze and respond to different types of communication.

REFERENCE BOOKS :

R1.Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
R2.Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
R3.High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
R4.Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2018.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA3103	FOURIER ANALYSIS AND STATISTICS (COMMON TO AERO, AUTO, MECH, EEE AND EIE)	3	1	0	4

Course Objectives

1. Introduce Fourier series analysis which is central to many applications in engineering.
2. Solve boundary value problems by applying Fourier series.
3. Acquaint with Fourier transform techniques used in wide variety of situations.
4. Provide the necessary basic concepts of some statistical methods.
5. Manipulate different kinds of problems occurring in engineering and technology by applying the design of experiments.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Half range sine and cosine series – Change of Interval - Parseval's Identity - Harmonic analysis. A spring -mass system deriven by an alterating square force, A series circuit with a sqaure –wave voltage, power delievered by a periodic current and modelling radiation intensity.	12
II	**BOUNDARY VALUE PROBLEMS** Classification - solution of one dimensional wave equation — one dimensional heat equation — steady state solutions of two dimensional heat equations (excluding insulated edges) – Fourier series solution in cartesian coordinates.	12
III	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem – Parseval's identity.	12
IV	**TESTING OF HYPOTHESIS** Large sample test based on Normal distribution for single mean and difference of means – Tests based on t (for single mean and difference of means) - F distribution – for testing difference of variance, Chi – Square test for Contingency table (Test for Independency) – Goodness of fit.	12
V	**DESIGN OF EXPERIMENTS** One way and two way classifications - Completely randomized design – Randomized block design –Latin square design.	12
	Total Instructional Hours	60 Hrs

Course Outcomes

CO1: Understand the mathematical principles of Fourier series which would provide them the ability to formulate and solve some of the physical problems of engineering.
CO2: Acquire the knowledge of application of Fourier series in solving the heat and wave equations.
CO3: Obtain the knowledge of Fourier transform techniques which extend its applications in Electrical circuit analysis, control system design and signal processing.
CO4: Acquire skills in analyzing statistical methods.
CO5: Have a clear perception of the statistical ideas and demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

T1 - Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Secondreprint, New Delhi, 2012.

T2 - Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Reprint 2011.

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REFERENCE BOOKS :

R1 - C.Roy Wylie " Advance Engineering Mathematics" Louis C. Barret, 6th Edition, Mc Graw Hill Education India Private Limited, New Delhi 2003.

R2 - Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III", S.Chand& Company Ltd., New Delhi, 1996.

R3 - Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineersand Scientists", 8th Edition, Pearson Education, Asia, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3201	ELECTRONIC INSTRUMENTATION	3	0	0	3

Course Objective

1. Describe the various analog electronic instruments and it's working
2. Classify signal generators and different types of wave analyzers
3. Illustrate cathode ray oscilloscope and display devices.
4. Explain about digital electronic instruments and its conversion techniques.
5. Outline smart instrumentation and measurements.

Unit	Description	Instructional Hours
I	**ELECTRONIC ANALOG METERS** A.C and D.C voltmeters - ammeter, multimeter - power meter - Q meter - true RMS meter - vector impedance meter - vector voltmeter - component measuring instruments - RF voltage and power measurements. AF oscillators - Instrument Transformers - Instrumentation amplifier.	9
II	**SIGNAL GENERATORS AND WAVE ANALYZERS** Sine wave generator - Frequency synthesized sine wave generator - Sweep frequency generator, pulse and square wave generator - Function generator - Noise generator - Applications. Wave analyzer: Types - Harmonic distortion analyzer - Spectrum analyzer.	9
III	**CATHODE RAY OSCILLOSCOPE, RECORDERS AND DISPLAYS** General purpose oscilloscope - Screens for CRT graticules - Vertical & horizontal deflection systems - Delay line - Multiple trace - Dual beam & dual trace - Probes - Storage oscilloscopes - Applications. X-Y Plotters, magnetic tape recording - Data loggers. Display devices: LED, LCD - Bar graph display - seven segments and dot matrix displays.	9
IV	**DIGITAL INSTRUMENTS** Digital Ammeter and Voltmeter - auto ranging, auto zeroing - Measurements of Frequency and Time Interval - DMM, DPM, Comparison between analog and digital techniques of measurement. Successive approximation and dual slope types of ADC - digital frequency counters - digital storage oscilloscopes - LCR meter.	9
V	**SMART INSTRUMENTS AND APPLICATIONS** Serial, parallel ports, USB–IEEE 802.15.4/ZigBee - Instruments used in computer controlled system - Digital Transducers - Smart/intelligent instruments, comparison with conventional type instruments - Role of measuring instruments and recorders in Industries - Applications of digital instruments.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Define the construction and working nature of A.C and D.C analog instruments.
CO2: Summarize the signal generators and analyzers for various parameter measurements.
CO3: Demonstrate the working of oscilloscope, recorders and display devices.
CO4: Implement digital measuring instruments for applications.
CO5: Build a computer controlled digital instruments and transducers for suitable industrial applications.

TEXT BOOKS:

T1 - Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2008.
T2 - Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill, 2010.

REFERENCE BOOKS:

R1 - Patranabis.D "Principles of Electronic Instrumentation", Prentice Hall of India Learning Pvt Ltd, 2009.
R2 - Rangan, C.S., Sarma G.R. and Mani V.S.V., "Instrumentation devices and systems", Tata McGraw Hill, New Delhi, 2008.
R3 - Kazem Sohraby, Daniel Minoli and Taieb Znati, "Wireless Sensor Networks - Technology, Protocols, and Applications" A John Wiley & Sons, Inc. Publications, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3202	ELECTRONIC DEVICES AND CIRCUITS (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Recall the basics of electronic devices.
2. Interpret the structure, operation and characteristics of transistors.
3. Analyze various configurations of BJT amplifiers.
4. Infer the basic concepts of large signal amplifiers.
5. Interpret the operations of feedback amplifiers and oscillators.

Unit	Description	Instructional Hours
I	**SEMICONDUCTOR DIODE** PN Junction Diode - Structure, Operation and V-I Characteristics, Diode Current Equation, Application of Diode - Rectifiers: Half Wave and Full Wave Rectifier - Zener Diode: Characteristics, Application of Zener Diode	9
II	**TRANSISTORS** Junction transistor - BJT: CE, CB and CC configurations, Transistor Biasing Circuits - JFET: Output and Transfer Characteristics, Structure, Operation and Characteristics of MOSFET and UJT.	9
III	**DESIGN AND ANALYSIS OF SMALL SIGNAL AMPLIFIER** BJT - Transistor Modeling, Hybrid Equivalent Circuit, Small Signal Analysis - Low Frequency Model : CE,CB,CC amplifiers, Differential Amplifier - A.C and D.C Analysis, Single Tuned Amplifiers.	9
IV	**LARGE SIGNAL AMPLIFIERS** Classification of Power Amplifiers, Efficiency of Class A and Class B Amplifier Complementary - Symmetry, Push - Pull Power Amplifiers- Calculation of Power Output, Efficiency and Power Dissipation - Crossover Distortion.	9
V	**FEEDBACK AMPLIFIERS AND OSCILLATORS** Advantages of Negative Feedback - Voltage / Current, Series, Shunt Feedback - Positive Feedback - Condition for Oscillations, RC Phase Shift - Wien bridge, Hartley, Colpitts and Crystal Oscillators.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the knowledge acquired about electronic devices.
CO2: Summarize the concepts of transistors.
CO3: Transform the acquired skill in designing an amplifier circuit.
CO4: Illustrate the working of large signal amplifiers.
CO5: Outline the concepts of feedback amplifiers, conditions for oscillation and types of oscillators.

TEXT BOOKS:

T1 - R.S.Sedha, "Applied Electronics" S.Chand Publications, 2008.
T2 - David A. Bell, "Electronic Devices and Circuits", 5th Edition, Prentice Hall of India, 2008.

REFERENCE BOOKS:

R1 - Rashid, "Micro Electronic Circuits" Thomson Publications, 1999.
R2 - Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
R3 - Robert L. Boylestad, "Electronic Devices and Circuit Theory", Prentice Hall of India, 2002.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3203	MEASUREMENTS AND INSTRUMENTATION (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Recognize the fundamentals of measurement system.
2. Understand the instruments used for measuring electrical parameters.
3. Examine the D.C. and A.C. bridges.
4. Enumerate the data storage and display devices.
5. Describe the various transducers and data acquisition system.

Unit	Description	Instructional Hours
I	**CHARACTERISTICS, ERRORS AND STANDARDS OF INSTRUMENTS** Functional elements of an instrument - Static and dynamic characteristics - Errors in measurement - Statistical evaluation of measurement data - Standards and Calibration.	9
II	**MEASURING INSTRUMENTS** Principle – Construction - operation of Moving Coil and Moving Iron Instruments - Ammeters and Voltmeters - Single phase, three phase wattmeters and energy meters - Instrument transformers- Instruments for measurement of frequency and phase.	9
III	**COMPARISON METHODS OF MEASUREMENTS** D.C Bridges: Wheatstone - Kelvin double bride - AC bridges: Anderson bridge –Maxwell bridge and Schering bridge - D.C & A.C Potentiometers- Transformer ratio bridge - Self-balancing bridge.	9
IV	**STORAGE AND DISPLAY DEVICES** Introduction - Magnetic disk and tape recorders - XY Recorders- CRT display- Display storage oscilloscope - LED & LCD display - Inkjet and Dot matrix printer.	9
V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS** Classification of transducers- Resistive transducer - RTD and Strain gauge transducer, Capacitive transducers - Inductive transducers - LVDT- Piezoelectric transducer- Hall effect transducers - Elements of data acquisition - Smart sensor.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate the fundamentals of measurement system.
CO2: Analyze the instruments used for measuring electrical parameters.
CO3: Determine the circuit parameters (R, L, C and frequency) using bridges.
CO4: Describe the data storage and display devices.
CO5: Select and use various transducers and data acquisition system.

TEXT BOOKS:

T1 - Doebelin. E, "Measurement Systems: Application and Design", 6th Edition, Tata McGraw Hill Private Limited, 2012.
T2 - Sawhney. A.K, "A Course in Electrical and Electronics – Measurement and Instrumentation", 19th Edition, Dhanpat Rai & Sons, 2014.

REFERENCE BOOKS:

R1- D.V.S. Moorthy, "Transducers and Instrumentation", Prentice Hall of India Pvt Ltd, 2007.
R2 - H.S. Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 2nd Edition 2004.
R3 - J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3204	TRANSDUCER ENGINEERING	3	0	0	3

Course Objective

1. Recall the fundamentals of measurement system.
2. Infer various resistive transducers operation with industrial parameters measurement.
3. Discuss the principle of working of various inductive transducers.
4. Apply the capacitive transducer working principle on industrial parameters measurement.
5. Illustrate the function of various miscellaneous transducers and sensors.

Unit	Description	Instructional Hours
I	**SIGNIFICANCE OF MEASUREMENT AND CHARACTERISTICS OF TRANSDUCER** Measurement system - Methods of measurements - Units and standards of measurement - Errors in measurement - Calibration methods - Statistical error analysis. Classification transducers - Characteristics of transducer - Mathematical model of transducer - Zero, First and Second order transducer - Response to impulse, step, ramp and sinusoidal inputs.	9
II	**RESISTIVE TRANSDUCERS** Resistance transducer - Principle of operation, construction, characteristics and application of potentiometer, strain gauge, thermocouple, Resistance Temperature Detector, thermostat, hot wire anemometer, moisture and humidity resistive transducer.	9
III	**INDUCTIVE TRANSDUCERS** Inductance transducer - Self and mutual inductive transducer- Principle of operation, construction, characteristics and application of LVDT, RVDT, synchro, variable reluctance transducer, eddy current transducer.	9
IV	**CAPACITIVE TRANSDUCERS** Capacitance transducer - Variable area type, variable air gap type - variable permittivity type; capacitive microphone - Frequency response - Applications (measurement of pressure, level, thickness, moisture and density).	9
V	**MISCELLANEOUS TRANSDUCERS AND SENSORS** Hall effect transducer-piezoelectric transducer - Magnetostrictive transducer - Digital transducer - Electrochemical transducer. Smart sensors - Proximity sensor - SQUID sensor - Biosensors - IC sensors - Safety sensor (Fire, smoke and gas leakage detection).	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Definition of errors, error analysis and characteristics response of different order transducers.
CO2: In-depth knowledge about resistive transducers.
CO3: Outline an adequate knowledge about various inductive transducers.
CO4: Make use of capacitive transducers on industrial parameters measurement.
CO5: Summarize the role of different industrial transducers and sensors.

TEXT BOOKS:

T1 - Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 19th Edition, Dhanpat Rai & Company Private Limited, 2004.
T2 - Renganathan. S, "Transducer Engineering", Allied Publishers, Chennai, 2003.

REFERENCE BOOKS:

R1 - Ernest O.Doebelin, "Measurement systems", 6th Edition, Tata McGraw Hill, New Delhi, 2011.
R2 - Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 2003.
R3 - Patranabis. D, "Principles of Industrial Instrumentation", Tata McGraw Hill, New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME3231	FUNDAMENTALS OF THERMODYNAMICS AND FLUID DYNAMICS	3	0	0	3

Course Objectives

1. To familiarize the students to understand the fundamentals of thermodynamics.
2. To acquire the knowledge and quantify the energy conversion.
3. To understand the energy degradation in thermodynamic systems.
4. To impart knowledge on the properties of fluids and its dimensions.
5. To learn about the performance of fluid machineries.

Unit	Description	Instructional Hours
I	**FUNDAMENTAL CONCEPTS & DEFINITIONS** Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions, state and processes. Intensive and extensive property, System and their types. Thermodynamic Equilibrium and Zeroth law of thermodynamics. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement and other modes of work. Relationship between temperature scales, Modes of heat transfer.	9
II	**FIRST LAW OF THERMODYNAMICS** Closed system: Constant pressure, constant volume, constant temperature, adiabatic and polytropic process, P-V diagram. Steady flow energy equation - Open systems: Turbines, pumps, nozzles, boiler and heat exchanger.	9
III	**SECOND LAW OF THERMODYNAMICS AND BOILERS** Statements of second law and its corollaries - Heat Reservoir, source and sink- Heat Engine, Refrigerator and Heat pump. Steam Boilers and its types, Mountings and accessories of boilers.	9
IV	**FLUID PROPERTIES AND DIMENSIONAL ANALYSIS** Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapour pressure and cavitation - Pressure and flow measuring instruments. Dimensions, Dimensional homogeneity, methods of dimensional analysis-Rayleigh and Buckingham's-π theorem.	9
V	**FLUID MACHINES** Classification of fluid machines- Fans, blowers, pumps, Turbines and compressors - working principle.	9
	Total Instructional Hours	**45**

Course Outcome

Upon completion of this course, the students will be able to:
CO1: Apply the thermodynamic Principles on its applications.
CO2: Solve the processes in Closed and open systems.
CO3: Calculate the performance of engine, refrigerator, and heat pump.
CO4: Develop skills in the properties of fluids and its dimensions.
CO5: Analyze the working and performance of various hydraulic machineries.

TEXT BOOK:

T1 – Nag P.K., "Basic and Applied Thermodynamics", 2nd Edition, Tata McGraw Hill Publication, 2002.
T2 - Claus Borgnakke and Richard E.Sonntag, "Fundamentals of thermodynamics", 7th Edition, John Wiley & sons, 2009.

REFERENCES:

R1 - Rajput R.K, "Thermal Engineering", 3rd Edition, Laxmi Publication, Delhi, 2012.
R2 - Yahya S.M., "Turbines, Compressors and Fans", 4th Edition, McGraw-Hill Education 2011.
R3 - Bansal R.K., —Fluid Mechanics and Hydraulic Machines, 9th Ed, Laxmi Publications, Delhi, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3001	TRANSDUCER AND MEASUREMENTS LABORATORY	0	0	4	2

Course Objective

1. Analyze the suitable instruments to meet the requirements of industrial applications.
2. Infer the various techniques of resistance, capacitance and inductance measurements.
3. Assess the concept of calibration technique in various measuring instruments.

Expt. No.	Description of the Experiments
1.	Characteristics of a Potentiometric transducer.
2.	Characteristics of Strain gauge and Load cell.
3.	Temperature Characteristics of a. Thermocouple. b. Thermistor. c. RTD.
4.	Characteristics of LVDT.
5.	Characteristics of Photoelectric tachometer.
6.	Characteristics of Hall effect transducer.
7.	Measurement of resistance using a. Wheatstone bridge. b. Kelvin's bridge.
8.	Measurement of Capacitance using Schering Bridge.
9.	Measurement of Inductance using Anderson Bridge.
10.	Calibration of Ammeter and Voltmeter using Student type Potentiometer.
11.	Calibration of Single-phase Energy meter and Wattmeter.
12.	Study of Smart Transducers.

Total Practical Hours 45

Course Outcome

CO1: Make use of sensors and transducers to measure the industrial parameters.
CO2: Represent the designing knowledge in signal conditioning circuits.
CO3: Analyze the characteristics of different transducers.
CO4: Discuss the various techniques of passive element measurements.
CO5: Impart knowledge to the students in handling the different kinds of transducers which they often meet in different aspects of transducers.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI3002	ELECTRONIC DEVICES AND CIRCUITS LABORATORY (COMMON TO EIE AND EEE)	0	0	4	2

Course Objective	1.Apply the knowledge gained in designing basic electronic circuits 2.Design feedback amplifiers and oscillators 3.Infer the working of cathode ray oscilloscope

Expt. No.	Description of the Experiments
1.	Characteristics of a. Semi conductor diode b. Zener diode
2.	Single Phase half-wave rectifiers with filters
3.	Single Phase full wave rectifiers with filters
4.	Characteristics of Transistor under a. Common Emitter Configuration b. Common Collector Configuration c. Common Base Configurations
5.	Characteristics of JFET and UJT
6.	Design of Relaxation Oscillator
7.	Design and Frequency response characteristics of a Common Emitter amplifier
8.	Design of Feedback Amplifier-Current series
9.	Design of transistor RC phase shift oscillator
10.	Characteristics of photo diode and photo transistor, study of light activated relay circuit
11.	Realization of first order passive filters
12.	Study of CRO and DSO for phase and frequency measurements
	Total Practical Hours 45

Course Outcome	CO1: Analyze about the characteristics of semiconductor devices CO2: Experiment the working of rectifier CO3: Design various electronic circuit configurations CO4: Demonstrate the frequency response of amplifiers CO5: Examine the design of current series feedback amplifier and RC phase shift oscillator

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA4107	NUMERICAL METHODS (COMMON TO AERO, AUTO, MECH,EEE &EIE)	3	1	0	4

Course Objective

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Apply various methods to find the intermediate values for the given data.
3. Be Familiar with the concepts of numerical differentiation and numerical integration of the unknownfunctions.
4. Understand the concept of solving ordinary differential equations by applying single and multi-step methods.
5. Appraise the methods introduced in the solution of ordinary differential equations and partial differentialequations.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of equation – Fixed point iteration : x = g(x) method – Newton-Raphson method – Solution oflinear system by Gauss Elimination and Gauss Jordan method – Iterative method : Gauss seidel method.	12
II	**INTERPOLATION** Interpolation: Newton's forward and backward difference formulae – Lagrangian interpolation forunequal intervals – Divided difference for unequal intervals : Newton's divided difference formula.	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Differentiation using interpolation formula – Newton's forward and backward interpolation formulae for equal intervals – Newton's divided difference formula for unequal intervals - Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Double integration using Trapezoidal and Simpson's rules	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods: Taylor's series method – Euler and Modified Euler methods for first orderequation – Fourth order Runge- kutta method for solving first order equations – Multi step method: Milne's predictor and corrector method and Adam – Bash forth predictor corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Finite difference solution of second order ordinary differential equation – Finite difference solutionof one dimensional heat equation by explicit and implicit methods – One dimensional Wave equation – Two dimensional Heat equations – Laplace and Poisson Equations.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Solve the system of linear algebraic equations representing steady state models and non linearequations arising in the field of engineering.
CO2: Understand the concept of interpolation in both cases of equal and unequal intervals.
CO3: Express the information from discrete data set through numerical differentiation and summaryinformation through numerical integration.
CO4: Classify and solve ordinary differential equations by using single and multi step methods.
CO5: Acquire knowledge of finding the solution of ordinary and partial differential equations which areuseful in attempting any engineering problems.

TEXT BOOKS:

T1 Sankara Rao K, "Numerical Methods for Scientists and Engineers", 3rd edition, Prentice Hall of India Private limited, New Delhi,2007.

T2 M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Computation", Fifth Edition, New Age International publishers 2010.

REFERENCE BOOKS:

R1 Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley and sons (Asia) limited.

R2 Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4201	ELECTRICAL MACHINES	3	0	0	3

Course Objective

1. Understand the principles of operations of electrical machines
2. Define the construction details of transformers
3. Understand the construction of AC electrical machines
4. Draw the phasor diagram of various machines
5. Introduce special electrical machines

Unit	Description	Instructional Hours
I	**D.C. MACHINES** D.C. Generator - Principle of operation and construction of DC generator - EMF equation - Characteristics - Armature reaction - Commutation. D.C. Motor - Types - Torque equation - Characteristics - Starting and speed control D.C. Motor	9
II	**TRANSFORMERS** Principle - Theory of ideal transformer - EMF equation - Construction details of shell and core type transformers - Tests on transformers - Equivalent circuit - Phasor diagram - Introduction to three-phase transformer connections.	9
III	**SYNCHRONOUS MACHINES** Synchronous Generator - Principle of operation and construction - types - EMF Equation - Vector diagram. Synchronous motor- Starting Methods - Torque equation - V curves - Speed control - Hunting	9
IV	**INDUCTION MACHINES** Three-phase Induction motor - principle of operation - Types - Torque-slip and Torque-speed characteristics - Starting methods and Speed control of induction motors. Introduction to induction generators.	9
V	**SINGLE PHASE INDUCTION MOTOR AND SPECIAL ELECTRICAL MACHINES (QUANTITATIVE TREATMENT ONLY)** Single phase induction motors - Double field revolving theory - Capacitor start capacitor run motors - Shaded pole motor - Repulsion type motor - Universal motor - Hysteresis motor - Permanent magnet synchronous motor - Switched reluctance motor - Brushless D.C motor - Stepper motor.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: State the principle of operation and construction of D.C. machines
CO2: Ability to write the transformers operation and construction
CO3: List the operation of synchronous machines
CO4: Explain the operation and control of induction machines
CO5: Illustrate the operation of special electrical machines

TEXT BOOKS:

T1 - Kothari D. P. and Nagrath I. J, "Electric Machines", Fourth Edition, McGraw Hill Education (India) Private Limited, 2015.
T2 - Deshpande M. V., "Electrical Machines", Prentice Hall of India Learning Pvt. Ltd., New Delhi, 2011.

REFERENCE BOOKS :

R1 - M.N.Bandyopadhyay, "Electrical Machines Theory and Practice", Prentice Hall of India Learning Pvt. Ltd., New Delhi, 2009.
R2 - B.L.Theraja and A.K.Theraja, "A Text Book of Electrical Technology" Volume II, S.Chand and Company, 2013.
R3 - C.A.Gross, "Electric Machines", CRC Press 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4202	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Infer adequate knowledge on IC fabrication procedure.
2. Relate the characteristics of linear integrated circuits and their applications.
3. Apply OP-AMP on various applications like Timers, PLL circuits, ADC and DAC.
4. Impart the basic knowledge of regulator circuits and special function ICs.
5. Summarize internal functional blocks of special function ICs.

Unit	Description	Instructional Hours
I	**IC FABRICATION** IC classification - chip size and circuit complexity - fundamental of monolithic IC technology - Silicon wafer preparation - Epitaxial growth - Oxidation - Masking and Etching - diffusion of impurities - Assembly Processing and packaging - Fabrication of Diode and FET.	9
II	**CHARACTERISTICS OF OP-AMP** Basic information of OP-AMP - Ideal OP-AMP characteristics - DC characteristics - AC characteristics - frequency response of OP-AMP - Slew Rate - differential amplifier - Basic applications of OP-AMP - Inverting and Non-inverting Amplifiers- summer - differentiator and integrator - V/I and I/V converters.	9
III	**APPLICATIONS OF OP-AMP** Instrumentation amplifier - First order LPF - First order HPF - First order Band pass and Band reject filters - Comparators - multivibrators - waveform generators - clippers - clampers - peak detector- S/H circuit - D/A converter : R- 2R ladder and weighted resistor types - A/D converters : Duel Slope, Successive Approximations.	9
IV	**SPECIAL IC's** Functional block- characteristics and application circuits with IC 555 Timer - Application: Missing pulse detector, PWM, FSK Generator, PPM,SCHMITT Trigger - IC566 voltage controlled oscillator - IC565 - Phase Lock Loop IC - PLL application: frequency multiplication/division, AM Detection.	9
V	**APPLICATION IC's** IC voltage regulators - LM78XX - 79XX Fixed voltage regulators - LM317 - 723 Variable voltage regulators - switching regulator - LM 380 power amplifier - IC8038 function generator - Opto Coupler IC's.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret the IC fabrication procedure.
CO2: Analyze the characteristics of operational amplifiers.
CO3: Outline the applications of OP-AMP.
CO4: Understand the working principle of special IC's.
CO5: Outline the function of voltage regulator as special IC's.

TEXT BOOKS:

T1 - D.Roy Choudhary, Sheil B.Jani, "Linear Integrated Circuits", Second Edition, New Age International Pvt. Ltd, 2003.
T2 - S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill, 2008.

REFERENCE BOOKS:

R1 - Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", Fourth Edition, Prentice Hall of India Learning Pvt. Ltd 2000.
R2 - Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", Prentice Hall of India Learning Pvt. Ltd, 6th Edition, 2012.
R3 - Floyd, Buchla, "Fundamentals of Analog Circuits", Pearson Education, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4203	DIGITAL LOGIC CIRCUITS (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Recall the basic number systems, codes and logical gates.
2. Infer the Boolean algebra and minimization logic.
3. Design combinational circuits.
4. Outline the design of synchronous and asynchronous sequential circuits.
5. Write a VHDL Coding for digital circuits

Unit	Description	Instructional Hours
I	**DIGITAL SYSTEM** Binary Numbers - Octal - Hexa Decimal and other base numbers - Number base conversions - complements - signed binary numbers - Floating point number representation - binary codes - error detecting and correcting codes - digital logic gates - Boolean algebra - basic theorems - Boolean functions - canonical and standard forms	9
II	**MINIMIZATION OF LOGIC CIRCUITS** Gate - Level Minimization and combination circuits - K-Map Methods - Three Variable - Four Variable - Five Variable - sum of products - product of sums Simplification - Don't care conditions - NAND and NOR implementation and other two level implementation.	9
III	**COMBINATIONAL LOGIC CIRCUITS** Design Procedure - Combinational circuit for different code converters and other problems - Binary Adder - subtractor - Multiplier - Magnitude Comparator - Decoders - Encoders - Multiplexers - Demultiplexers	9
IV	**SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS** Latches - Flip-flops - analysis of clocked sequential circuits - design of counters – Up counters -Down counters - Ripple counters - Registers - Shift registers - Synchronous Counters - Asynchronous Sequential Circuits: Reduction of state and flow tables - Race free state assignment	9
V	**VHDL AND PROGRAMMABLE LOGIC DEVICES** RTL Design - combinational logic - Sequential circuit - Operators - Introduction to Packages - Subprograms - Test bench. (Simulation / Tutorial Examples: adders, counters, flip-flops, FSM, Multiplexers / Demultiplexers) - Introduction to Programmable Logic Devices: PROM - PLA - PALS	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply knowledge of various number systems and simplify the logical expressions using Boolean functions.
CO2: Evaluate the concepts and minimization of logic circuits.
CO3: Develop combinational circuits.
CO4: Design and analysis of synchronous and asynchronous sequential circuits.
CO5: Build VHDL program for adders, counters, flip-flops, FSM, Multiplexers / De-multiplexers.

TEXT BOOKS:

T1 - Raj Kamal, ' Digital systems-Principles and Design', Pearson Education 2nd edition, 2007.
T2 - M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education 2013.

REFERENCE BOOKS:

R1 - Anand Kumar, "Fundamentals of Digital Circuits, Prentice Hall of India, 2013.
R2 - John F.Wakerly, 'Digital Design Principles and Practices", 4th edition , Prentice Hall of India Learning Private Ltd 2006.
R3 - Albert Paul Malvino Donald P.Leach,"Digital Principles and Applications, 4th edition, Tata Mc Graw-Hill 1994.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4204	POWER PLANT INSTRUMENTATION	3	0	0	3

Course Objective

1. Discuss the types of various methods of power generation.
2. Analyse the parameter for monitoring and controlling power plant.
3. Distinguish the various control loops available in boiler.
4. Discuss the operation of turbines and various control methods.
5. Interpret the operation of nuclear power plants.

Unit	Description	Instructional Hours
I	**METHODS OF POWER GENERATION** Power generation - types - importance of instrumentation in power generation - basic building block for all types of power generation plants – Piping and Instrumentation diagram (P&I)- cogeneration.	9
II	**PARAMETERS OF POWER PLANT AND ITS MEASUREMENT** Electrical and non electrical parameter measurement - correction factor for steam temp and steam pressure - drum level measurement - radiations detector - smoke density measurement - dust monitor - speed vibration, shell temperature monitoring and control.	9
III	**CONTROL LOOPS IN BOILER** Combustion Control-air/fuel ratio control - furnace draft control - main steam and reheat steam temperature control - super heater control - attemperator - deaerator control - distributed control system in power plants - Furnace safety interlocks and interlocks in boiler operation. Trimming of combustion air - Soot blowing. Burner management - Coal pulverizer control - Boiler types	9
IV	**TURBINE MONITORING AND MEASUREMENT** Types of steam turbines - Turbine protection measurement - Speed measurement - Free governor mode operation - Automatic Load-Frequency Control - Turbine oil system - Oil pressure drop relay - Oil cooling system - Turbine run up system.	9
V	**RENEWABLE POWER GENERATION** Solar energy resource - Solar sites and land resources - Solar power generation technologies - Solar thermal power generation - Photovoltaic devices - Cost of solar power - Wind resources - Wind turbine technology - Wind turbine anatomy - Offshore wind turbine technology - Wind farms - Environmental effects of wind power - Wind intermittency and grid issues - Wind capacity limits – Repowering - Cost of wind power	9
	Total Instructional Hours	**45**

Course Outcome

CO1 : Outline the various methods of power generation.
CO2 : Correlate the important measurement of various parameters instruments associated with power plants.
CO3 : Identify the appropriate control loop in boilers.
CO4 : Appraise the process involved in the operation of turbines.
CO5 : Outline the operation of nuclear power plants.

TEXT BOOKS:

T1 - Jain. R.K, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1995.
T2 - Sam Dukelow. G "The control of Boilers", Instrument Society of America, 1991.

REFERENCE BOOKS :

R1 - Elonka. S.M and Kohan. A.L, "Standard Boilers Operations", McGraw Hill, New Delhi, 1994.
R2 - S.N. Singh, "Electrical Power Generation, Transmission and Distribution", Prentice Hall of India, 2011.
R3 - Chattopadhyay. P , " Boiler Operation Engineering", Tata McGraw Hill Education, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4205	INDUSTRIAL INSTRUMENTATION-I	3	0	0	3

Course Objective

1. Infer the concepts of Speed, Force and Torque measurements in instrumentation.
2. Discuss the methods of Acceleration, Vibration, Density and Viscosity measurements.
3. Illustrate various pressure measurement instruments.
4. Demonstrate various temperature measuring instruments.
5. Outline the methods used for the measurement of temperature.

Unit	Description	Instructional Hours
I	**MEASUREMENT OF SPEED, FORCE AND TORQUE** Speed - Measurement of speed - moving iron and moving coil type - AC and DC tacho generators, photo electric pickup - stroboscope - Force - Measurement of force - Load cell, pneumatic and hydraulic load cell - Torque - Measurement of torque - Strain gauge, relative regular twist.	9
II	**MEASUREMENT OF ACCELERATION, VIBRATION, DENSITY AND VISCOSITY** Accelerometers - LVDT, piezoelectric, and variable reluctance type accelerometers Mechanical type vibration instruments - Seismic instrument as an accelerometer and vibrometer - Calibration of vibration pick-ups Units of density, specific gravity and viscosity used in industries - Baume scale, API scale - Pressure head type densitometer - Float type densitometer - Ultrasonic densitometer - Bridge type gas densitometer - Viscosity terms - Saybolt viscometer Rotameter type.	9
III	**MEASUREMENT OF PRESSURE** Units of pressure - Manometers - different types - Elastic type pressure gauges - Bourdon tube, bellows, diaphragms - Electrical methods - Measurement of vacuum-McLeod gauge, thermal conductivity gauges, Ionization gauge - flapper-nozzle assembly, Dead weight tester - Calibration and selection of pressure gauges.	9
IV	**MEASUREMENT OF TEMPERATURE** Temperature scales - bimetallic thermometer - filled-in thermometer - Electrical method of measurement - RTD - 3wire and 4 wire RTD, Thermistor, Thermocouples, laws of thermocouple, cold junction compensation, special techniques for measuring high temperature using thermocouples - thermal well - Radiation methods of temperature measurement - Pyrometers - radiation pyrometer and optical pyrometers - Calibration and selection of thermal sensing meters.	9
V	**THERMOCOUPLE AND RADIATION PYROMETER** Thermocouples - Laws of thermocouple, Fabrication of industrial thermocouples, Signal conditioning for thermocouple, isothermal block reference junctions, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Two colour radiation pyrometers - Fiber optic sensor for temperature measurement.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret the measurement of Speed, Force and Torque in instrumentation
CO2: Classify the Instruments used for measurement of Acceleration, Vibration, Density and Viscosity
CO3: Choose the instruments used for the measurement of pressure
CO4: Design temperature measuring instruments
CO5: Identify the methods used for the measurement of temperature

TEXT BOOKS:

T1 - E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill Ltd., 2003.
T2 - R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1999.

REFERENCE BOOKS :

R1 - D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Ltd.,1996.
R2 - A.K. Sawhney and P. Sawhney, "A Course on Mechanical Measurements, Instrumentation and Control", Dhanpat Rai and Co, 2004.
R3 - S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4001	ELECTRICAL MACHINES LABORATORY	0	0	4	2

Course Objective

1. Apply the knowledge gained to conduct load test on D.C machines.
2. Exposed to the load test on single and three phase induction motor.
3. Familiar with the operation of starters.

Expt. No.	Description of the Experiments
1.	a. Open circuit characteristics of D.C. shunt generator. b. Load characteristics of D.C. shunt generator
2.	Load test on D.C. shunt motor.
3.	Load test on D.C. series motor.
4.	Load test on D.C. Compound motor.
5.	Swinburne's test
6.	Speed control of D.C. shunt motor.
7.	Load test on single phase transformer
8.	a. Open circuit test on single phase transformer b. Short circuit test on single phase transformer
9.	Load test on single phase induction motor.
10.	Load test on three phase induction motor.
11.	a. No load test on three phase induction motor b. Blocked rotor test on three phase induction motor
12.	Study of starters

Total Practical Hours **45**

Course Outcome

CO1: Demonstrate the principle of DC generators, DC motors.
CO2: Explain the principle and to conduct test on transformers.
CO3: Validate suitable test to compute the characteristics of motors.
CO4: Establish suitable experiments on generators.
CO5: Demonstrate about starting methods of motors.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI4002	LINEAR AND DIGITAL INTEGRATED CIRCUIT LABORATORY (COMMON TO EIE AND EEE)	0	0	4	2

Course Objective

1. Impart the knowledge on Boolean function, code converter and D to A.
2. Analyze the functions of encoder and decoder, multiplexer and shift register.
3. Design the functions and characteristics of Op- amp.

S.No	Description of the Experiments
	DIGITAL LOGIC CIRCUITS
1.	Implementation of Boolean Functions, Adder/ Subtractor circuits.
2.	Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa.
3.	Encoders and Decoders.
4.	Multiplexer and De-multiplexer.
5.	Shift Register and Ring Counter.
	ANALOG CIRCUITS
6.	A stable and Monostable multivibrator and using IC 555 timer
7.	Performance characteristics of Op-amp IC.
8.	D/A and A/D Converter.
9.	Application of Op-Amp: Inverting and Non-Inverting amplifier.
10	Application of Op-Amp: Adder and Subtractor.
11.	Application of Op-Amp: Differential amplifier, Integrator and Differentiator
12.	Study of VCO and PLL ICs.
	Total Practical Hours 45

Course Outcome

CO1: Implement the Boolean function and analyze the performance of code conversion.
CO2: Evaluate the functions of D to A converter, encoder and decoder.
CO3: Understand the performance of multiplexer, shift register and ring counters.
CO4: Analyze the performance of Op-amp IC.
CO4: Assimilate the knowledge on VCO and PLL ICS.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5201	INDUSTRIAL INSTRUMENTATION - II	3	0	0	3

Course Objective

1. Outline the types of variable head type flow meters.
2. Discuss the different types of flow meters.
3. Illustrate the working of electrical type flow meters.
4. Classify the different level measurement techniques.
5. Observe the measurement techniques of viscosity, humidity and moisture content.

Unit	Description	Instructional Hours
I	**VARIABLE HEAD TYPE FLOW METERS** Measurement of Flow - Variable Head Type Flow meters - Orifice plate - venture tube - Flow Nozzle - Dall Tube - Installation of Head flow meters - Pitot tube.	9
II	**QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS** Differential pressure transmitters - Quantity meters - Inferential flow meters - variable area flow meters - Mass flow meters - Open Channel flow measurement - Calibration of Flow meters - selection of flow meters.	9
III	**ELECTRICAL TYPE FLOW METERS** Electromagnetic flow meter - Ultrasonic flow meters - Solid flow measurement - vortex shedding flow meter - Flow switches - Anemometer.	9
IV	**LEVEL MEASUREMENT** Float-Type level Indicators - Level measurement using displacer and torque tube - Air purge system - boiler drum level measurement - Electrical methods - Radiometric method - Ultrasonic sensors - Solid level measurement.	9
V	**MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE** Basics of Viscosity measurement - Saybolt viscometer - Rotameter viscometer- Consistency meters - measurement of Humidity - Dry and Wet Bulb Psychrometers - Dew-point Hygrometers - moisture measurement in solids.	9
	Total Instructional Hours	45

Course Outcome

CO1: Categorise variable head type flow meters.
CO2: Summarise the different types of flow meters.
CO3: Demonstrate the electrical characteristics used in flow meters.
CO4: Analyse the level measurement techniques for different applications.
CO5: Prioritize the different measuring meters for viscosity, humidity and moisture.

TEXT BOOKS:

T1 - D.Patranabis, "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2010.
T2 - K.Krishnaswamy, S.Vijayachitra, "Industrial Instrumentation", Second Edition, New Age International Publishers, 2010.

REFERENCE BOOKS:

R1 - B.G.Liptak, "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.
R2 - S.K.Singh., "Industrial Instrumentation and Control", Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2009.
R3 - Eckman, D.P., "Industrial Instrumentation", CBS Publishers and Distributer Pvt Limited, 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5202	ANALYTICAL INSTRUMENTATION	3	0	0	3

Course Objective

1. Understand various methods of analysis in electromagnetic spectrum.
2. Study important methods of analysis of in chromatography.
3. Introduce pollution monitoring instruments.
4. Infer the knowledge about pH meters.
5. Gain knowledge about Microscopic techniques.

Unit	Description	Instructional Hours
I	**COLORIMETRY AND SPECTROPHOTOMETRY** Elements of Analytical Instruments - Beer-Lambert law - Colorimeters - Single and double beam filter photometer - Multi-channel photometer - IR Spectrophotometers - Basic components - Types - FTIR spectrophotometers - Flame photometers - Atomic absorption and emission spectrophotometers.	9
II	**CHROMATOGRAPHY** Liquid Chromatography - Types - Column chromatography - Thin layer Chromatography - Paper partition Chromatography-Applications - High pressure liquid chromatography. Gas chromatography - Basic parts - Chromatographic column - Sources - Detectors - Thermal conductivity detector, Flame-ionization detector - Flame photometric detector-Atomic emission detector.	9
III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS** Types of gas analyzers - Paramagnetic oxygen analyzer, IR gas analyzer, Thermal conductivity analyzer - Gas density analyzer - Ionization of gases. Air pollution due to Co,So_2,No_2 analyzers, Dust and smoke measurements.	9
IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS** Principle of pH measurement - Hydrogen electrode, Glass electrode, Reference electrode - Selective Ion electrode, ammonia electrodes - Biosensors - Dissolved oxygen analyzer - Sodium analyzer - Silicon analyzer.	9
V	**NUCLEAR MAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES** Principle of NMR - types - Construction and applications - Electron spin resonance spectroscopy - components. Scanning Electron Microscope (SEM) - Basic principles, Instrumentation and applications. Transmission Electron Microscope (TEM) - Basic principles, Instrumentation and applications. Mass spectrometers - Types and applications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the principle of Spectrophotometers
CO2: Identify liquid and gas chromatographic techniques
CO3: Gain knowledge about gas analyzers and pollution monitoring system
CO4: Analyze pH measurements and dissolved gas components
CO5: Explain the principle of nuclear magnetic resonance and microscopic techniques

TEXT BOOKS:

T1 - R.S. Khandpur, "Handbook of Analytical Instruments", McGraw Hill Education (India) Private Limited, Third edition, 2015.
T2 - Robert D.Braun, "Introduction to Instrumental Analysis", PharmaMed Press/BSP books, Second edition, 2012.

REFERENCE BOOKS:

R1 - Bela G. Liptak, "Process Measurement and Analysis", Volume I, CRC Press, Forth edition, 2003.
R2 - G.W. Ewing, "Instrumental Methods of Analysis", Mc Graw Hill, 2004
R3 - James Keeler, "Understanding NMR Spectroscopy", Second Edition John Wiley & Sons, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5203	MICROPROCESSORS AND MICROCONTROLLERS (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Infer the fundamental components of 8085 architecture.
2. Discuss the assembly language programming with simple examples.
3. Integrate the concept of peripheral's interfacing with assembly language programming.
4. Explain the fundamental architecture of 8051 microcontroller and its programming concepts.
5. Propose the architecture study of advance microprocessors and microcontrollers.

Unit	Description	Instructional Hours
I	**ARCHITECTURE AND MEMORY INTERFACING OF 8085 PROCESSOR** Functional Block Diagram - Pinouts and signals - Memory Interfacing - I/O ports and Interfacing Concepts - Timing Diagram - Interrupts.	9
II	**PROGRAMMING OF 8085 PROCESSOR** Instruction format, Data Transfer, Arithmetic & Logic, Branch, Machine Control Instructions- Addressing Modes - Writing Assembly Language Programming: Loop Structure with Counting & Indexing - Look up table - Stack and Subroutine Instructions Stack-Sample Programs.	9
III	**PERIPHERAL INTERFACING** Study of Architecture and Programming of Peripheral IC's:8255 PPI, 8259 PIC, 8251 USART,8279 Keyboard Display Controller and 8253 Timer/ Counter - 8237 DMA - Interfacing with 8085:A/D & D/A converter.	9
IV	**MICROCONTROLLER 8051** Difference between Microprocessor and Microcontroller - Functional Block Diagram - Pinouts and Signals - Memory Organization - Interrupt Structure - Timer - I/O Ports and Data Transfer concepts - Serial Communication.	9
V	**MICROCONTROLLER PROGRAMMING & APPLICATIONS** Instruction Format - Addressing modes - Simple Programming Exercises - Interfacing: Keyboard and Display, Closed Loop Control of Servo Motor, Stepper Motor, Washing Machine Control. Study of Architecture of PIC Microcontroller, Arduino, Beagle bone, Raspberry pi modules.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret architecture of 8085 microprocessor and 8051 microcontroller
CO2: Observe the programming concept involved in 8085 & 8051.
CO3: Discuss the commonly used peripheral/ interfacing IC's with its programming.
CO4: Outline on simple programming skill for 8051 and its applications.
CO5: Employ the role of advanced microcontrollers & it's module in an embedded industries.

TEXT BOOKS:

T1 - Krishna Kant, "Microprocessors and Microcontrollers", Prentice Hall of India, New Delhi, 2007.
T2 - Muhammad Ali Mazidi, Janice G. Mazidi "The 8051 Microcontroller and Embedded System", Pearson Education, 2003.

REFERENCE BOOKS:

R1 - R.S. Gaonkar, "Microprocessor Architecture Programming and Application", Penram International Publishing Private limited, 5th edition 2010.
R2 - N.K.Srinath, "8085 Microprocessor Programming and Interfacing", Prentice Hall of India, Pvt Ltd, 2010.
R3 - N.Senthil Kumar, M.Saravanan, S.Jeevananthan, "Microprocessors and Microcontrollers" Oxford press, 2013.
R4 - William Kleitz, "Microprocessor and Microcontroller: Fundamental of 8085 and 8051 Hardware and Software" Pearson Education, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5204	CONTROL SYSTEMS (COMMON TO EIE AND EEE)	3	1	0	4

Course Objective

1. State the different methods of system representations and transfer function models for various systems.
2. Discuss time response system analysis.
3. Explain about frequency response system analysis.
4. Establish methods of stability analysis and controller compensators.
5. Outline advanced and sampled data control systems.

Unit	Description	Instructional Hours
I	**CONTROL SYSTEMS AND THEIR REPRESENTATIONS** Basic elements in control system, Systems and their representation – Open and closed loop systems – Transfer Function models – Mechanical Translational, Rotational systems – Electrical systems – Analogies – mechanical and Electrical analogous systems – Synchros – AC and DC servomotors.	12
II	**TIME RESPONSE ANALYSIS** Block diagram representation, Construction, Block diagram reduction techniques – Signal flow graphs – Standard test signals – Order of a system – impulse, step response of first order systems – second order system(under damped and critically damped) – Time domain specifications – Type Number of control system –Static Error constants – Steady state error.	12
III	**FREQUENCY RESPONSE ANALYSIS** Frequency response –Advantages – Frequency domain specifications, Types – Bode plot – Polar plot – M and N circles – Correlation between frequency and time domain specifications.	12
IV	**STABILITY AND COMPENSATOR DESIGN** Characteristics equation – Routh Hurwitz criterion – Relative and conditional stability, Root locus concept, construction, stability criterion. Effects of P,PI,PID controller modes of feedback control – Compensator – Types – Lag, lead and lag-lead networks – Lag-Lead compensator design using Bode plot.	12
V	**STATE MODELS AND SAMPLED DATA SYSTEMS** Concept of state and state models – State models for linear and time invariant Systems – State model of Armature and Field control system – Concept of Controllability and Observability. Introduction to digital control system, Introduction of Digital Controllers (Qualitative Treatment only).	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Apply basic knowledge for modeling of mechanical, electrical control systems
CO2: Deduct the different order systems with various inputs and their response
CO3: Estimate the various frequency domain specifications by phase analysis
CO4: Investigate the open and closed loop control systems stability and stability corrections
CO5: Develop a state models and discrete control systems for any application

TEXT BOOKS:

T1 - Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Learning Private Ltd, 5th Edition, 2010.
T2 - I.J.Nagrath and M.Gopal, "Control System Engineering," New Age international (P) Ltd, New Delhi, 2006.

REFERENCE BOOKS :

R1 - Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall of India, 2012.
R2 - M.Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill, New Delhi, 2003.
R3 - Nagoor Kani A " Control Systems Engineering," RBA publications, Chennai, 2006

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16IT5231	OBJECT ORIENTED PROGRAMMING USING JAVA (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Describe the concepts of Object Oriented Programming
2. Impart the fundamental concepts of core JAVA.
3. Enable the students to gain programming skills in JAVA.
4. Know how to handle exceptions.
5. Understand multithread programming logic

Unit	Description	Instructional Hours
I	**INTRODUCTION** Object oriented programming concepts – objects-classes- methods and messages-abstraction and encapsulation-inheritance- abstract classes- polymorphism-Overview of Object Oriented System Development –Object basics-Class hierarchy-UML	9
II	**OVERVIEW OF JAVA LANGUAGES** Basics of Java programming, Data types, Variables and Arrays, Operators, Control structures – Classes, Objects and Methods- access specifiers – static members –Constructors-this keyword-finalize method	9
III	**PACKAGES AND INTERFACES** Inheritance– Method Overriding- Abstract class-final keyword- Java API Packages –Naming conventions-creating, accessing, using Packages-Hiding classes- Interfaces: Multiple inheritance-defining, extending, implementing interfaces	9
IV	**EXCEPTION HANDLING** Fundamentals-Exception types –Uncaught exceptions-Using try and catch-Multiple Catch-Nested try-Throws-Finally-Built in Exceptions-Throwing own exceptions	9
V	**MULTITHREAD PROGRAMMING** Creating Threads- Extending thread class-Stopping and Blocking Thread-Life cycle –Using Thread-Thread Exceptions-Thread priority-Synchronization-Runnable Interface-Inter thread communications	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the concepts of OOPs
CO2: Design the syntax, semantics and classes in Java language
CO3: Analyze object inheritance and its use.
CO4: Apply various types of Exception handling
CO5: Implement the use of multithread programming.

TEXT BOOKS:

T1 - Herbert Schild, "Java The Complete Reference", Eighth Edition, McGraw Hill, 2011.
T2 - Ali Bahrami, "Object Oriented Systems Development", Pearson Education, 2008.

REFERENCE BOOKS :

R1 - E Balagurusamy, "Programming with JAVA", Fifth Edition, McGraw Hill, 2015.
R2 - Michael Blaha, JamesRumbaugh, "Object-Oriented Modeling and Design With UML", Second Edition, Pearson Education, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5001	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY (COMMON TO EIE AND EEE)	0	0	4	2

Course Objective

1. Discuss the assembly language programming with simple examples.
2. Integrate the concept of peripheral's interfacing with assembly language programming.
3. Propose the concepts of industrial drive interfacing concepts with programming.

Expt. No.	Description of the Experiments
1.	Simple arithmetic operations: d. 8-bit addition/subtraction/multiplication/division. e. 16 bit addition/subtraction.
2.	Programming with control instructions: a. Sorting Operations. b. Largest/ Smallest of given numbers. c. Code conversions.
3.	Programming using Rotate and Complement instructions.
4.	Generation of waveforms by interfacing D/A.
5.	Conversion of Analog signal to digital code with A/D interfacing.
6.	Traffic light controller.
7.	Keyboard and 7-segment display interface with 8279.
8.	Interface the stepper motor to perform clockwise and anti-clock wise rotation.
9.	Demonstration of basic function with 8051 microcontroller execution, including a. Conditional jumps b. Calling subroutines.
10.	Programming Practices with 8085 Simulators.
11.	Generation of PWM signal using timer and counter with 8051.
12.	Study on a. Raspberry pi/ Arduino based interfacing b. Stepper motor interfacing

Total Practical Hours 45

Course Outcome

CO1: Outline the 8085 architecture and its programming execution.
CO2: Implement interfacing knowledge with different applications.
CO3: Discriminate the programming concepts of 8051 with 8085.
CO4: Simplify the assembly language programming to text based programming with open source compiler.
CO5: Interpret the programming relevant to industrial applications.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5002	INDUSTRIAL INSTRUMENTATION LABORATORY	0	0	4	2

Course Objective

1. Analyze various measurement schemes that meet the desired specifications and requirements.
2. Interpret the principles of level and flow measurements.
3. Demonstrate various bio medical equipments.

Expt. No.	Description of the Experiments
1.	Discharge coefficient of a. Orifice plate. b. Venturi Tube. c. Pitot Tube.
2.	Testing of pressure gauge using dead weight tester.
3.	Measurement of viscosity of test solutions.
4.	Characteristics of vacuum pressure measurement.
5.	Level measurement using d/p transmitter and capacitance based level measurement.
6.	Measurement of absorbance and transmittance of test solutions using UV – Visible spectrophotometer.
7.	pH meter standardization and measurement of pH values of solutions.
8.	Measurements of conductivity of test solutions.
9.	Study of Control valve characteristics.
10.	ECG and pulse rate measurement.
11.	Respiration rate and blood pressure measurement using oscillometric method
12.	Study of EEG measurement.
	Total Practical Hours 45

Course Outcome

CO1: Illustrate the characteristics of Pressure, Temperature, flow, level, density and viscosity measurements.
CO2: Analyze the measured value for displaying or controlling the physical variables
CO3: Categorise different field instruments for different applications.
CO4: Demonstrate the principles involved in different measuring techniques.
CO5: Examine the bio medical related measuring devices.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16IT5031	OBJECT ORIENTED PROGRAMMING LABORATORY (COMMON TO EIE AND EEE)	0	0	4	2

Course Objective

1. Get a clear understanding of object-oriented concepts.
2. Write java programs to solve mathematics, science and engineering problems.
3. Identify compile time and runtime errors, syntax and logical errors
4. Import the essentials of java class library and user defined packages.
5. Make the students to write programs using multithreading concepts and handle exceptions

Expt. No.	Description of the Experiments
	Simple Java Applications
1.	Understanding References to an Instant of a Class
2.	Handling Strings
3.	Concept of class and arrays
4.	Constructor
5.	Overloading and overriding
6.	Inheritance
7.	Developing interfaces- multiple inheritance, extending interfaces
8.	Creating and accessing packages
	Threading
9.	Creation of Threading
10.	Multi-Threading
	Exception Handling Mechanism in Java
11.	Implementing Predefined Exceptions
12.	Implementing User Defined Exceptions
	Total Practical Hours 45

Course Outcome

CO1: Gain the basic knowledge on Object Oriented concepts.
CO2: Ability to develop applications using Object Oriented Programming Concepts.
CO3: Ability to implement features of object oriented programming to solve real world problems.
CO4:Demonstrate simple applications using java
CO5:Implementing various java applications using multithread programming

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6201	PROCESS CONTROL	3	1	0	4

Course Objective

1. Define the basic concept of mathematical modeling of any physical process.
2. Observe the characteristics of various controller actions and its form.
3. Illustrate the various types of final control elements in process control.
4. Establish an evaluation criterion and different controller tuning methods.
5. Build a multi loop control schemes for suitable applications.

Unit	Description	Instructional Hours
I	**PROCESS MODELING AND DYNAMICS** Introduction to Process control - Need for process control - Degrees of freedom - Mathematical model of Flow, Level, Pressure and Thermal processes - Interacting and non-interacting systems - Continuous and batch processes - Self regulation - Servo and regulatory operations - Heat exchanger - CSTR - Linearization of nonlinear systems.	12
II	**CONTROL ACTIONS AND CONTROLLERS** Characteristic of on-off, proportional, single speed floating, integral and derivative controllers - P+I,P+D and P+I+D control modes - Electronic PID controller, controller design problems - Auto/manual transfer–Reset Wind-up and prevention - Derivative and Proportional kick - Bumpless transfer, Practical forms of PID Controller.	12
III	**FINAL CONTROL ELEMENTS** I/P converter - Pneumatic and electric actuators - Valve Positioner - Control Valves - Characteristic of Control Valves:- Inherent and Installed characteristics - Valve body:- Commercial valve bodies - Types - Control valve sizing - Cavitation and flashing - Selection of control valves.	12
IV	**CONTROLLER TUNING** Evaluation Criteria - IAE, ISE, ITAE and ¼ decay ratio - Tuning: - Process reaction curve method, Ziegler-Nichols method, Tyreus-Luyben method and Damped oscillation method - Determination of optimum settings for mathematically described processes using frequency response approach – Autotuning- Design of Hybrid-PID:Motor Control.	12
V	**MULTILOOP PROCESS CONTROL** Feed-forward control - Ratio control - Cascade control - Inferential control - Split-range and introduction to multivariable control - MIMO systems, Examples - IMC - Model Predictive Control - Adaptive control. Case Studies: Distillation column - Boiler drum level control - P&ID diagram.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Develop a mathematical model for any process control systems.
CO2: Classify the different controller modes and its design methodologies.
CO3: Distinguish the valves, positioner and their operation on environment.
CO4: Choose a proper tuning method for P, I, D controllers and capable to simulate them.
CO5: Implementing conventional control architectures with advanced multi-loop technique with piping and instrumentation diagrams.

TEXT BOOKS:

T1 - Stephanopoulos. G, "Chemical Process Control - An Introduction to Theory and Practice", Prentice Hall of India, 2008.

T2 - D. P. Eckman, "Automatic Process Control", 7th Edition, John Wiley, New York, 1958.

REFERENCE BOOKS:

R1 - Johnson .C.D, "Process Control Instrument Technology", 8th Edition, Pearson Education, 2006.

R2 - Bequette. B.W,"Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.

R3 - Krishnaswamy.K, "Process Control", New Age International Publishers, 2015.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI6202	APPLIED VLSI DESIGN	3	0	0	3

Course Objective

1. Infer the basic concepts of CMOS technology.
2. Recall the concepts of combinational logic circuits.
3. Relate the fundamentals of sequential logic circuits.
4. Implement the chip design using programming devices.
5. Write VHDL program for digital circuits.

Unit	Description	Instructional Hours
I	**CMOS TECHNOLOGY** Fabrication Technology - Electrical Properties of CMOS Circuits - Scaling Principles and Fundamental Limits - Layout Design Rules - Stick Diagram	9
II	**COMBINATIONAL LOGIC CIRCUITS** Examples of Combinational Logic Design - Elmore's Constant, Pass Transistor Logic - Transmission Gates - Static and Dynamic CMOS Design - Power Dissipation - Low Power Design Principles	9
III	**SEQUENTIAL LOGIC CIRCUITS** Static and Dynamic latches and registers - Timing Issues - Pipelines, Clock Strategies - Memory Architecture and Memory Control Circuits - Low Power Memory Circuits	9
IV	**IMPLEMENTATION STRATEGIES** Full custom and Semi Custom Design, Standard Cell Design and Cell Libraries - FPGA Building Block Architecture - FPGA Interconnect Routing Procedures	9
V	**VHDL PROGRAMMING** RTL Design - Combinational Logic Types - Operators - Packages - Sequential circuits - Subprograms - Test Benches (Adders, Flip flop, Counters, FSM, Multiplexer, Demultiplexer)	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Explain the fabrication of basic CMOS circuit.
CO2: Design combinational logic circuits.
CO3: Demonstrate sequential CMOS logic circuits.
CO4: Establish digital system using FPGA.
CO5: Build VHDL programming for digital circuits.

TEXT BOOKS:

T1 - Weste and Harris,"CMOS VLSI Design", Pearson Education,4th Edition,2005
T2 - Charles. H, Roth, "Digital System Design using VHDL", Thomson learning, 2004.

REFERENCE BOOKS :

R1 - N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 2000.
R2 - R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 2005.
R3 - A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI6203	DISCRETE TIME AND SIGNAL PROCESSING	3	0	0	3

Course Objectives

1. Enumerate signals, systems, time and frequency domain concepts.
2. Recall the concepts of z-transforms.
3. Interpret fundamental mathematical tools of DSP techniques.
4. Classify digital filters for processing of discrete time signals.
5. Categorize programmable digital signal processor and its applications.

Unit	Description	Instructional Hours
I	**SIGNALS AND SYSTEMS** Introduction - Classification of Discrete time signals and systems - analysis of discrete-time linear time - invariant systems - discrete time systems described by difference equations - implementation of discrete time systems- correlation - Sampling and quantization.	9
II	**DISCRETE TIME SYSTEM ANALYSIS** Definition - properties of z-transform - rational z transform - region of convergence - inverse z - transform - computation of the convolution sum of finite length sequences - analysis of linear time invariant systems in the z domain - one sided z transform - Frequency analysis of discrete time signals.	9
III	**DISCRETE FOURIER TRANSFORM AND COMPUTATION** DFT - properties - IDFT -convolution- overlap add and save method - Efficient computation of the DFT using Radix - 2 FFT algorithms - Decimation in time - Decimation in frequency.	9
IV	**DESIGN OF DIGITAL FILTERS** Design of IIR filters - characteristics of commonly used analog filters - Butterworth and Chebyshev filters - digital design using impulse invariant and bilinear transformation. Design of FIR filters - Symmetric and Antisymmetric FIR filters - Windowing techniques - Structures realization of digital filters.	9
V	**DIGITAL SIGNAL PROCESSORS** General and special purpose digital signal processors - Introduction to programmable DSPs - Architecture of TMS320C5X - assembly language instructions - instruction pipelining in C5x - application programs in C5x - DSP applications.	9
	Total Instructional Hours	45

Course Outcomes

CO1: Understand about discrete time signals and systems.
CO2: Demonstrate the use of z transforms for signal processing applications.
CO3: Apply mathematical tools for all DSP techniques.
CO4: Analyse linear digital filters both FIR and IIR using different techniques and their associated structures.
CO5: Illustrate the selection of DSP processors for different applications.

TEXT BOOKS:

T1 - J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Fourth Edition, Prentice Hall of India Learning Private Limited, 2008.
T2 - B.Venkataramani, M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw Hill,2003.

REFERENCE BOOKS:

R1 - Andreas Antonious, "Digital Signal Processing – Signals, Systems and Filter", Tata McGraw Hill , 2006.
R2 - Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal Processing, a practical approach", Pearson Education, 2004.
R3 - S.K. Mitra, "Digital Signal Processing", Third Edition, Tata McGraw Hill, 2006.
R4 - Alan V.Oppenheim,Ronald W.Schafer with John R.Buck, "Discrete Time Signal Processing", 2nd Edition, Pearson Education, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6204	EMBEDDED SYSTEMS (COMMON TO EIE AND EEE)	3	0	0	3

Course Objective

1. Illustrate the design procedure and standards of embedded system
2. Describe the interfacing network components of embedded system.
3. Discussion of embedded system design technology with various modeling.
4. Review of embedded system design policies via RTOS.
5. Make use of embedded system for developing a real time system application.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO EMB.E.DDED SYSTEMS** Introduction to Embedded Systems - Design process of embedded systems - Structural units in embedded processor, Selection of processor & memory devices - Direct Memory Access - Memory management methods - Timer and Counter, Watchdog Timer, Real Time Clock.	9
II	**EMB.E.DDED NETWORKING** Introduction, I/O Device Ports & Buses - Serial Bus communication Protocols - UART-RS232 standard - RS422/ RS485 - CAN Bus -Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I^2C) - USB - Parallel Device Protocols - Need for device drivers.	9
III	**EMB.E.DDED PRODUCT DEVELOPMENT ENVIRONMENT** Embedded Product Development Life Cycle(EDLC) - Objectives, Different Phases of EDLC, Computational models of EDLC- Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent Model, Object Oriented Model - Hardware - software Co-design - issues - Embedded system design technology.	9
IV	**REAL-TIME OPERATING SYSTEM** Introduction to basic concepts of RTOS - Task, process & threads - Interrupt Service Routines, Multiprocessing and Multitasking, Preemptive and Non - preemptive scheduling, Context switching, Task communication- shared memory, message queue - synchronization between processes-semaphores, Mailbox, pipes. Real Time Operating systems: Vx Works, MUCOS-II.	9
V	**EMB.E.DDED SYSTEM APPLICATION** Case Study: Automatic Chocolate Vending Machine (ACVM), Digital Camera, Mobile phone, Washing Machine, Smart card System Application.	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Infer knowledge about various embedded development Strategies.
CO2. Illustrate the bus/ network communication among processor and I/O interfacing.
CO3. Abstract various multiprocessing scheduling algorithms.
CO4. Explanation of basic knowledge of various RTOS and their feature.
CO5. Employ the role of embedded system on various real-time application.

TEXT BOOKS:

T1 - Rajkamal, 'Embedded System-Architecture, Programming and Design', Tata McGraw Hill, 3rd Edition, 2015.
T2 - Peckol, "Embedded system Design", John Wiley & Sons, 2010.

REFERENCE BOOKS :

R1 - Shibu. K.V, "Introduction to Embedded Systems", Tata Mc Graw Hill, 2009.
R2 - Elicia White," Making Embedded Systems", O' Reilly Series, 2011.
R3 - Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6001	PROCESS CONTROL LABORATORY	0	0	4	2

Course Objective

1. Apply the knowledge gained in control of various physical systems.
2. To be exposed to the design of multi loop process control
3. To be familiar with the working of P, PI, PID Controllers and Tuning.
4. To experimentally verify the design and implementation of controllers for various physical processes

Expt. No.	Description of the Experiments

Simulation Based Experiments:

1. Response of First Order and Second order Systems with and without transportation lag.
2. Response of Second Order System with and without PID Controller.
3. Design and tuning of PID controller using Ziegler-Nichols and Cohen-Coon Method.
4. Modeling and control of Single/Two capacity level process .
5. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process.
6. Auto-tuning of PID Controller of a typical Industrial Process.

Hardware Based Experiments (Experiments carried out on the skid mounted plants):

7. (i) Study of a Process Control Training plant.
   (ii) Study the characteristic of Step and Impulse response of Interacting and Non-interacting systems.
8. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
9. (i)Closed loop control of Level process for Servo and Regulator Operation.
   (ii) Closed loop control of Flow process for Servo and Regulator Operation.
10. Closed loop control of Pressure process for Servo and Regulator Operation.
11. Closed loop control of ON/OFF controlled Thermal process.
12. (i)Design and implementation of Complex Control system (Ratio/Cascade/Feed forward).
    (ii) Study of AC and DC drives.

Total Practical Hours 45

Course Outcome

CO1: Infer the effect of different control modes on various processes.
CO2: Design the controller parameters using different tuning process.
CO3: Evaluate the servo and regulator response for various process control systems.
CO4: Analyze and verify the complex multi loop control system characteristics.
CO5: Demonstrate the control system response for servo motor applications.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6002	VIRTUAL INSTRUMENTATION LABORATORY	0	0	4	2

Course Objective

1. Observe the basic graphical programming knowledge using Lab VIEW platform.
2. Make use of data acquisition concept to interface real time instruments.
3. Design the programming for process control and other applications.

Expt. No.	Description of the Experiments
1.	Verification of Arithmetic and Boolean operations.
2.	Program to find Addition of first "n" natural numbers using FOR and WHILE loop.
3.	Implementation of Array functions.
4.	Implementation of Cluster functions.
5.	Program for implementing Seven segment displays.
6.	Program to perform Traffic light control.
7.	Generation of Waveform and its measurements.
8.	Design of Low and High Pass Filter using MULTISIM.
9.	Using NI ELVISmx , Design and verify the characteristics of a. Rectifier. b. Differentiator. c. Integrator circuit.
10.	Signal Generation Using NI-DAQmx, Frequency analysis.
11.	Program to control Temperature by using Thermocouple and DAQ.
12.	Program for controlling the speed of a DC motor using PID tool box.

Total Practical Hours **45**

Course Outcome

CO1 : Discuss about basic concepts of virtual instrumentation and its programming.
CO2 : Generalize the graphical programming knowledge with data flow concept.
CO3 : Compose the data acquisition concepts for interfacing real-instrument.
CO4 : Transform the circuit simulation concept to the hardware implementation using NI MULTISIM and ELVISmx.
CO5 : Evaluate the process control applications with graphical programming environment.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6701	TECHNICAL SEMINAR	0	0	2	1

Course Objective

1. Develop self knowledge skills of utilizing various resources for a technical presentation.
2. Appraise technical presentation ability and communication skills.
3. Motivate the commitment approach to complete tasks.

During the seminar session each student is expected to prepare and present a topic on their respective area of interest on engineering/technology, for about 8 to 10 minutes. In a session of two periods per week, 15 students are expected to present the seminar. Each student is expected to present at least twice during the semester.

At the end of the semester, he/she shall submit a report on his/her topic of seminar and a three member Departmental Committee constituted by Head of the Department will evaluate the presentation, report and conduct viva voce examination to award marks appropriately.

Course Outcome

CO1: Highlight technical ideas, strategies and methodologies
CO2: Choose a real world problem, identify the requirement and extend the presentation
CO3: Manipulate the recent tools and teaching aids in their presentation topics.
CO4: Explain their ideas with confidence
CO5: Validate the acquired knowledge through oral presentations and report submission

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PROFESSIONAL ELECTIVE - I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5301	THERMAL POWER PLANT INSTRUMENTATION	3	0	0	3

Course Objective

1. Identify the sources of thermal energy generation.
2. Understand the process involved in steam power generation and it's impact on environment.
3. Outline the operation of various equipments involved in the generation of steam.
4. Design various control loops in boiler.
5. Analyze the operation and plot the performance characteristics of turbines.

Unit	Description	Instructional Hours
I	**FUELS AND COMBUSTION** Sources of Chemical Energy - Availability of Fuels-Characteristics of Coal - Other Solid Fuels-Petroleum and Natural Gas - Principles of Combustion - Combustion Calculations - Design Aspect of Burner - Flame Stability - Design Aspects of Furnace.	9
II	**STEAM POWER PLANT CYCLES AND ITS IMPACT ON ENVIRONMENT** Laws of Thermodynamics-Carnot Cycle - Stirling Cycle-Ericsson Cycle - Rankine Cycle - Kalina Cycle-Binary Vapor Cycle - Impact of Performance Parameter on Economics of Generation-Impact of Performance Parameter on the Environment	9
III	**STEAM GENERATORS AND BOILERS** Boiling and Circulation- Design-Classification and Utilization- Boiler Mounting and Accessories - Superheaters and Reheaters - Economizers - Air Heaters - Insulation - Supercritical Boilers - Pulverized Coal-Fired Boilers - Fluidized - Bed Combustion Boilers	9
IV	**CONTROL LOOPS IN BOILER** Combustion Control-air/fuel ratio control - furnace draft control - main steam and reheat steam temperature control - super heater control - attemperator - deaerator control - distributed control system in power plants - interlocks in boiler operation - Trimming of combustion air - Soot blowing - Combustion control for liquid and solid fuel fired boiler.	9
V	**TURBINE MONITORING AND CONTROL** 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.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the knowledge acquired to design the equipments involved in thermal power generation.
CO2: Summarize the process involved in steam power generation and it's impact on environment.
CO3: Outline the operation of equipments involved in the generation of steam.
CO4: Assess the performance of various control loops in boiler.
CO5: Appraise the operation of turbines.

TEXT BOOKS:

T1 - Dipak Sarkar, "Thermal Power Plant", Elsevier, 2015
T2 - Sam Dukelow. G "The Control of Boilers", Instrument Society of America, Second Edition 1991.

REFERENCE BOOKS:

R1 - Mukopadhyaya, "Operation and Maintenance of Thermal Power Plants", Springer, 2016.
R2 - Elonka. S.M, and Kohan. A.L, "Standard Boilers Operations", McGraw Hill, New Delhi, 1994.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI5302	DIGITAL SYSTEM DESIGN	3	0	0	3

Course Objective

1. Recall the concepts of combinational circuit design
2. Relate the fundamentals of sequential circuit design
3. Interpret programmable logic devices and memory
4. Summarize the concepts of digital system design
5. Infer the fundamental concepts of verilog

Unit	Description	Instructional Hours
I	**COMBINATIONAL CIRCUIT DESIGN** Introduction - Analysis and design procedures for Multiplexers - Demultiplexers - Encoders - Decoders - Code converters - comparators	9
II	**SEQUENTIAL CIRCUIT DESIGN** Analysis of clocked synchronous sequential circuits and modeling - State diagram, state table, state table assignment and reduction - Design of synchronous sequential circuits - Design of Asynchronous sequential circuits	9
III	**DESIGNING WITH PROGRAMMABLE LOGIC DEVICES AND MEMORY** Read only memory - Principles and design considerations of specific PROMS,EPROMS, SRAMS, and SDRAMS, PLA's ,PAL's - Other sequential programmable logic devices	9
IV	**DIGITAL SYSTEM DESIGN CASE STUDIES** Multiphase clock generators - digital FIR design using TTL/CMOS IC's - PRBS generator, digital PLL's - DRAM controller design - LED/LCD display controller and other examples.	9
V	**INTRODUCTION TO VERILOG** Verilog as HDL - Levels of Design Description - Concurrency - Gate level modeling - Data flow Modeling - Behavioral Modeling - Test benches.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the concepts of combinational circuit in a digital system
CO2: Demonstrate sequential circuit design
CO3: Design with programmable logic devices for applications
CO4: Apply the acquire knowledge in digital system design
CO5: Build VHDL/Verilog code for combinational and sequential circuits

TEXT BOOKS:

T1 - Charles. H, RothJr, "Digital System Design using VHDL", Thomson learning.2004.
T2 - Floyd,"Digital "Fundamentals with PLD Programming", Prentice Hall of India.,2006.

REFERENCE BOOKS :

R1 - Charles. H, RothJr, "Fundamentals of Logic Design", Cengage Learning.,2010.
R2 - Donald D.Givone, "Digital Principles and Design", Tata McGraw–Hill., 2007.
R3 - Morris Mano. M, "Digital Design", 3rd edition, Pearson Education, 3rd edition,2007.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI5303	DIGITAL IMAGE PROCESSING	3	0	0	3

Course Objective

1. Interpret the fundamentals of digital image.
2. Infer the basics of image enhancement technique.
3. Apply the image filtering and restoration technique.
4. Perform the image reconstruction process.
5. Analyze the image compression standards.

Unit	Description	Instructional Hours
I	**DIGITAL IMAGE FUNDAMENTALS** Digital Image Representation - Elements of Digital Image Processing system - Elements of Visual Perception - Image Sampling and Quantization - Relationship between Pixels - Color Models.	9
II	**IMAGE ENHANCEMENT** Spatial Domain: Point Operation, Histogram Modelling, Basics of Spatial Filtering - Smoothing and Sharpening Spatial Filter - Multispectral Image Enhancement.	9
III	**IMAGE FILTERING AND RESTORATION** Image Observation Models - Mean Filters - Inverse and Wiener Filtering - Segmentation: Edge and Boundary Detection - Morphological Processing - Erosion and Dilation- Watershed Algorithm.	9
IV	**IMAGE RECONSTRUCTION** Random Transform - Reconstruction from Blurred Noisy Projection, Fourier Reconstruction - Fan Beam Reconstruction - Three Dimensional Tomography.	9
V	**IMAGE DATA COMPRESSION** Fundamentals of Coding - Pixel Coding ,Shannon's coding, Huffman Coding, Variable Length Coding - Image Compression Standards - JPEG, MPEG Standards.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the fundamentals of digital image processing.
CO2: Apply the spatial and multispectral enhancement techniques in a image.
CO3: Construct the segmentation algorithm for restoration of digital image.
CO4: Establish the image reconstruction techniques.
CO5: Assess the encoding process and image compression standards.

TEXT BOOKS:

T1 - Anil Jain.K "Fundamentals of Digital Image Processing", Prentice Hall of India Learning Pvt.Ltd,2011.
T2 - Rafeal C. Gonzalez, Richard E. Woods "Digital Image Processing" Third Edition, Pearson Education, 2010.

REFERENCE BOOKS :

R1 - S.Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" Tata McGraw Hill Education Private Ltd, 2009.
R2 - Willliam K Pratt, "Digital Image Processing", John Willey, 2002.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI5304	COMMUNICATION ENGINEERING	3	0	0	3

Course Objective

1. Interpret the basic concepts involved in amplitude modulation.
2. Discuss about the angle and discrete modulation systems.
3. Analyze the source code information theory and coding techniques.
4. Discuss the multiple access techniques involved in wire and wireless Communication.
5. Categorize the different modes of communication systems.

Unit	Description	Instructional Hours
I	**AMPLITUDE MODULATION** Introduction - Amplitude Modulation - Generation of AM waves - DSB- DSB/SC – SSB -VSB - AM Transmitter - AM Receiver - TRF, Super Heterodyne Receivers.	9
II	**ANGLE AND DISCRETE MODULATION SYSTEMS** Introduction to Phase Modulation - Frequency Modulation - Introduction - Frequency Spectrum of FM wave - Types of FM Generation of FM - Amstrong Method & Reactance Modulations, Introduction to Pulse Modulation – PAM,PWM,PPM - Sampling and Quantization - Comparisons of Pulse Modulation Technique.	9
III	**INFORMATION THEORY AND CODING** Primary Communication - Entropy - Shannon Fano Coding - Huffman Coding - Line Encoding - BW-SNR Trade Off Codes - Error Control Codes: Convolution Codes and Linear Block Codes.	9
IV	**MULTIPLE ACCESS TECHNIQUE** SS&MA techniques : FDMA - TDMA - CDMA - SDMA - Application in Wire and Wireless Communication - Advantages.	9
V	**SATELLITE AND OPTICAL FIB.E.R COMMUNICATION** Introduction to Satellite Communication - Types of Satellite Orbits - Satellite Earth Station - Multiple Access in Satellite Communication - Introduction to Optical Communication - Optical fiber link - Optical Fiber Modes and Configuration - Light Sources and Detectors.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Describe the concept and generation methods involved in amplitude modulation system.
CO2: Compare the phase, frequency and pulse modulation techniques.
CO3: Determine the amount of information in a high bit rate transmission.
CO4: Elaborate the multiple access techniques involved in communication.
CO5: Innovate various medium for digital communication.

TEXT BOOKS:

T1 - Taub & Schilling," Principles of Communication Systems", Tata McGraw Hill 2007.
T2 - Theodore S Rappaport, "Wireless Communications", Second Edition, Pearson Education, 2011.

REFERENCE BOOKS :

R1 – Sklar,"Digital Communication Fundamentals and Applications", Pearson Education, 2001.
R2 - Wilbur L.Pritchard, Henri G.Suyderhoud, "Satellite Communication Systems Engineering" Pearson Education, Second Edition, 2011.
R3 - R.P.Khare, "Fiber Optics and Optoelectronics", Oxford University Press, 2008.

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PROFESSIONAL ELECTIVE - II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6301	INDUSTRIAL ELECTRONICS	3	0	0	3

Course Objective

1. Discuss the operation of power semiconductor devices and their switching characteristics
2. Design controlled converter circuits.
3. Differentiate the operation of various chopper circuits.
4. Analyse the operation of inverter circuits for 120° mode and180° mode operation.
5. Classify AC to AC converter circuits based on it's operation.

Unit	Description	Instructional Hours
I	**POWER SEMICONDUCTOR DEVICES** Power Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT - Static and Dynamic characteristics - Triggering and commutation circuit for SCR - Design of Driver and snubber circuit.	9
II	**PHASE CONTROLLED CONVERTERS** 2 pulse, 3 pulse and 6 pulse converters - performance parameters - Effect of source inductance - Dual converters - steady state analysis	9
III	**DC TO DC CONVERTER** Step down and step up chopper - control strategy - Commutation in choppers - Switched mode regulators - Buck, Boost, Buck- Boost converter - Resonant Converters and its topologies	9
IV	**INVERTERS** Inverters Basics - PWM techniques - Single phase and Three Phase Voltage Source Inverters (120° mode and180° mode) - Current Source Inverter - Voltage and Harmonic Control - Space Vector Modulation techniques for inverters .	9
V	**AC TO AC CONVERTERS** Single phase and Three Phase AC voltage controllers - Control Strategy - Power Factor Control - Multistage Sequence Control - Single Phase and Three Phase Cyclo Converters - Matrix Converters.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Outline the operation of power semiconductor devices and their switching characteristics.
CO2: Illustrate the operation of power electronic rectifier circuits.
CO3: Identify the appropriate chopper circuit for various applications.
CO4: Choose the appropriate mode of operation of inverter.
CO5: Compile the operation of AC to AC converters.

TEXT BOOKS:

T1 - M. H .Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, Third Edition, New Delhi, 2004.
T2 - P. S. Bhimbra "Power Electronics", Khanna Publishers, Third edition, 2003.

REFERENCE BOOKS :

R1 – Joseph Vithayathil, "Power Electronics, Principles and Applications", McGraw Hill , 6th Reprint, 2013.
R2 - Ned Mohan, Tore. M. Undel and, William. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and sons, Third Edition, 2003.
R3 - M. D. Singh and K.B. Khanchandani, "Power Electronics," McGraw Hill India, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6302	BIOMEDICAL INSTRUMENTATION	3	0	0	3

Course Objective

1. Recall fundamentals of biomedical systems.
2. Discuss about the communication mechanics involved in biomedical system with few examples.
3. Outline the measurement of certain important non-electrical parameters.
4. Infer the basic principles in medical imaging techniques.
5. Generalize about life assisting and therapeutic devices.

Unit	Description	Instructional Hours
I	**PHYSIOLOGY AND TRANSDUCERS** Cell and its structure - Resting and Action Potential - Nervous system - synapse - transmitters and neural communication - Basic components of a biomedical system - Transducers - selection criteria Tremor Measuring Instruments - Radiation Thermometry.	9
II	**ELECTRO – PHYSIOLOGICAL MEASUREMENTS** Electrodes - Limb electrode - pregelled disposable electrodes - Micro, needle and surface electrodes - Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers. ECG – EEG – EMG – ERG - Lead systems and recording methods - Typical waveforms.	9
III	**NON-ELECTRICAL PARAMETER MEASUREMENTS** Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - spirometer - Body Plethysmography - Blood Gas analysers: pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.	9
IV	**MEDICAL IMAGING AND TELEMETRY** X-ray machine, echocardiography - CT - MRI - Ultrasonography Endoscopy - Gamma camera - Thermography - Different types of biotelemetry systems Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.	9
V	**ASSISTING AND THERAPEUTIC EQUIPMENTS** Pacemakers - Defibrillators - Ventilators - Nerve and muscle stimulators - Diathermy - Heart - Lung machine - Audio meters - Dialyzers - Lithotripsy - Robotic surgery - orthopedic prostheses fixation.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the concepts of physiology and transducers
CO2: Choose different electro-physiological measurements techniques
CO3: Apply the measurement techniques of non-electrical parameters
CO4: Elaborate the basic principles in imaging techniques
CO5: Experiment the basic knowledge in life assisting and therapeutic devices

TEXT BOOKS:

T1 - R.S.Khandpur, "Hand Book of Bio-Medical instrumentation", Tata McGraw Hill, 2003.
T2 - R.Ananda Natarajan, "Biomedical Instrumentation and Measurements", Second edition, Prentice Hall of India Learning Private Ltd., 2016.

REFERENCE BOOKS:

R1 - M.Arumugam, "Bio-Medical Instrumentation", Anuradha Publications, 2003.
R2 - L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 1975.
R3 - J.Webster, "Medical Instrumentation", John Wiley & Sons, 1995.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6303	ADVANCED CONTROL THEORY	3	0	0	3

Course Objective

1. Recall the basics of state and state models.
2. List the methods of sampling and its stability tests.
3. Illustrate about non-linear systems.
4. Establish phase plane analysis on control systems.
5. Interpret about stability analysis of linear and non-linear systems.

Unit	Description	Instructional Hours
I	**STATE VARIABLE REPRESENTATION** Introduction to state concept - state equation of linear continuous time systems, matrix representation of state equations. Phase variable and canonical forms of state representation - state transition matrix - Controllability - Observability, State feedback design via pole placement technique.	9
II	**SAMPLED DATA CONTROL SYSTEMS** Sampling process - Z transform method - pulse transfer function - analysis of the sampling process - data reconstruction and hold circuits - zero order hold circuit - Sampling theorem. Stability of sampled data system - Jury's test, Bilinear Transformation.	9
III	**NONLINEAR SYSTEMS** Introduction - characteristics of nonlinear systems. Types of non-linearity -Analysis through Linearization about an operating point - harmonic linearization - Stability analysis by describing Method - application of describing function for stability analysis of autonomous system with single nonlinearity.	9
IV	**PHASE PLANE ANALYSIS** Concept - Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities - Singular points - Classification of singular points - Limit cycle - simple variable structure system.	9
V	**STABILITY ANALYSIS** Definition of stability - asymptotic stability and instability, Equilibrium points - BIBO and relative stability - Lyapunov stability criteria – Lyapunov methods to stability of linear and nonlinear systems, continuous and discrete time systems.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Develop the state space model and state feedback design for advanced control systems.
CO2: Manipulate the sampled data control systems and discrete control systems.
CO3: Classify the linear/non-linear system theory and their representations.
CO4: Constructing the phase plane trajectories for various nonlinear systems.
CO5: Evaluate advanced control system problems using various stability criterion.

TEXT BOOKS:

T1 - Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Learning Pvt Ltd, 5th Edition,2010.
T2 - Hassan K. Kahalil, "Non-linear Systems", Pearson Education, 2002.

REFERENCE BOOKS :

R1 - B.C.Kuo, "Automatic Control Systems", Prentice Hall of India Pvt. Ltd., New Delhi,1998.
R2 - M.Gopal, "Digital Control and State Variable Methods", Tata McGrawHill, New Delhi,2003.
R3 - A.Nagoor Kani "Advanced Control System", 2nd Edition, RBA publications, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6304	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	3	0	0	3

Course Objective

1. Interpret the process involved in oil extraction.
2. Categorize the petroleum refining process.
3. Discuss the various products available from petroleum
4. Classify the control loops available in petrochemical industry.
5. Observe various safety instrumentation systems available in petrochemical industry.

Unit	Description	Instructional Hours
I	**OIL EXTRACTION AND PROCESSING** Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system – Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil – control loops in oil gas separator - scrubber - coalescer.	9
II	**PETROLEUM REFINING PROCESS** Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic hydrocracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum	9
III	**CHEMICALS PRODUCTS FROM PETROLEUM** Chemicals from methane, acetylene, ethylene and propylene - production process of polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC	9
IV	**CONTROL LOOPS IN PETROCHEMICAL INDUSTRY** Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production - Control of VCM and PVC production	9
V	**SAFETY IN INSTRUMENTATION SYSTEMS** Area and material classification as per National Electric Code (NEC) - Classification as per International Electro technical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit	9
	Total Instructional Hours	**45**

Course Outcome

CO1. Outline the process involved in oil extraction.
CO2. Outline the methods of oil refining.
CO3. Discuss the various products available from petroleum industry.
CO4. Identify the appropriate control loop existing in the petrochemical industry.
CO5. Appraise various safety instrumentation systems existing in petrochemical industry.

TEXT BOOKS:

T1 - Ram Prasad, "Petroleum Refining Technology", Khanna Publishers, New Delhi, 2000.
T2 - J.H.Gary, J.E.Handwork, M.J.Kaiser, "Petroleum Refining (Technology and Economics)", CRC Press, 2007.

REFERENCE BOOKS:

R1 - B.G.Liptak, "Instrumentation in Process Industries", Chilton Book Company, 2005.
R2 - A.L.Waddams, "Chemicals from Petroleum", Butter and Janner Ltd., 2000.
R3 - Oil and Gas Production Handbook, ABB, 2013.

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI6401	NEURAL NETWORKS AND FUZZY SYSTEMS	3	0	0	3

Course Objective

1. Introduce about artificial neural networks.
2. Classify on various neural network architectures and its training algorithms.
3. To learn about fuzzy systems.
4. Gain knowledge about fuzzy logic control design.
5. Build application based on neural network and fuzzy control systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO NEURAL NETWORKS** Introduction to Artificial Neural Networks-Differences between biological and artificial neural networks - Typical architecture - Common activation functions - Learning Rules and Learning Methods of ANN - McCulloch-Pitts network - Perceptron - Single layer and Multi layer Feed forward network.	9
II	**NEURAL NETWORK ARCHITECTURES AND ALGORITHMS** Feedback networks - Back propagation neural net - Algorithm and Applications - Discrete time hop field networks - Self organising maps - Counter propagation - Architecture - Algorithm and applications - Adaptive Resonance Theory.	9
III	**INTRODUCTION TO FUZZY SYSTEMS** Introduction to Fuzzy logic - Properties and operations on classical sets and fuzzy sets - Crisp and fuzzy relations - Cardinality - Features of membership function - Standard forms and boundaries - Fuzzification - Membership value assignments - Lambda cuts for fuzzy sets and relations - De-fuzzification methods.	9
IV	**FUZZY LOGIC CONTROL** Membership function - Fuzzy Rules - Knowledge base - Rule base - Decision making logic - Fuzzy Inference system - Optimizations of membership function using neural networks - Adaptive fuzzy systems - ANFIS.	9
V	**APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC** Applications of neural networks: Pattern recognition - Image compression – Communication - Control systems - Applications of fuzzy logic: Fuzzy pattern recognition - Fuzzy image compression – Washing machine.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Infer the concepts of feed forward neural networks.
CO2: Summarize the various neural networks architectures and its training algorithms
CO3: Discover the concept of fuzziness involved in various systems and fuzzy set theory.
CO4: Implement the fuzzy logic control mechanism and adaptive fuzzy logic systems for suitable control problems.
CO5: Design the neural network/fuzzy logic control for real time applications.

TEXT BOOKS:

T1 – Laurene V. Fausett, "Fundamentals of Neural Networks", Pearson Education, New Delhi, 2004.
T2 - Timothy J Ross, "Fuzzy Logic with Engineering Applications", John Willey and Sons, 2005.

REFERENCE BOOKS:

R1 - Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall of India, 2004.
R2 - Zimmerman H.J., "Fuzzy set theory and its Applications", Allied Publishers, 2001.
R3 - Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co, 2002.
R4 - Klir G J and Folger T "Fuzzy Sets, Uncertainty and Information", Prentice Hall of India, 2002.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7201	COMPUTER CONTROL OF PROCESS	3	0	0	3

Course Objective

1. Infer the basic concepts of sampled data control system
2. Interpret the system modeling and identification
3. Design a digital control algorithm for a discrete system
4. Discuss the concepts of adaptive control
5. Outline the fundamentals of multi variable control system

Unit	Description	Instructional Hours
I	**SAMPLED DATA CONTROL SYSTEM** Introduction - Review of Z transform - Modified Z transform - Need of computer in a control system – Functional block diagram of a computer control system - Direct Digital Control(DDC) - supervisory control - Data logger - SCADA .	9
II	**SYSTEM MODELLING AND IDENTIFICATION** Introduction to pulse transfer function - Open loop and closed loop response of SDS - Pulse testing for process identification - Linear least square algorithm - Implementation of digital controllers - Digital temperature control system - Digital position control system - Stepping motors and their control.	9
III	**DESIGN OF DIGITAL CONTROL ALGORITHM** Design and implementation of different digital control algorithm - Dead beat - Dahlin - Kalmans algorithm - Pole placement controller - Position and velocity form algorithm - Selection of sampling time - Smith predictor algorithm - Jury's stability test - Schur Cohn stability criterion.	9
IV	**ADAPTIVE CONTROL** Self tuning - gain scheduling - Model Reference Adaptive Control - Self tuning regulator - Auto tuning and gain scheduling adaptive control design with examples - Feed forward control - Cascade control.	9
V	**MULTI VARIABLE CONTROL SYSTEM** Interaction Analysis - Singular value decomposition - Internal model control - Simplified model predictive control	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the need of computer in process industry
CO2: Outline about modeling and system identification techniques
CO3: Build digital control algorithm for a direct discrete system
CO4: Design adaptive controller for applications
CO5: Explain the concepts of multivariable regulatory control

TEXT BOOKS:

T1 - P.B.Deshpande and R.H.Ash, "Computer Process Control", International Society of Automation publication, USA,1995
T2 - Lennart Ljung "System Identification Theory for the user", Prentice Hall of India, 1999.

REFERENCE BOOKS :

R1 - H.Richard, C Middleton and Graham, Goodwin, "Digital Control and Estimation A Unified Approach" Prentice Hall of India, 1990.
R2 - Dale Seborg. E, Thomas. F, Edgar, Duncan. A, Mellichamp, "Process Dynamics and Control",Willey India, 2006.
R3 - Karl J Astrom and Bjorn Wittenmark, "Adaptive Control", Pearson Education Inc, Second Edition, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7202	INDUSTRIAL DATA NETWORKS	3	0	0	3

Course Objective

1. Understand the fundamentals of data networks.
2. Gain knowledge on various internetworking standards.
3. Analyze the modes of data transfer.
4. Impart knowledge about the importance of MODBUS, PROFIBUS and other communication protocol in networking.
5. Observe the use of industrial ethernet in various applications.

Unit	Description	Instructional Hours
I	**DATA NETWORK FUNDAMENTALS** Networks hierarchy and switching - Open System Interconnection model - Data link control protocol - Media access protocol - Command / response - Token passing - CSMA/CD, TCP/IP	9
II	**INTERNET WORKING and RS 232, RS 485** Standard ETHERNET and ARCNET configuration - RS 232, RS 485 configuration Actuator Sensor (AS) - interface. Field bus: architecture - Basic requirements-topology. Interoperability - Interchangeability - OLE for process control (OPC).	9
III	**HART AND FIELDBUS** HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).	9
IV	**MODBUS AND PROFIBUS PA/DP/FMS AND FF** MODBUS protocol structure - function codes - troubleshooting Profibus: Introduction, protocol stack, communication model - communication objects - system operation - troubleshooting.	9
V	**INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION** Industrial Ethernet, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.	9
	Total Instructional Hours	**45**

Course Outcome

CO1 : Outline the basics of data networks.
CO2 : Associate appropriate internetworking standards for data transfer.
CO3 : Understand the importance of HART and field bus in networking.
CO4 : Appraise about MODBUS, PROFIBUS and other communication protocol in networking.
CO5 : Outline various standards and applications of wireless communication.

TEXT BOOKS:

T1 - Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, "Practical Industrial Data Networks Design, Installation and Troubleshooting", Newnes Publication, Elsevier First Edition, 2004
T2 - William Buchanan, "Computer Buses", CRC Press, 2000.

REFERENCE BOOKS:

R1 - Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
R2 - Theodore S Rappaport, "Wireless Communication: Principles and Practice", Prentice Hall of India 2nd Edition, 2001.
R3 - William Stallings, "Wireless Communication & Networks", Prentice Hall of India, 2nd Edition, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7203	PROGRAMMABLE LOGIC AND DISTRIBUTED CONTROL SYSTEM	3	0	0	3

Course Objective

1. Outline the basics of programmable logic controllers and the programming using ladder diagram.
2. Cite the applications of programmable logic controllers.
3. Explain the fundamentals of data acquisition system.
4. Interpret the concepts of distributed control system and its communication standards.
5. Observe the different interfaces used in Distributed Control Systems.

Unit	Description	Instructional Hours
I	**PROGRAMMABLE LOGIC CONTROLLERS** Overview - Hardware components - basics of PLC programming - PLC wiring diagrams and Ladder Logic programs - Programming of Timers and Counters.	9
II	**PLC INSTRUCTIONS AND APPLICATIONS** Program control instructions - Data manipulation instructions - math instructions - sequencer and shift register - motor controls - closed loop and PID control - Case Study: Bottle Filling System, Pneumatic Stamping System.	9
III	**COMPUTER CONTROLLED SYSTEMS** Data loggers – Data Acquisition Systems (DAS) - Direct Digital Control (DDC) - Supervisory Control and Data Acquisition Systems (SCADA) - Remote Terminal Units - Master station - Communication architectures.	9
IV	**DISTRIBUTED CONTROL SYSTEMS** Evolution - Local Control Unit - Architecture, Programming of DCS, Process Interfacing Issues - Communication Facilities.	9
V	**INTERFACES IN DCS AND APPLICATIONS** Operator Interface - Low level and High level operator interface - Engineering Interface - low level and high level engineering interface - Implementation of High level functions - Packaging and power system issues - Case studies in DCS.	9
	Total Instructional Hours	45

Course Outcome

CO1: Demonstrate the knowledge of programmable logic controllers and programs using ladder diagram.
CO2: Summarise the various fields the Programmable logic controllers can be used.
CO3: Illustrate the characteristics of data acquisition system.
CO4: Illustrate the need for distributed control systems.
CO5: Demonstrate the knowledge of interfaces in distributed control systems and its applications.

TEXT BOOKS:

T1 - F.D. Petruzella, "Programmable Logic Controllers", Tata Mc-Graw Hill, Third edition, 2010.
T2 - Michael P. Lukas, "Distributed Control Systems: Their Evaluation and Design", Van Nostrand Reinhold Co., 1986.

REFERENCE BOOKS:

R1 - Krishna Kant, "Computer Based Industrial Control", Second edition', Prentice Hall of India, New Delhi, 2010.
R2 - John R. Hackworth and Frederick D. Hackworth Jr, "Programmable Logic Controllers", Pearson Education, New Delhi, 2004.
R3 - M.Chidambaram, "Computer Control of Process", Narosa Publishing, New Delhi, 2003.
R4 - David Bailey, Edwin Wright, "Practical SCADA for Industry", Elsevier, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7001	COMPUTER CONTROL OF PROCESS AND SIMULATION LABORATORY	0	0	4	2

Course Objective

1. Design and simulate the computer based controller algorithms for various physical processes.
2. Categorize various multi loop control systems.
3. Selection of suitable controllers for different processes
4. Be familiar with the PLC Programming.

Expt. No.	Description of the Experiments
1.	Digital Simulation of Linear system.
2.	Design of Lag and Lead Compensator using Bode Plot.
3.	Simulate the response of the following discrete system a. First Order Discrete System With and Without Dead time. b. Second Order Discrete System With and Without Dead time.
4.	(i)Design of Dead beat and Dahlin's algorithms using MATLAB (ii) Design of Kalman's Algorithms using MATLAB
5.	Response of computer controlled liquid level system
6.	Response of computer controlled Thermal system
7.	Design of Dynamic Matrix Control for a Self Regulating Process.
8.	(i) Study of PLC Field Device Interface Modules (AI, AO, DI, DO Modules) (ii) Types of PLC Programming
9.	Simple exercises using Ladder Logic of an Industrial Type PLC.
10.	DC Motor Control using PLC.
11.	Pneumatic Stamping System using PLC.
12.	Bottle Filling System using PLC.

Total Practical Hours 45

Course Outcome

CO1: Compare various linear system simulated responses.

CO2: Evaluate the discrete controller parameters using different tuning process.

CO3: Compile various discrete controller algorithms for different systems.

CO4: Visualize the computer based control system response for various physical processes.

CO5: Demonstrate PLC based control applications and its working in real time.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7002	INSTRUMENTATION SYSTEM DESIGN LABORATORY	0	0	4	2

Course Objective

1. Infer knowledge in designing electronic circuits.
2. Predict the performance of various instruments.
3. Design appropriate controller for various instruments.

Expt. No.	Description of the Experiments
1.	Design of Instrumentation Amplifier
2.	Design of Active Filters a. Low Pass and High Pass b. Band Pass and Band Reject
3.	Design of Regulated Power Supply
4.	Design of V/I And I/V Converters
5.	Design of a. Linearizing Circuits for Thermocouple. b. Cold Junction Compensation Circuit for Thermocouple.
6.	Design of Signal Conditioning Circuit for a. Strain Gauge. b. RTD.
7.	Design of Orifice Plate And Rotameter.
8.	Design of Control Valve Flow Lift Characteristics
9.	Design of PID Controller (Using Operational Amplifier)
10.	Design of A Multi Channel Data Acquisition System
11.	Design of Multi Range DP Transmitter
12.	Study of Control Valve Sizing

Total Practical Hours **45**

Course Outcome

CO1 : Design various types of filter circuits and amplifiers.
CO2 : Suggest a suitable power supply circuit.
CO3 : Able to analyse the performance of thermocouple, strain gauge and RTD.
CO4 : Plot the performance characteristics of control valve.
CO5 : Design a data acquisition system.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7701	INTERNSHIP / INDUSTRIAL TRAINING	0	0	0	2

Course Objectives

1. Apply the knowledge and skills which they have acquired on campus in a real-life work situation.
2. Create opportunities for practical, hands-on learning from practitioners in the students' field of study
3. Establish an exposure for the students to the work environment, common practices, employment opportunities and work ethics in the relevant field.

The student shall undergo Internship / Industrial Training and the credits earned will be indicated in the grade sheet. The student is allowed to undergo a maximum of 4 weeks Internship / Industrial Training during the entire period of study. The Internship / Industrial Training shall carry 100 marks and shall be evaluated at end semester examination.

The review committee may be constituted by the Head of the Department at the end of Internship / Industrial training, the student shall submit a report on the training undergone and a certificate from the organization concerned.

The evaluation will be made based on this report and a viva-voce examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department.

Course Outcomes

CO1: Improve the skills to communicate efficiently and gain management skills related to industry / research organizations.
CO2: Extend the boundaries of knowledge through research and development.
CO3: Discriminate the knowledge and skills acquired at the workplace to their on-campus studies.
CO4: Develop greater clarity about academic and career goals.
CO5: Visualize the impact of engineering solutions to the society.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8901	PROJECT WORK	0	0	20	10

Course Objectives

1. Analyse a methodology to select a good project and able to work in a team.
2. Transform the ideas behind the project into a product.
3. Validate the technical report.

A project must be selected either from research literature published list or the students themselves may propose suitable topics in consultation with their guides.

The aim of the project work is to strengthen the comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee shall be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Controller of Examination based on oral presentation and the project report.

Course Outcome

CO1: Implement the skills acquired in the previous semesters to solve complex engineering problems.
CO2: Develop a model / prototype of an idea related to the field of specialization.
CO3: Establish the work individually or in a team to identify, troubleshoot and build products for environmental and societal issues.
CO4: Effective presentation of ideas with clarity.
CO5: Evaluate surveys towards developing a product which helps in life time learning.

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PROFESSIONAL ELECTIVE - III

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7301	FIBER OPTICS AND LASER INSTRUMENTATION	3	0	0	3

Course Objective

1. Recall the fundamentals of optical fiber and its properties
2. Infer the industrial applications of optical fiber
3. Relate the concepts of lasers
4. Apply lasers in various applications
5. Interpret hologram and medical applications

Unit	Description	Instructional Hours
I	**OPTICAL FIBRES AND THEIR PROPERTIES** Principles of light propagation through a fiber - Different types of fibers and their properties, fiber characteristics - Absorption losses - Scattering losses - Dispersion - Fiber Optic Connectors - Splices- Fiber termination - Optical sources - Optical detectors	9
II	**INDUSTRIAL APPLICATIONS OF OPTICAL FIBRES** Sensors - Fiber optic instrumentation system - Different types of modulators - Interferometric method of measurement of length - Moire fringes - Measurement of pressure, temperature, current, voltage, liquid level and strain.	9
III	**LASER FUNDAMENTALS** Fundamental characteristics of lasers - Laser Levels - Properties of laser - Laser modes - Resonator configuration Q-switching and mode locking - Cavity damping - Types of lasers	9
IV	**INDUSTRIAL APPLICATION OF LASERS** Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect - Material processing - Laser heating, welding, melting and trimming of material, removal and vaporization.	9
V	**HOLOGRAM AND MEDICAL APPLICATIONS** Holography - Basic principle - Methods - Holographic interferometry and application, Holography for non-destructive testing - Holographic components - Medical applications of lasers - laser and tissue interactive - Laser instruments for surgery - Removal of tumors of vocal cards - Brain surgery - Plastic surgery - Gynaecology and Oncology.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the basic concepts of optical fibers in applications.
CO2: Demonstrate fibre optic instrumentation system in industrial applications.
CO3: Develop applications based on lasers.
CO4: Validate the industrial applications of lasers
CO5: Establish industrial application of holography and medical applications of lasers

TEXT BOOKS:

T1 - R.P.Khare, "Fiber Optics and Optoelectronics", Oxford university press, 2008.
T2 - J. Wilson and J.F.B. Hawkes, "Introduction to Opto Electronics", Prentice Hall of India, 2001.

REFERENCE BOOKS :

R1 - Asu Ram Jha, "Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems", Prentice Hall of India learning Private limited, 2009.
R2 - M. Arumugam, "Optical Fiber Communication and Sensors", Anuradha Publication, 2002.
R3 - John F. Read, "Industrial Applications of Lasers", Academic Press, 1978.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7302	ADAPTIVE CONTROL AND SYSTEM IDENTIFICATION	3	0	0	3

Course Objective

1. Define the adaptive control systems.
2. Explain adaptive system tuning and parameter estimation.
3. Discuss about system identification and it's model.
4. Illustrate the various non-linear identification methods.
5. Employing adaptive systems design in modern control environments.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO ADAPTIVE CONTROL** Introduction - use of Adaptive control - definitions - classification - Model Reference Adaptive Systems - different configurations - direct and indirect MRAC - Continuous time MRAC systems - Model Reference Adaptive System Design based on Gradient method.	9
II	**SELF TUNING REGULATORS AND GAIN SCHEDULING** Self Tuning Regulators (STR) - different approaches to self tuning –Recursive parameter estimation - implicit STR - Explicit STR - Principle and Design of Gain Scheduling Controllers - Nonlinear Transformations of second Order Systems - Applications.	9
III	**PARAMETRIC AND NON-PARAMETRIC IDENTIFICATION** Parametric Methods: Linear Models - State space Models - Least square estimation - Parameter estimates for linear models - The recursive least square method - recursive prediction error methods - Maximum likelihood. Non-Parametric Methods: Transient response and frequency analysis - Correlation analysis - Spectral analysis.	9
IV	**NON-LINEAR IDENTIFICATION** Open and closed loop identification: Approaches - Direct and indirect identification - Joint input-output identification - Wiener models - Volterra Models - Non linear identification using Neural Networks and Fuzzy Logic.	9
V	**PRACTICAL ASPECTS IN ADAPTIVE CONTROL AND APPLICATIONS** Stability – Convergence - Averaging, Applications: Inverted Pendulum, Robotic manipulators, heat exchanger, Distillation column, Electric drives, Satellite altitude control, Space craft control.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Represent complex control systems with adaptive control design.
CO2: Design the controller by using STR and gain scheduling adaptive system.
CO3: Estimate the controller parameters for parametric and non-parametric identification schemes.
CO4: Elaborate advanced identification models for non-linear systems.
CO5: Implement adaptive and system identification concept for various application domain.

TEXT BOOKS:

T1 - Karl J Astrom and Bjorn Wittenmark, "Adaptive Control", Pearson Education Inc, Second Edition, 2008.
T2 - Soder storm T and Peter Stoica, "System Identification", Prentice Hall of India ,1989.

REFERENCE BOOKS :

R1 - Ljung L, "System Identification: Theory for the user", Prentice Hall of India, 1999.
R2- Sankar Sastry,Marc Bodson, "Adaptive Control – Stability, convergence and Robustness", Prentice Hall of India,1989.
R3 - Arun K.Tangirala, "Principles of System Identification: Theory and Practice", CRC Press, 2014.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI7303	INSTRUMENTATION IN CEMENT AND STEEL INDUSTRIES	3	0	0	3

Course Objective

1. Illustrate the various process involved in cement manufacturing industry.
2. Discussion of various measuring instruments involved in cement manufacturing process.
3. In-depth understanding of the various manufacturing process in the steel industries.
4. Discussion of various control systems involved in steel industries.
5. Extend the steel process controlling technique via computer control system.

Unit	Description	Instructional Hours
I	**MANUFACTURING CEMENT** Process overview - Raw material mining - Processing of raw materials - Cement making equipment - Rotary kilns - Pre heaters - Pre calciners - Multi channel burners - Silo - Cooling systems.	9
II	**MEASUREMENT AND ANALYZERS** Temperature measurement - Pneumatic and Hydraulic load cells - Measurement of humidity and moisture - Gamma metrics - XRD and SEM analyzers - Gas analyzers - Coal analyzers - Particle size analyzers - Particulate emission analyzers - Pollution control instruments.	9
III	**IRON AND STEEL - PROCESS DESCRIPTION** Raw material operation – Blast furnace iron making - Raw steel making - Electric steel making - Oxygen steel making – Secondary steel making-Stainless steel making - Casting of steel.	9
IV	**CONTROLS AND SYSTEMS** Graphic displays - Alarms - Measurement of flow, weight, thickness and shape - Blast furnace stove combustion control systems - Gas and water control in BOF furnaces - Continuous casting mould level control.	9
V	**COMPUTER CONTROL SYSTEM IN PLANTS** Computer control of metal rolling mill - Computer control of annealing processes - Fuzzy logic control of cement kiln - Distributed computer control systems in cement plant.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Infer the manufacturing processes of cement industries.
CO2: Summarize various measurement and analyzers involved in process industries.
CO3: Outline the manufacturing processes of steel industries
CO4: Make use of various controls and system involved in steel industries.
CO5: Innovate the steel manufacturing processes with the help of computer control system.

TEXT BOOKS:

T1 - Ghosh.S.N, "Cement and Concrete-Science and Technology", Vol-1 Part-1, Abi books Pvt. Ltd. 1991.
T2 - Ahindra Ghosh and Amit Chatterjee, "Iron Making and Steel Making" Prentice Hall of India Learning Private Limited, 2008.

REFERENCE BOOKS:

R1 - Dobrivojie Popovic and Vijay P. Bhatkar, "Distributed Computer Control Systems in Industrial Automation" Marcel Dekkar Inc. New York, 1990.
R2 - Liptak B.G, "Instrumentation in the processing industries", First Edition, Chilton book company, 1973.
R3 - Gregory K. McMillan Douglas M. Considine "Process/ Industrial Instruments and Controls Handbook", Fifth Edition, McGraw-Hill, 1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7304	TELEMETRY AND TELECONTROL	3	0	0	3

Course Objective

1. Discuss the basics involved in telemetry.
2. Interpret the concepts of telemetry.
3. Outline the concepts involved in radio telemetry.
4. Observe the optical fiber communication concepts related to telemetry.
5. Interpret the different telecontrol methods.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO TELEMETRY** Introduction - basic system - Classification - Non-Electrical Telemetry - Electrical Telemetry - Local Transmitters and Connectors - Frequency Telemetry - Signals and Transmission Basics	9
II	**CONCEPTS IN TELEMETRY** Symbols and Codes - Frequency Division Multiplexing - Time Division Multiplexing - Analog Frequency Modulation - Binary Phase-Shift Keying	9
III	**RADIO TELEMETRY** Transmitters and Receivers - Transmitter techniques - Transmission Lines - Antennas - Wave Propagation - Filters	9
IV	**SATELLITE AND OPTICAL FIBRE TELEMETRY** Introduction - TT & C Services - Digital Transmission System - Optical fiber cable - Coherent Optical fiber Communication - Wavelength Division Multiplexing	9
V	**TELECONTROL METHODS** Analog and digital techniques in telecontrol - Telecontrol apparatus - Remote adjustment-guidance and regulation - Telecontrol using information theory - Example of a telecontrol system.	9
	Total Instructional Hours	45

Course Outcome

CO1: Illustrate the different telemetry methods.
CO2: Summarise the operation involved in telemetry.
CO3: Identify the techniques used in radio telemetry.
CO4: Correlate satellite and optical fiber communication telemetry.
CO5: Demonstrate the use of computers for different telecontrol methods.

TEXT BOOKS:

T1 - Patranabis D, "Telemetry Principles", Tata McGraw- Hill, 1999.
T2 - Swoboda G, "Telecontrol Methods and Applications of Telemetry and Remote Control", Reinhold Publishing Corp, 1991.

REFERENCE BOOKS:

R1 - Gruenberg L , "Handbook of telemetry and remote control" , Tata McGraw-Hill, 1987.
R2 - Housley T , "Data communication and teleprocessing system", Prentice Hall of India, 1987.
R3 - Frank Carden, Russell Jedlicka, Robert Henry, "Telemetry Systems Engineering", Artech House, 2002.

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PROFESSIONAL ELECTIVE - IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7305	INSTRUMENTATION IN PAPER INDUSTRIES	3	0	0	3

Course Objective

1. Categorize the process parameters involved in paper making.
2. Differentiate the properties of paper and its measurement methods.
3. Analyse methods for measurement of consistency.
4. Infer about the working and quality parameters of paper making machine.
5. Analyse various control aspects involved in paper production.

Unit	Description	Instructional Hours
I	**OVERVIEW OF PAPER MAKING PROCESS** Description of The Process - Measurements of various parameters involved in paper making process - Control Operations - various types of controls involved in paper making process - computer applications.	9
II	**PAPER PROPERTIES AND ITS MEASUREMENT** Physical, electrical, optical and chemical properties of paper - compressive test method-quality measurement method - optical testing-ultrasonic measurement - standards in testing.	9
III	**CONSISTENCY MEASUREMENT** Definition of consistency - Techniques for head box consistency measurement - Stock consistency measurement and control instrumentation.	9
IV	**PAPER MAKING MACHINE** Functioning of Paper making machine - Quality parameters - moisture, basic weight, caliper, brightness, colour, ash content, strength, gloss and tensile strength - parameters monitoring	9
V	**CONTROL ASPECTS** Machine and cross direction control technique - consistency, moisture and basic weight control - dryer control - computer based control systems - mill wide control	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the process learnt in real time application.
CO2: Summarise various properties of paper and it's testing methods.
CO3 : Demonstrate the consistency of paper through the learnt methodologies.
CO4 : Appraise about the quality parameters associated in production of paper.
CO5 : Point out the appropriate control technique involved in production of paper.

TEXT BOOKS:

T1 - B.G Liptak, "Instrumentation in Process Industries", Chilton Book Company, 2003
T2 - P.E.Sankaranarayanan, "Pulp and Paper Industries- Technology and Instrumentation", Kotharis Desk book series, 1995.

REFERENCE BOOKS:

R1 - Britt K.W, "Handbook of Pulp and Paper Technology", Reinbold Company Second Edition, 2004.
R2 - James P.Casey , "Pulp and Paper Chemistry and Chemical Technology", John Wiley and sons, 1981.
R3 - Randolph Norris Shreve and George, "Shreve's Chemical Process Industries", McGraw Hill International Student Edition, Singapore,1985.

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Programme	Course code	Name of the Course	L	T	P	C
B.E.	16EI7306	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3

Course Objective

1. Infer the basic concept in MEMS.
2. Recall the working of sensors and actuators.
3. Interpret the micro fabrication and manufacturing technique.
4. Infer the design of a micro system.
5. List various applications of MEMS.

Unit	Description	Instructional Hours
I	**INTRODUCTION** MEMS and Microsystems - Evolution of Micro Fabrication - Microsystems and Microelectronics - Multidisciplinary Nature of Micro System Design and Manufacture - Materials for MEMS and Microsystems - Scaling Laws in Miniaturization.	9
II	**SENSORS AND ACTUATORS** Working Principles of Micro Systems, Micro Sensors- Acoustic Sensor, Biomedical Sensor, Chemical Sensor ,Optical Sensor, Pressure Sensor, Thermal Sensor, Micro Actuation Techniques - Actuation using Thermal Forces, SMA, piezoelectric effect, Actuation using electrostatic forces - Micro Gripper, Micro Motor, Micro Valve, Micro Accelerometers.	9
III	**MICRO FABRICATION AND MICRO MANUFACTURING TECHNIQUES** Materials for Micro Systems, Photolithography, Oxidation, Diffusion, CVD, PVD, etching, Micro Manufacturing: Bulk Micro Manufacturing, Surface Micromachining, LIGA Process, Packaging Techniques: Die Preparation, Surface Bonding, Sealing.	9
IV	**MICRO SYSTEMS DESIGN** Introduction - Design Considerations - Process Design - Mechanical Design, Mechanical design using Finite Element Method - Design of Micro Fluidic Network Systems.	9
V	**APPLICATIONS OF MEMS** Applications of MEMS in Automotive Industry - Application of Microsystems in other Industries - Health Care, Aerospace, Industrial Products, Telecommunication, Optical MEMS.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the concepts of semiconductors and solid mechanics to fabricate MEMS device.
CO2: Analyze the suitable sensors and actuators for various applications.
CO3: Outline the rudiments of micro fabrication techniques.
CO4: Illustrate the design of micro system.
CO5: Implement MEMS in various applications.

TEXT BOOKS:

T1 - Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture",Tata McGraw Hill, New Delhi, 2002.
T2 - Nitaigour Premchand Mahalik "MEMS", Tata McGraw Hill,2007.

REFERENCE BOOKS :

R1 - Nadim Maluf,"An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
R2 - Mohamed Gad-el-Hak, " The MEMS Handbook", CRC press Baco Raton, 2000.
R3 - Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son Ltd, 2002.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7307	NON-LINEAR CONTROL SYSTEM	3	0	0	3

Course Objective

1. Identify the common non-linearities which exist among all the systems.
2. Generalise describing function based approach of non-linear analysis.
3. Explain about Lyapunov Theory and it's methods
4. Discover on Linearization schemes on SISO, MIMO systems.
5. Highlight on Sliding Mode Control.

Unit	Description	Instructional Hours
I	**INRODUCTION TO NON-LINEAR THEORY** Linear versus nonlinear systems - Common Nonlinear behavior, Examples - Types of Nonlinearities - Autonomy - Equilibrium points of nonlinear systems, Feedback Linearization, Series Approximation Methods.	9
II	**DESCRIBING FUNCTION** Describing function analysis: Fundamentals, common nonlinearities (saturation, dead - zone, on - off Non - linearity, backlash, hysteresis) and their describing functions. Compensation and design of nonlinear system using describing function, Limit Cycles.	9
III	**LYAPUNOV THEORY** Lyapunov's stability, concept, Lyapunov's Direct Method - Positive definite Functions and Lyapunov Functions - Krasovski's Method - Variable Gradient Method - Control Design based on Lyapunov's Direct Method.	9
IV	**FEEDBACK LINEARIZATION** Feedback Linearization and the Canonical Form - Mathematical Tools-Input - State Linearization of SISO Systems - input-Output Linearization of SISO Systems - Generating a Linear Input - Output Relation–Stabilization and Tracking - Feedback Linearization of MIMO Systems.	9
V	**SLIDING MODE CONTROL** Sliding Surfaces - Continuous approximations of Switching Control laws - The Modeling/Performance Trade-Offs - MIMO Systems. Case Study - Sliding mode approach to speed control of dc motors, applications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Classify the linear/non-linear system theory and their types.
CO2: Analyse the various non-linear systems with describing functions.
CO3: Appraise the stability for various nonlinear functions using lyapunov method.
CO4: Design the SISO, MIMO system with feedback linearization.
CO5: Implement sliding mode control approach to various non-linear applications.

TEXT BOOKS:

T1 - Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 5th Edition 2010.
T2 - Jean-Jacques E. Slotine, Weiping Li, "Applied nonlinear Control", Prentice Hall of India , 2004.

REFERENCE BOOKS :

R1 -Torkel Glad and Lennart Ljung, "Control Theory – Multivariable and Nonlinear Methods", Taylor & Francis, 2002.
R2 - Richard C Dorf and Robert H Bishop, "Modern Control Systems," 11th Edition, Pearson Education, 2008.
R3 - A.Nagoor Kani, "Advanced Control System", 2nd Edition, RBA publications, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7308	SENSOR TECHNOLOGY	3	0	0	3

Course Objective

1. Recall the fundamentals of sensors.
2. Infer the physical principles of sensing.
3. Summarize the sensor materials and technologies incorporated.
4. Relate the interfacing concepts used in electronic circuits.
5. Apply sensors in various applications.

Unit	Description	Instructional Hours
I	**SENSORS FUNDAMENTALS AND CHARACTERISTICS** Sensors, Signals and systems - Sensor classification - Units of measurements - Sensor characteristics - Sensor selection-Measurement issues and criteria.	9
II	**PHYSICAL PRINCIPLES OF SENSING** Electric charges, fields, and potentials - Capacitance - Magnetism-Induction - Resistance - Piezoelectric effect - Hall effect - Temperature and thermal properties of material - Heat transfer - Light - Dynamic models of sensor elements.	9
III	**SENSOR MATERIALS AND TECHNOLOGIES** Sensing Materials - Process of Developing Sensors - Trends in Sensor Technology and IC Sensors - Surface Processing, Nano - Technology-Sensor Arrays and Multisensor Systems.	9
IV	**INTERFACE ELECTRONIC CIRCUITS** Input Characteristics of Interface Circuits - Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits - Data Transmission - Batteries for Low Power Sensors.	9
V	**SENSORS IN DIFFERENT APPLICATION AREA** Occupancy and Motion Detectors - Position, Displacement and Level - Velocity and Acceleration - Force, Strain - Pressure Sensors, Temperature Sensors - Acoustic Sensors - Robot Vision and Tactile Sensors - Optical and Radiation Sensors - Biosensors - Chemical sensor - Wireless Sensor Networks.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the fundamental characteristics of sensor.
CO2: Illustrate the physical sensing principles.
CO3: Decide about the sensing materials and technologies used.
CO4: Discuss electronics circuit experiences for interfacing.
CO5: Validate applications of sensors in different specialization

TEXT BOOKS:

T1 - J. Fraden, "Handbook of Modern Sensors: Physical, Designs, and Applications", AIP Press, Springer, 2003.
T2 - D.Patranabis, "Sensors and Transducers", Prentice Hall of India, 2003.

REFERENCE BOOKS:

R1 - Jon S. Wilson, "Sensor Technology Handbook" Newnes, Elsevier, 2005.
R2 - Ian Sinclair, "Sensors and Transducers", Third edition, Newnes, Butterworth-Heinemann, 2001.
R3 - Halit Eren, "Wireless Sensors and Instruments: Networks, Design and Applications" CRC Press, 2006.

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PROFESSIONAL ELECTIVE - V

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8301	INSTRUMENTATION SYSTEM DESIGN	3	0	0	3

Course Objective

1. Infer the basic concepts of instrument design.
2. Outline the design aspects of instruments.
3. Design printed circuit board.
4. Discuss about the control panel design.
5. Interpret the reliability concepts.

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS ON INSTRUMENT DESIGN** Functional Requirements and Specification - Operational Environment - Commercial, Industrial, Military - NEMA, DIN, BIS And ANSI Standards with special reference packaging - One Line Diagram of Hydraulic, Pneumatic and Electrical Instrumentation System - Instruments Symbols and Signals.	9
II	**DESIGN ASPECTS** Performance Characteristics and Selection Criteria for Flow, Temperature, Pressure and Level Transducers - Range, Specification Standards and Recommended Practice for Instruments - Interface Primary Element with End Devices - Engineering Display- Calibrating and Testing Standards for Instruments and Transducers.	9
III	**PRINTED CIRCUIT BOARD DESIGN** Design Guideline - General Components, Layout Scheme, PCB Size, Design Rules for Digital Circuit and Analog Circuit PCB's Single and Multiplayer Boards - Automation and Computer in PCB Design - Artwork and CAD Packages and Tools - Electronic Circuit and Minimum System Design by using PCB Design Software Packages.	9
IV	**CONTROL PANEL DESIGN** Operating Console and Control Room Panel Design - Control Room Environment for Electronic Equipment - Requirement of Instrument Quality, Air Heat Dissipation, Forced Air Circulation and Humidity Consideration - Enclosure Design Guidelines - Grounding and Shielding Techniques - Packaging for Various Operational Environments including IP-51, IP-54 and IP-67.	9
V	**RELIABILITY CONCEPTS** MTTR - MTBF - Concepts of Availability - Instrument Evaluation (Test/Inspection Method) - Failure Rate Analysis - Product Quality Variance Report - Control Charts - SQC - TQM Principles - ISO Series - Quality Standards Procedure - Certifications Policies - Quality Audit.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply acquired skill in designing instrument.
CO2: Analyze various design aspects involved in manufacturing instruments.
CO3: Demonstrate printed circuit board.
CO4: Summarize the concepts of designing a control panel.
CO5: Illustrate various reliability concepts involved in the design and operation of instruments.

TEXT BOOKS:

T1 - Warren Boxleitner, "Electrostatic Discharge and Electronic Equipment", IEEE press., 1988.
T2 - E. Balguruswamy, "Reliability Engineering", Tata Mc Graw Hill, 2013.
T3 - R.S. Khandpur, "Printed Circuit Boards", Tata Mc Graw Hill, 2005.

REFERENCE BOOKS :

R1 - B.G. Liptak, "Process control ", CRC Press, 2005.
R2 - Christopher.T. Robertson, "Printed Circuit Boards", Prentice Hall of India, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8302	MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	3

Course Objective

1. Review the fundamental architecture of 8051 microcontroller.
2. Describe the instructions involved in assembly language programming of 8051.
3. Discussion of PIC microcontroller architecture and registers
4. Make use of peripheral interfacing concept with PIC microcontroller.
5. Elaborate the various case studies of microcontroller based system design.

Unit	Description	Instructional Hours
I	**8051 ARCHITECTURE** Architecture - Memory Organization - Addressing Modes - Instruction Set - Timers - Interrupts - I/O ports, Interfacing I/O Devices - Serial Communication.	9
II	**8051 PROGRAMMING** Assembly language programming - Arithmetic Instructions - Logical Instructions - Single bit Instructions - Timer Counter Programming - Serial Communication Programming Interrupt Programming - RTOS for 8051 - RTOS Lite - Full RTOS - Task creation and run - LCD digital clock/thermometer using Full RTOS.	9
III	**PIC MICROCONTROLLER** Introduction to PIC Microcontroller - PIC16C6x and PIC16C7x Architecture - PIC16cxx Pipelining - Memory organization - Register File Structure - Instruction Set - Addressing modes.	9
IV	**PERIPHERALS AND INTERFACING** Timers - Interrupts - I^2C Bus for Peripherals Chip Access - Serial EEPROM - CCP modules - Analog to Digital Converter - UART - LCD, Keyboard Interfacing - ADC, DAC and Temperature Sensor Interfacing.	9
V	**SYSTEM DESIGN CASE STUDY** Interfacing LCD Display -Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control - Controlling DC/ AC appliances - Measurement of frequency - Stand alone Data Acquisition System.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Infer the role of fundamental components of 8051 architecture.
CO2: Abstract the programming concepts involved in 8051 microcontroller.
CO3: Outline the fundamental architecture of PIC family controllers.
CO4: Implementing the Interfacing experiences for various peripheral devices.
CO5: Influence of PIC controller on various industrial case studies.

TEXT BOOKS:

T1 - Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded System", Prentice Hall of India, 2005.
T2 - Peatman J.B., "Design with PIC Microcontrollers" Pearson Education, 3rd Edition, 2004.

REFERENCE BOOKS:

R1 - Myke Predko, "Programming and customizing the 8051 microcontroller", Tata McGraw Hill,2001.
R2 - M.Am.Mazidi Rollin Mckinlay and Danny causey, "PIC Microcontroller", Prentice Hall of India, 2007.
R3 - Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems Using Assembly and C for PIC18", Pearson Education, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8303	ROBOTICS AND AUTOMATION	3	0	0	3

Course Objective

1. Infer the fundamentals of robotics.
2. Recall the concepts of sensors and vision system.
3. Outline the working of robot dynamics and grippers.
4. Write program for developing a robot.
5. Apply robotics applications and its principles.

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF ROBOTICS** Origin & various generation of robot - Robotic System Components - Classification of robot - Degree of freedom - Need for automation - Types of automation - fixed, flexible automation	9
II	**SENSORS AND VISION SYSTEM** Sensors in robotics - Uses of sensors in robotics - Proximity, Range, Tactile - Machine Vision - Introduction - Image component - image representation - Image processing and analysis - Object recognition	9
III	**ROBOT DYNAMICS AND GRIPPERS** Robot dynamics - manipulator path control - Configuration of robot controller - End effectors -Types of grippers	9
IV	**ROBOT PROGRAMMING AND LANGUAGES** Robot programming - Introduction ,General programming language - Motion interpolation - Robot Languages - Generation of robot programming languages - robot language structure - Motion commands - Program control and subroutines	9
V	**ROBOT APPLICATIONS AND IMPLEMENTATION PRINCIPLES** Applications - Manufacturing, Nuclear, Thermal - Implementation Principles - Plant Survey - Selection of robot - Economic analysis and installation - Artificial Intelligence in robotics	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate the fundamentals of robots
CO2: Apply knowledge on sensors and robotic vision system
CO3: Develop robots with differential motion and control
CO4: Build programs for robots in various applications
CO5: Innovate the robotic applications

TEXT BOOKS:

T1 - M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, "Industrial Robotics", McGraw-Hill,1996.
T2 - R.D.Klafter, Chemieleskio, T.A.and Negin .M, "Robotics Engineering an Integrated Approach" Prentice Hall of India,1989.

REFERENCE BOOKS :

R1 - John J Craig , "Introduction to Robotics Mechanics & Control," Pearson Education,Inc,2005.
R2 - Ghosh, "Control in Robotics and Automation : Sensor Based Integration", Allied Publishers,1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8304	NUCLEAR POWER PLANT INSTRUMENTATION	3	0	0	3

Course Objective

1. Understand the nuclear power scenario in India and international level.
2. Infer the process associated with nuclear power generation.
3. Estimate thermal effects on the performance of nuclear power plants.
4. Classify the types of nuclear reactors.
5. Discuss about the safety measuring instruments, health issues, solutions for nuclear radiation.

Unit	Description	Instructional Hours
I	**PREVIEW OF NUCLEAR POWER GENERATION** Introduction - World Energy Sources, Indian Power Scenario, Nuclear Power Scenario in the World and India - Review of Nuclear Physics - Elements of Nuclear Power Stations.	9
II	**NUCLEAR POWER PLANT PROCESS** Basic Concepts in Neutron Reactions - Neutron Moderation and Diffusion - Nuclear Reactor Theory - One Speed Diffusion Theory Model - Nuclear Reactor Kinetics.	9
III	**DESIGN OF NUCLEAR POWER PLANT** Nuclear Reactor Dynamics and Control- Thermal Hydraulics analysis of Nuclear Reactor – Core Power Distributions - Reactivity Control.	9
IV	**NUCLEAR REACTOR TYPES** Different types of nuclear power plant - Power Reactors and it's types - Principles of Costing - Nuclear Power Economics - Economic Implications of Nuclear Power Plants.	9
V	**SAFETY MEASURING INSTRUMENTS, HEALTH ISSUES & SOLUTIONS** Nuclear Instrumentation - radiations detection instruments - Spectrum Analyzer - Health Physics - Radiation Shielding- Nuclear Reactor Safety and licensing.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Express the scenario of nuclear power generation at nationwide and worldwide.
CO2 : Outline the process involved in nuclear power generation.
CO3 : Establish the thermal effects on the performance of nuclear power plants.
CO4 : Adapt the appropriate nuclear power plant.
CO5 : Highlight the health issues of nuclear radiation and solutions.

TEXT BOOKS:

T1 - J.R.Lamarsh and A.J.Baratta, "Introduction to Nuclear Engineering", 3rd Edition, Prentice Hall of India, 2001.
T2 - Duderstadt, J.J. and Hamilton, L.J., "Nuclear Reactor Analysis", John Wiley and Sons, 1976.

REFERENCE BOOKS :

R1 - S.Glasstone and A.Sesonske, "Nuclear Reactor Engineering Vol-1: Reactor Design Basics", 4th Edition, Elsevier, 1996.
R2 - Kenneth.S. Krane, "Introductory Nuclear Physics", 1st Edition, Wiley India Private Limited, 2008.
R3 - G. I. Bell and S. Glasstone, "Nuclear Reactor Theory", 1st Edition, Van Nostrand Reinhold., United States, 1970.

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PROFESSIONAL ELECTIVE - VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8305	ENVIRONMENTAL INSTRUMENTATION	3	0	0	3

Course Objective

1. Recall the basic concepts of environmental laws and standards.
2. Infer various methods of air pollution control system.
3. Discuss about the sources and effects of noise pollution and solid waste management.
4. Outline the water quality parameters.
5. Summarize the ground water monitoring instruments.

Unit	Description	Instructional Hours
I	**ENVIRONMENTAL LAWS AND STANDARDS** Administrative Law - Natural Resource Laws - Pollution Control Laws - Technology Standards - Other Air Standards - Noise Standards - Water Quality Standards.	9
II	**AIR POLLUTION CONTROL SYSTEMS** Sources-Effects - Macro Air Pollution Effects - General System Types - Flares - Thermal Oxidizers - Regenerative Thermal Oxidizers - Catalytic Oxidizers - Scrubber Systems-Instrumentation.	9
III	**NOISE POLLUTION AND SOLID WASTE TREATMENT** Noise Sources - The Effects of Noise - Noise Measurements - Noise Control at the Source - Noise Control in the Transmission Path - Source and Effect of Solid waste - Resource Conservation and Recovery - Treatment and Disposal.	9
IV	**WATER QUALITY PARAMETERS** Thermal Conductivity Detectors - pH Analyzers and their Application - Turbidity Monitoring - Watershed Scale, Water Quality Monitoring - Water Sample Collection - Conductivity Analyzers and their application.	9
V	**GROUND WATER MONITORING** Level Measurements in Groundwater Monitoring Wells - Techniques for Groundwater Sampling - Soil Permeability and Dispersion Analysis - Instrumentation in Groundwater Monitoring - Microbiological Field Sampling and Instrumentation in Assessment of Soil and Groundwater Pollution.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the concepts of environmental laws and standards for a healthy environment
CO2: Illustrate air pollution control systems
CO3: Summarize the effects of noise pollution and solid waste treatment
CO4: Interpret water quality parameters
CO5: Determine different ground water monitoring techniques

TEXT BOOKS:

T1 - Randy d. Down and Jay H. Lehr, "Environmental Instrumentation and Analysis Handbook", John Wiley & sons Publication, New Jersey, 2005.
T2 - David H.F. Liu, Bela G. Liptak, "Environmental Engineers' Handbook", Second edition, CRC Press, New York, 1997.

REFERENCE BOOKS :

R1 - Leo J. Fritschen and LloydW. Gay, "Environmental Instrumentation", Springer Advanced Texts in Life Sciences, 1st Edition, New York, 1979.
R2 - C S Rao, "Environmental Pollution Control Engineering", New Age International Pvt Limited, New Delhi, 2003.
R3 - Mackenzie L. Davis, "Water and Wastewater Engineering Design Principle and Practice", McGraw Hill Education India Pvt Limited, Publishers, New Delhi, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8306	SAFETY INSTRUMENTATION SYSTEM	3	0	0	3

Course Objective

1. Infer the basic concepts of safety life cycle
2. Discuss the safety instrument system
3. Generalize the reliability engineering and system reliability engineering
4. Create awareness on equipment failure modes
5. Apply logic solvers and safety instrumentation system

Unit	Description	Instructional Hours
I	**THE SAFETY LIFECYCLE** Introduction - Functional Safety - Functional Safety standards-Safety Lifecycle-Analysis Phase - Realization Phase - Operation Phase - Benefits of the Safety Lifecycle - Safety Lifecycle Adoption.	9
II	**SAFETY INSTRUMENT SYSTEMS** Safety Instrumented Systems - BPCS versus SIS - SIS Engineering Requirements-Safety Instrumented Function - Failure - The well Designed System - Failure Rate -Time - Dependent Failure Rates - Censored Data - Confidence Factor - Getting Failure Rate Data.	9
III	**BASIC RELIABILITY ENGINEERING AND SYSTEM RELIABILITY ENGINEERING** Measurements of Successful Operation - No Repair-useful approximations - Repairable Systems - Periodic Restoration and Imperfect Testing - System Model Building - Reliability block diagrams.	9
IV	**EQUIPMENT FAILURE MODES** Introduction - Equipment Failure Modes-Fail Safe - Fail Danger - Annunciation No Effect - Detected/Undetected - SIF Modeling of Failure Modes - PFS/PFD - The Conceptual Design Process - SIF Testing Techniques.	9
V	**SAFETY PLC** Introduction - Relays/Pneumatic Logic - Solid State / Intrinsically Safe Solid State - Programmable Logic Controllers - Safety Programmable Logic Controllers - Probabilistic Modeling of the PLC - Final Elements - The "Well Designed" Remote Actuated Valve Actuator Types - Valve Failure Modes.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the rudiments of safety lifecycle
CO2: Apply suitable instrumentation system for safety management
CO3: Distinguish basic reliability and system reliability engineering
CO4: Recommend a suitable equipment failure mode
CO5: Demonstrate logic solvers for a safety instrumentation system.

TEXT BOOKS:

T1 - William M. Goble, Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations", Thomson learning, 2004.
T2 - R.K.Jain, Sunil S. Rao, "Industrial Safety ,Health and Environment Management system", Khanna Publishers, First Edition,2006.

REFERENCE BOOKS :

R1 - Dr David J Smith, "Reliability, Maintainability and Risk", 7th Edition - Elsevier Publication 2006.
R2 - Michael Yastre benetsky and Yuri Rozen, "Nuclear Power Plant Instrumentation and Control Systems for Safety and Security", IGI Global book series, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8307	INSTRUMENTATION SYSTEMS FOR DISASTER MANAGEMENT	3	0	0	3

Course Objective

1. Interpret the basic knowledge of disaster management.
2. Discuss about the exposure of environmental disaster.
3. Create awareness about earthquake and Tsunami.
4. Express the cyclone management techniques.
5. Apply the technologies in disaster management.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Disaster - Disaster management - Disaster prevention and preparedness measures - Types of Disaster Causal factor of Disaster - Natural, Manmade and creeping disaster - Disaster in the Indian context-various measures - Disaster related policy goals - United Nations Development Program (UNDP) - United Nations Disaster Relief Organization (UNDRO) - Govt. of India.	9
II	**ENVIRONMENTAL DISASTER** Environmental hazards - Typology - Assessment and response - the strategies - the scale of disaster - Vulnerability - Disaster trends - Paradigms towards a balanced view - Chemical hazards and Toxicology - Biological hazards - Hazard caused by world climate change - Risk analysis - other technological disasters.	9
III	**EARTHQUAKE AND TSUNAMI** Earthquake - Causes of earthquake - Earthquake scales - Measures of earth quake - Magnitude and Intensity - Seismic zone - Earthquake disaster mitigation - Forecasting techniques and Risk analysis – Tsunami - Causes of Tsunami - Effects of Tsunami - Tsunami warning system in India - International status of Tsunami warning and communication system - Tsunami warning centers - Pacific Tsunami Warning Center (PTWC) - Institutional arrangements and design criteria for Tsunami mitigation.	9
IV	**CYCLONE** Tropical cyclone - Warning system - Protection of buildings from cyclones - Precaution before and during cyclones - Tropical cyclone warning strategy in India - Cyclone related problems - Aerial survey - Management strategy - risk reduction by public awareness and education.	9
V	**APPLICATION OF TECHNOLOGY IN DIASTER MANAGEMENT** Hazard map - Multi hazard mapping - Application of satellites in Disaster Management - Application of remote sensing in forecasting and disaster relief - Use of digital image processing in disaster management - GIS in disaster management - Spatial data - GIS data base design - Convention mapping concepts and Coordinate system - Methods of spatial Interpolation in GIS.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Associate the basic concepts of disaster management in real life
CO2: Summarize the vulnerability of environmental disaster
CO3: Determine the measures to be taken during environmental disaster
CO4: Predict the consequences of cyclones
CO5: Innovate the technology in disaster management

TEXT BOOKS:

T1 - Pardeep Sahni, Madhavi malalgoda and Ariyabandu, "Disaster Risk Reduction in South Asia", Prentice Hall of India 2003 .
T2 - Amita Sinhal, "Understanding Earthquake Disasters", Tata McGraw-Hill, 2010.

REFERENCE BOOKS:

R1 - Pardeep Sahni, Alka Dhameja and Uma medury, "Disaster Mitigation: Experiences and Reflections", Prentice Hall of India ,2004
R2 - Jeff Groman, "The Atlas of Natural Disasters", Michael Friedman Publication, 2002.
R3 -Jaikrishna & Chandrasekar, "Elements of Earthquake Engineering", South Asian Publishers Private, Limited, 2000.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI8308	PROFESSIONAL ETHICS IN ENGINEERING	3	0	0	3

Course Objective

1. Infer the essentials of engineering ethics.
2. Interpret the rudiments of engineers as social experimentation.
3. Speculate the responsibilities of engineers for safety.
4. Create awareness on social responsibilities and rights.
5. Outline the global issues in environment.

Unit	Description	Instructional Hours
I	**ENGINEERING ETHICS** Senses of Engineering Ethics - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Professions and Professionalism - Professional ideals and virtues - Use of ethical theories.	9
II	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as experimentation - Engineers as responsible experimenters - Research ethics - Codes of ethics - Industrial Standards - Challenger Case Study.	9
III	**ENGINEERS' RESPONSIBILITY FOR SAFETY** Safety and risk - Assessment of safety and risk - Risk Benefit Analysis - Reducing risk - Case Studies: Chernobyl and Bhopal.	9
IV	**RESPONSIBILITIES AND RIGHTS** Collegiality and Loyalty - Respect for Authority - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination.	9
V	**GLOBAL ISSUES** Multinational Corporations - Business Ethics - Environmental Ethics -Computer Ethics - Weapons Development- Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Honesty - Moral Leadership - Sample code of conduct.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Practice engineering ethics and human values for a moral life.
CO2: Develop the codes of conduct for engineers in the society.
CO3: Experiment the safety measures as a responsible engineer.
CO4: Interpret the responsibilities, professional rights and moralities for the enhancement of an organization.
CO5: Validate the broad range of contemporary global issues.

TEXT BOOKS:

T1 - Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 2013.
T2 - Charles D Fledderman, "Engineering Ethics", Prentice Hall of India, 2004.

REFERENCE BOOKS:

R1 - Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
R2 - John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi,2003.
R3 -Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EI7402	ELECTRICAL ENERGY MANAGEMENT	3	0	0	3

Course Objective

1. Discuss on availability of renewable energy sources.
2. Understand and analyze the energy conservation methods.
3. Infer the Concepts of energy management system and role of energy manager.
4. Acquire Skills and techniques required to implement energy audit
5. Implement techniques required for energy audit.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO ENERGY SOURCES** General - Energy consumption as a measure of prosperity - World energy futures - Energy sources and their availability - Renewable energy sources - Types - Prospects of renewable energy sources.	9
II	**ENERGY CONSERVATION** Introduction - Load curve - cost of electrical energy - need for electrical energy conservation methods - Power factor improvement - concept of distributed generation - Deregulation - Need for Restructuring. Indian Energy Conservation Act - BEE star rating - List of Energy Intensive Industries - Rules for Efficient Energy Conservation.	9
III	**ENERGY MANAGEMENT** Definition and objectives of energy management - Energy management strategy - Key elements - Responsibility and duties of energy manager - Energy efficient programs - Energy monitoring systems - Importance of SCADA - Analysis technique.	9
IV	**ENERGY AUDIT** Aim of Energy audit - Energy flow diagram - Strategy of energy audit - comparison with standards - Energy management team - Considerations in implementing energy conservation programmes - Periodic progress review	9
V	**ENERGY AUDIT FOR VARIOUS APPLICATIONS** Types of Energy Audit : Internal Audit, External Audit, Walk through Energy Audit, Preliminary Energy Audit, Detailed Energy Audit, Residential Energy Audit. Instruments for energy audits - Energy audit for Illumination system - Electrical system - Heating - Ventilation - Air conditioning system - Buildings - Economic analysis.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate the working of different non conventional energy sources.
CO2: Outline the importance of energy conservation and aware of energy conservation act.
CO3: Identify the role and responsibilities of energy manager.
CO4: Outline the fundamentals of energy audit.
CO5: Implement energy audit for several applications.

TEXT BOOKS:

T1- B.R. Gupta, " Generation of Electrical Energy " , S.Chand Publications , New Delhi , 2014.
T2- S. Sivanagaraju," Generation and Utilization of Electrical Energy " Pearson Education, New Delhi , 2010.

REFERENCES:

R1- G.D.Rai, " Non Conventional Energy Sources " , Khanna publishers , New Delhi , 2014.
R2- W.C. Turner, "Energy Management Handbook", 6th Edition, CRC press, 2006.
R3- L.C. Witte, P.S. Schmidt, D.R. Brown "Industrial Energy Management and Utilization" , Hemisphere Publishing Corp., New York 1988.

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Hindusthan College of Engineering And Technology
Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Coimbatore - 641032

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

ACDEMIC YEAR 2019-2020

REGULATIONS 2019 & 2016

CO'S, PO'S & PSO'S MAPPING

REGULATIONS 2019

SEMESTER I

19HE1101-Technical English

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	1	1	2	-	1	2	1	2	3	1	3	3	2
CO2	1	2	1	1	1	2	1	1	1	3	1	2	2	3
CO3	1	2	1	1	1	2	1	1	2	3	1	2	2	2
CO4	1	1	-	1	1	1	1	1	2	3	1	2	3	3
CO5	-	1	1	1	1	1	1	2	2	3	1	2	2	2
Avg	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4

19MA1103- Calculus and Differential Equations

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2

19PH1151-Applied Physics

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	3	3
CO3	3	2	1	2	2	-	-	-	-	-	-	1	3	3
CO4	3	2	3	2	3	1	-	-	-	-	-	1	2	2
CO5	3	2	3	2	2	2	-	-	-	-	-	1	2	3
Avg	3	2.2	2	1.6	2	1.3	-	-	-	-	-	1	2.4	2.4

19CY1151- Chemistry for Engineers

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	2	1	1	-	-	-	-	1	1	1
CO2	3	2	2	-	2	1	-	-	-	-	-	1	1	-
CO3	3	2	2	-	2	1	1	-	-	-	-	1	1	-
CO4	3	2	2	2	2	1	-	-	-	-	-	1	1	1
CO5	3	2	2	-	2	1	-	-	-	-	-	1	1	1
Avg	3	2	2	2	2	1	1	-	-	-	-	1	1	1

19CS1151-Python Progrmming and Practices

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	3	-	2	-	-	-	-	-	-	2	2	2
CO2	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO3	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO4	2	3	3	-	2	-	-	-	2	-	-	2	2	2
CO5	2	3	3	-	2	-	-	-	2	-	-	2	2	2
Avg	2	3	3	-	2	-	-	-	2	-	-	2	2	2

19ME1152- Engineering Drawing

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	-	1	-	1	-	-	1	1	1	1	2
CO2	3	3	2	1	1	-	1	-	-	1	1	1	1	2
CO3	3	3	3	-	1	1	1	-	-	1	1	-	1	1
CO4	3	3	3	1	1	2	1	-	-	1	1	1	1	1
CO5	3	3	3	1	1	3	1	-	-	1	1	1	1	1
Avg	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4

SEMESTER II

19HE2101-Business English for Engineers

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2	1	1	1	2	1	2	2	3	-	3	1	-
CO2	2	1	1	1	1	2	2	2	2	3	-	2	-	1
CO3	2	2	1	1	1	2	2	2	2	3	1	3	1	-
CO4	2	2	1	1	2	2	2	2	3	3	1	3	1	1
CO5	1	1	1	1	1	2	2	1	2	3	1	3	1	1
Avg	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1

19MA2102-Complex Variables and Transform Calculus

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	2	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2
CO4	3	3	3	3	3	-	-	-	-	-	-	2	1	2
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	1.8

19PH2151-Material Science

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	1	1	1	-	-	-	-	-	1	2	1
CO2	3	3	1	1	2	-	-	-	-	-	-	1	2	2
CO3	3	2	1	2	2	-	-	-	-	-	-	1	2	3
CO4	3	3	1	2	2	1	-	-	-	-	-	1	2	2
CO5	3	2	2	3	2	1	2	-	-	-	-	1	2	3
Avg	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2

19CY2151-Environmental Studies

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO2	2	-	-	-	-	2	3	3	2	-	-	2	-	-
CO3	2	1	1	-	-	2	3	3	2	-	-	2	-	-
CO4	2	1	2	-	-	2	3	3	2	-	-	2	-	-
CO5	2	1	2	-	-	2	3	3	2	-	-	2	-	-
Avg	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-

19EE2151-Circuit Theory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	-	2	-	-	-	1	-	-	-	3	3
CO2	2	3	-	-	2	-	-	-	-	-	2	-	3	3
CO3	3	2	-	2	1	-	-	-	-	-	2	-	3	2
CO4	3	2	1	2	-	-	-	2	-	-	2	-	2	2
CO5	2	2	1	-	-	-	-	-	-	-	-	-	3	3
Avg	2.6	2.8	0.6	0.8	1	-	-	0.4	0.2	-	1.2	-	2.8	2.6

19CS2152-Essentials of C and C++ Programming

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-		3	-	-	1	1	-	2	2	3	3
CO2	3	3	2	2	3	-	-	1	1	-	2	2	2	3
CO3	3	3	2	2	3	-	-	1	1	-	2	2	2	3
CO4	3	3	-	2	3	-	-	1	1	-	2	2	2	3
CO5	3	-	2	2	3	-	-	1	1	-	2	2	2	3
Avg	3	3	2	2	3	-	-	1	1	-	2	2	2.2	3

19ME2001-Engineering Practices Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-		-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	
Avg	3	-	3	-	3	-	-	-	1	-	-	-	1	2

REGULATIONS 2016

SEMESTER III

16MA3103-Fourier Analysis and Statistics

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	1
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2

16EI3201- Electronic Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	2	-	-	2	-	-	-	3	3
CO3	3	2	-	-	-	-	2	-	-	-	-	1	3	3
CO4	3	2	2	3	-	-	1	-	-	-	-	2	3	3
CO5	3	3	3	3	-	-	1	-	-	1	-	2	3	3
Avg	3	2.2	1.6	1.2	-	0.2	1.4	-	0.4	0.2	-	1.2	3	3

16EI3202 - Electronic Devices and Circuits

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	2	1	-	2	-	-	-	3	2
CO3	3	2	-	-	-	-	2	-	-	-	-	-	2	3
CO4	3	2	2	3	-	-	1	-	-	-	-	2	3	3
CO5	1	3	3	3	-	-	1	-	-	1	-	2	3	3
Avg	2.6	2.8	1.6	1.2	-	0.2	1.4	-	0.4	0.2	-	0.8	2.8	3

16EI3203 - Measurements and Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	1	-	1	-	-	-	-	1	3	3
CO2	3	3	2	-	-	2	1	-	-	-	-	1	3	3
CO3	3	3	2	2	-	-	1	-	-	-	-	1	3	3
CO4	3	3	2	-	-	-	1	-	-	1	1	2	3	3
CO5	3	3	3	3	1	-	1	1	-	1	-	2	3	3
Avg	3	3	2.2	1	0.4	0.4	1	0.2	-	0.4	0.2	1.4	3	3

16EI3204 - Transducer Engineering

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	1	-	1	-	-	-	-	1	3	3
CO2	3	2	2	-	-	2	1	-	-	-	-	1	3	3
CO3	3	3	2	2	-	-	1	-	-	-	-	1	2	3
CO4	3	3	2	-	-	-	1	-	-	1	-	2	3	3
CO5	3	3	3	3	1	-	1	-	-	1	-	2	3	3
Avg	3	2.8	2.2	1	0.4	0.4	1	-	-	0.4	-	1.4	2.8	3

16ME3231 - Fundamentals of Thermodynamics and Fluid Dynamics

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	1	1	1	-	-	-	-	-	1	2	3
CO2	2	3	3	1	1	-	-	-	-	-	-	1	2	3
CO3	3	3	2	2	1	1	-	-	-	-	-	1	2	3
CO4	2	3	1	1	2	2	1	-	1	-	2	1	3	2
CO5	3	3	1	1	1	3	-	-	1	-	-	1	3	3
Avg	2.6	3	1.8	1.2	1.2	1.4	0.2	-	0.4	-	0.4	1	2.2	2.8

16EI3001 - Transducer and Measurements Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	3	-	-	-	-	-	3	-	-	-	3	3
CO2	2	3	3	3	-	-	-	-	3	-	-	-	3	3
CO3	2	3	3	-	-	-	-	-	3	-	-	-	3	3
CO4	2	1	3	2	-	-	1	-	3	-	-	-	3	2
CO5	2	-	3	-	3	-	1	-	3	-	-	3	3	2
Avg	2	1.6	3	0.4	0.5	-	0.4	-	3	-	-	0.5	3	2.6

16EI3002 - Electronic Devices and Circuits Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	3	-	-	-	-	3
CO2	2	1	2	-	-	1	-	-	3	-	2	-	2	3
CO3	3	1	3	-	-	2	-	-	3	-	1	-	2	2
CO4	3	1	1	-	-	3	-	-	3	-	-	-	1	2
CO5	3	-	-	-	-	-	-	-	3	-	-	-	3	3
Avg	2.8	1.2	1	-	-	1	-	-	3	-	0.5	-	1.6	2.2

SEMESTER IV

16MA4107-Numerical Methods

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	-	-	-	-	-	-	2	2	2
CO2	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	2	2	1
CO4	3	3	3	3	3	-	-	-	-	-	-	2	2	1
CO5	3	3	3	3	3	-	-	-	-	-	-	2	2	1
Avg	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2

16EI4201 - Electrical Machines

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	1	1	1	1	-	-	-	-	1	3	3
CO2	3	3	3	3	1	-	-	-	-	-	-	1	3	3
CO3	3	3	3	2	1	-	1	-	1	-	-	1	1	3
CO4	3	3	3	3	1	1	1	-	1	-	-	2	1	3
CO5	3	3	2	2	1	-	-	-	-	-	1	2	3	3
Avg	2.8	3	2.6	2.2	1	0.4	0.6	-	0.4	-	0.2	1.4	2.2	3

16EI4202 - Linear Integrated Circuits and Applications

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	1	2	-	-	2	-	-	-	-	-	-	3	3
CO3	3	1	2	2	-	-	-	-	-	-	-	-	1	3
CO4	3	1	2	-	-	-	2	-	-	-	-	2	1	3
CO5	3	3	3	3	-	-	-	-	-	-	-	2	-	3
Avg	3	2.2	2.2	2.5	-	2	0.4	-	-	-	-	2	2.2	3

16EI4203 - Digital Logic Circuits

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	1	-	1	-	-	-	-	1	3	2
CO2	3	-	2	-	-	2	1	-	-	-	-	-	3	2
CO3	-	1	2	2	-	-	1	-	-	-	-	-	1	3
CO4	3	-	2	-	-	-	1	-	-	1	-	2	1	3
CO5	1	3	3	3	1	-	1	-	-	-	-	2	1	3
Avg	2	1.2	2.2	0.5	0.4	0.4	1	-	-	0.2	-	0.5	1.8	2.6

16EI4204-Power Plant Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	1		1	-	1	1	1	1	-	-	2	2
CO2	-	2	2	2	1	2	1	-	-	-	-	-	2	2
CO3	2	2	2	-	1	1	1	-	1	-	-	-	2	2
CO4	2	2	2	-	1	1	1	-	-	-	1	1	2	2
CO5	-	1	2	1	1	1	1	-	-	-	1	-	2	2
Avg.	1.2	1.4	1.8	0.6	1	1	1	0.2	0.4	0.2	0.4	0.2	2	2

16EI4205- Industrial Instrumentation-I

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO4	3	-	-	-	-	-	-	1	2	-	-	2	-	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3
Avg	2	1.2	2.2	1	-	0.4	-	0.2	0.4	-	-	0.8	1.2	2.6

16EI4001 - Electrical Machines Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	3	-	-	2	-	3
CO2	3	2	-	2	-	-	-	-	3	-	-	2	-	3
CO3	3	2	-	2	-	-	-	-	3	-	-	-	-	3
CO4	3	1	-	-	-	-	1	-	3	-	-	-	1	3
CO5	3	-	-	-	-	-	-	-	3	-	-	2	3	3
Avg	3	1.2	-	0.8	-	-	0.2	-	3	-	-	1.2	1.2	3

16EI4002 - Linear and Digital Integrated Circuits Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	3	-	-	2	-	3
CO2	2	-	2	-	-	-	-		3	-	-	2	-	3
CO3	3	-	3	2	-	-	-	-	3	-	-	-	-	3
CO4	3	-	-	-	2	-	-	-	3	-	-	-	-	2
CO5	3	-	-	2	-	-	-	-	3	-	-	2	3	3
Avg	2.8	0.4	2.5	0.8	0.4	-	-	-	3	-	-	1	0.6	2.8

SEMESTER V

16EI5201 -Industrial Instrumentation – II

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	-	-	-	-	-	-	-	3	3
CO2	3	2	2	2	1	-	-	-	-	-	-	1	3	3
CO3	3	2	2	2	1	-	1	-	-	-	-	1	3	3
CO4	3	2	1	2	1	-	1	-	-	1	-	1	2	3
CO5	3	3	3	2	1	-	-	-	-	1	-		2	3
Avg	3	2.2	2	2	1	-	0.4	-	-	0.4	-	0.6	2.6	3

16EI5202 - Analytical Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	-	2	-	-	2	2	-	-	-	-	-	3	3
CO3	-	1	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	-	2	-	-	-	1	-	-	1	-	2	2	3
CO5	1	3	3	3	-	-	1	-	-	-	-	2	3	3
Avg	2	1.2	2.2	1	-	0.4	1.2	-	-	0.2	-	0.8	2.6	3

16EI5203 - Microprocessors and Microcontrollers

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	1	-	1	-	-	-	-	1	2	2
CO2	3	-	2	-	-	2	1	-	-	-	-	1	2	2
CO3	2	1	2	2	-	-	1	-	-	-	-	1	2	3
CO4	3	-	2	-	-	-	1	-	-	-	-	2	2	3
CO5	2	3	3	3	1	-	1	-	1	-	-	2	2	3
Avg	2.6	1.2	2.2	1	0.4	0.4	1	-	0.2	-	-	1.4	2	2.6

16EI5204 – Control Systems

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	2	-	-	-	-	-	1	3	3
CO3	3	1	2	2	2	2	-	-	-	-	-	-	2	3
CO4	3	2	2	-	-	-	1	-	-	1	-	2	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	2	3	3
Avg	3	2.4	2.2	1	0.4	0.4	0.2	-	-	0.2	-	1.2	2.8	3

16IT5231 - Object Oriented Programming Using Java

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	1	1	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	-	2	-	-	-	-	-	1	-	-	2	1	3
CO5	1	3	3	3	-	-	-	-	1	-	-	2	1	3
Avg	2.2	1.2	2.2	1	-	0.4	-	-	0.4	-	-	0.6	2	2.6

16EI5001-Microprocessors and Microcontrollers Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	3	-	-	-	3	-	3	-	-	-	3	3
CO2	2	3	3	3	-	-	3	-	3	-	-	-	3	3
CO3	2	3	3	-	-	-	3	-	2	-	-	1	1	3
CO4	2	1	3	2	-	-	3	-	2	-	-	1	3	2
CO5	2	-	3	-	3	-	3	-	3	-	-	3	3	3
Avg	2	1.6	3	1	0.6	-	3	-	2.3	-	--	1	2.6	2.8

16EI5002 - Industrial Instrumentation Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	3	-	3	-	-	2	-	3
CO2	2	3	-	1	-	-	3	-	3	-	-	2	-	3
CO3	3	2	3	2	-	-	3	-	3	-	-	3	1	2
CO4	3	-	-	1	2	-	3	-	3	-	1	-	2	2
CO5	3	-	-	-	-	-	3	-	3	-	-	2	3	3
Avg	2.8	1.2	0.6	0.8	0.4	-	3	-	3	-	0.2	1.8	1.2	2.8

16IT5031- Object Oriented Programming Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	-	-	-	3	-	3	-	-	-	3	3
CO2	2	2	3	3	-	-	3	-	3	-	-	-	3	3
CO3	2	2	3	-	2	-	3	-	2	-	-	1	1	3
CO4	3	2	3	2	1	-	3	-	2	-	-	1	3	3
CO5	2	2	3	-	3	-	3	-	3	-	-	3	3	3
Avg	2.2	2	3	1	1	-	3	-	2.3	-	-	1	2.6	3

16EI5301 -Thermal Power Plant Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	1	-	1	-	1	1	1	1	-	-	2	3
CO2	3	2	2	2	1	2	1	-	-	-	-	-	2	3
CO3	3	2	2	-	1	1	1	-	1	-	-	-	3	3
CO4	3	3	2	-	1	1	2	-	-	-	1	1	3	3
CO5	3	3	2	1	1	1	1	-	-	-	1	-	3	3
Avg	3	2.6	1.8	0.6	1	1	1.2	0.2	0.4	0.2	0.4	0.2	2.6	3

16EI5302-Digital System Design

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	3	1	-	-	-	2	3	3
CO2	3	2	2	-	-	-	3	1	-	-	-	2	3	3
CO3	3	3	2	-	-	1	2	1	-	1	-	2	3	3
CO4	3	3		-	-	1	-	1	-	-	1	2	3	3
CO5	3	3	1	3	3	-	-	1	-	-	1	2	3	3
Avg	3	2.6	1.2	0.6	0.6	0.4	1.2	1	-	0.2	0.4	2	3	3

16EI5303-Digital Image Processing

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	2	-	2	-	-	-	-	3	3	3
CO2	3	2	3	2	2	-	2	-	1	-	-	3	3	3
CO3	3	2	2	3	2	-	1	-	-	-	-	3	3	3
CO4	3	3	3	3	2	-	2	-	-	1	-	3	3	3
CO5	3	3	3	3	2	-	1	-	-	1	-	2	3	3
Avg	3	2.6	2.8	2.8	2	-	1.2	-	0.2	0.4	-	2.8	3	3

16EI5304-Communication Engineering

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	1	1	1	3	1	1	-	1	2	3
CO2	3	3	2	2	1	1	1	3	1	1	-	-	3	3
CO3	3	3	3	3	1	1	2	3	1	3	-	1	3	3
CO4	3	3	3	3	-	-	2	3	1	3	1	-	2	3
CO5	3	2	2	2	1	-	2	3	1	1	-	-	2	3
Avg	3	3	2.4	2.4	0.8	0.8	1.4	3	1	1.8	0.4	0.6	2.2	3

SEMESTER VI

16EI6201 – Process Control

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	2	-	-	-	1	-	-	3	3
CO3	3	1	2	2	2	2	-	-	-	-	-	-	2	3
CO4	3	1	2	-	-	-	1	-	1	2	-	2	2	3
CO5	3	3	3	3	-	-	1	-	-	-	-	2	2	3
Avg	3	2.2	2.2	1	0.4	0.8	0.4	-	0.2	0.6	-	0.8	2.2	3

16EI6202-Applied VLSI Design

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	3	2	-	-	-	1	-	-	1	-	3	3
CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	2	3	3	2	-	-	-	-	1	-	-	3	3
CO4	3	2	3	3	-	-	-	1	-	-	-	-	3	3
CO5	3	2	3	3	2	-	-	1	-	-	2	-	3	3
Avg	3	2	3	2.8	2	-	-	0.6	-	0.2	0.6	-	3	3

16EI6203- Discrete Time and Signal Processing

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	2	1	-	-	-	-	-	-	-	2	2
CO2	3	2	2	2	1	-	-	-	-	-	-	-	2	3
CO3	3	2	2	2	1	-	-	-	-	1	-	-	2	3
CO4	3	3	1	2	1	-	-	1	-	1	-	-	2	2
CO5	3	1	3	2	1	-	-	-	-	-	-	-	2	2
Avg	3	2	2	2	1	-	-	0.2	-	0.4	-	-	2	2.6

16EI6204 -Embedded System

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	2	-	-	-	-	-	-	3	3
CO3	2	1	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	2	2	-	-	-	-	-	1	-	-	2	2	3
CO5	3	3	3	3	-	-	-	1	1	1	-	2	2	3
Avg	2.8	2.2	2.2	1	-	0.4	-	0.2	0.4	0.2	-	0.8	2.2	3

19EI6001 – Process Control laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	3	-	-	-	3	-	3	-	-	2	3	3
CO2	3	3	3	3	2	-	3	-	3	-	-	-	2	3
CO3	3	3	3	1	2	-	3	-	3	-	-	2	3	3
CO4	3	2	3	2	3	-	3	-	3	-	-	3	3	3
CO5	3	2	3	1	2	-	3	-	3	-	-	3	3	3
Avg	3	2.2	3	1.4	1.8	-	3	-	3	-	-	2	2.8	3

16EI6002 - Virtual Instrumentation Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	2	-	3	-	-	2	-	3
CO2	2	1	-	-	-	-	2	-	3	-	-	2	1	3
CO3	3	-	3	-	-	-	2	-	3	-	-	-	1	3
CO4	3	-	-	-	2	-	2	-	3	-	-	-	-	2
CO5	3	-	-	-	-	-	2	-	3	-	1	2	3	3
Avg	2.8	0.6	1	0.8	0.4	-	2	-	3	-	0.2	1.2	1.2	2.8

16EI6701- Technical Seminar

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	2	-	3	-	-	2	2	3
CO2	2	1	-	-	-	-	2	-	3	-	-	2	2	3
CO3	3	1	3	-	-	-	2	-	3	-	-	-	2	3
CO4	3	2	-	-	2	-	2	-	3	-	1	-	2	2
CO5	3	-	-	-	1	-	2	-	3	-	1	2	2	2
Avg	2.8	1.2	1	0.8	0.6	-	2	-	3	-	0.4	1.2	2	2.6

16EI6301-Industrial Electronics

PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	1	-	-	-	-	-	2	3
CO2	3	3	2	-	2	-	2	-	-	-	-	-	2	3
CO3	3	2	3	-	2	-	2	-	-	-	-	-	3	2
CO4	3	3	1	-	1	-	-	-	1	-	1	-	2	3
CO5	3	2	2	-	2	-	-	-	1	-	-	-	3	3
Avg	3	2.6	2.2	-	1.4	-	1.2	-	0.4	-	0.2	-	2.2	2.8

16EI6302-Biomedical Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	3
CO2	3	3	1	-	-	-	2	-	-	-	-	2	2	3
CO3	3	3	3	-	1	-	-	-	-	-	-	1	2	3
CO4	3	2	3	2	-	-	-	-	-	-	-	1	2	3
CO5	3	3	-	-	2	-	1	-	-	-	-	2	3	3
Avg	3	2.6	2	0.4	0.6	-	1.2	-	-	-	-	1.4	2.2	3

16EI6303-Advanced Control Theory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	2	2	3	1	3	3
CO2	3	3	2	3	2	-	-	-	2	2	3	3	3	3
CO3	3	3	1	2	3	-	1	-	2	2	1	2	3	3
CO4	2	3	3	3	3	-	-	1	2	2	3	2	3	3
CO5	3	3	1	3	3	-	-	1	3	1	3	2	3	2
Avg	2.8	3	2.2	2.8	2.8	-	0.2	0.4	2.2	1.8	2.6	2	3	2.8

16EI6304-Instrumentation in Petrochemical Industries

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	-	1	-	-	-	-	-	-	-	-	3	3
CO3	2	2	3	1	-	-	-	-	1	-	2	3	3	3
CO4	3	2	3	1	-	1	-	1	1	-		3	3	3
CO5	3	2	1	-	-	2	-	-	-	-	2	-	3	3
Avg	2.8	2	1.8	1	-	0.6	-	0.2	0.4	-	0.8	2	3	3

OPEN ELECTIVE

16EI6401-Neural Networks and Fuzzy Systems

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	-	-	2	3	3	3
CO2	3	2	2	3	-	-	-	-	-	-	2	2	3	3
CO3	3	2	1	3	-	-	1	-	1	-	2	2	3	3
CO4	3	3	1	3	-	-	2	-	1	-	3	2	3	3
CO5	3	3	2	3	-	-	-	-	-	-	3	2	3	3
Avg	3	3	2.2	3	-	-	0.6	-	0.4	-	2.2	2	3	3

SEMESTER VII

16EI7201 – Computer Control of Process

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	2	1	2	2	2	2	1	-	-	-	-	-	2	3
CO4	3	-	2	-	-	-	1	-	2	-	-	2	2	3
CO5	2	3	3	3	-	-	-	-	-	-	-	2	2	3
Avg	2.6	1.2	2.2	1	0.4	0.8	0.4	-	0.4	-	-	0.8	2.2	2.6

16EI7202 – Industrial Data Networks

PO & PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	3	-	-	-	1	-	-	-	-	-	2	3
CO2	1	3	2	-	2	-	-	-	-	-	-	-	2	3
CO3	2	1	3	-	2	-	2	-	-	-	-	-	3	2
CO4	2	3	1	-	1	-	1	-	1	-	1	-	2	2
CO5	3	2	2	-	2	-		-	1	-	-	-	2	2
Avg	2.2	1.8	2.2	-	1.4	-	0.8	-	0.4	-	0.2	-	2	2.4

16EI7203- Programmable Logic and Distributed Control System

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	3
CO2	3	3	1	-	-	-	-	-	-	-	-	2	2	3
CO3	2	2	3	-	1	-	-	-	-	-	-	1	2	2
CO4	3	2	3	2	-	-	-	-	2	-	-	1	2	3
CO5	3	2	-	-	2	-	1	-	-	-	-	2	2	2
Avg	2.8	2.2	2	0.4	0.6	-	0.2	-	0.4	-	-	1.4	2	2.8

16EI7001 - Computer Control of Process Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	3	-	-	2	2	3
CO2	2	1	2	-	-	-	-	-	3	-	-	2	-	3
CO3	3	1	3	2	-	-	-	-	3	-	-	-	1	3
CO4	3	1	-	-	2	-	2	-	3	-	-	-	1	2
CO5	3	2	-	2	1	-	-	-	3	-	-	2	3	3
Avg	2.8	1.2	1	0.8	0.6	-	0.4	-	3	-	-	1.2	1.2	2.8

16EI7002- Instrumentation System Design Laboratory

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	3	-	-	2	-	3
CO2	2	2	2	-	-	-	-	-	3	-	-	2	1	3
CO3	3	2	3	2	-	-	-	-	3	-	-	-	1	3
CO4	3	-	-	-	2	-	2	-	2	-	-	-	1	2
CO5	3	-	-	2	-	-	-	-	2	-	-	2	3	3
Avg	2.8	1.2	1	0.8	0.4	-	0.4	-	2.6	-	-	1.2	1	2.8

16EI7701 - Internship / Industrial Training

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	3	3	-	2	3	3	-	--	-	-	-	-	3	2
CO3	3	3	-	-	-	1	3	-	3	-	-	1	2	2
CO4	3	2	-	-	-	2	1	3	3	-	1	1	3	2
CO5	3	3	-	-	-	-	1	-	2	-	-	3	3	3
Avg	3	2.8	0.6	1	0.6	1	1	0.6	1.6	-	0.2	0.8	2.8	2.2

16EI7301-Fiber Optics and Laser Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2		2									2	3
CO2	3	2	3										2	3
CO3	3	2	2				1	1		2		2	2	3
CO4	3	3	3					1				1	2	3
CO5	3	3	2	3									2	3
Avg	3	2.4	2	1			0.2	0.4		0.4		0.6	2	3

16EI7302-Adaptive Control and System Identification

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2		2									3	3
CO2	3	2	3										3	3
CO3	3	2	2				1	1		2		2	3	3
CO4	3	1	3				1	1		1		1	3	3
CO5	3	2	2	3									3	3
Avg	3	2.1	2	1			0.4	0.4		0.6		0.6	3	3

16EI7303-Instrumentation in Cement and Steel Industries

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO2	3	3	-	1	-	-	-	-	-	-	-	-	3	3
CO3	2	2	3	1	-	-	-	2	1	-	2	3	3	3
CO4	3	3	3	1	-	1	1	1	1	-	1	3	2	3
CO5	3	2	1	-	-	2	-	-	-	-	2	-	2	3
Avg.	2.8	2.2	1.8	1	-	0.6	0.2	0.8	0.4	-	1.2	2	2.6	3

16EI7304-Telemetry and Telecontrol

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		2	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	-	-	-	-	1	-	-	-	-	2	3
CO3	3	3	2	-	-	-	1	1	-	2	-	2	3	3
CO4	3	3	3	-	-	-	1	1	-	-	-	1	2	3
CO5	3	3	2	3	-	-	-	-	-	-	-	-	3	3
Avg	3	3	2	1	-	-	0.4	0.6	-	0.4	-	0.6	2.6	3

16EI7305-Instrumentation in Paper Industries

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	2	1	3	2	-	-	-	3	3	3
CO2	3	3	3	3	2	3	-	1	2	-	-	2	3	3
CO3	3	2	3	3	1	3	-	2	2	-	-	2	3	3
CO4	3	2	2	-	-	3	2	1	2	-	-	2	3	3
CO5	3	3	3	3	-	3	2	1	1	-	-	3	3	3
Avg	3	2.6	2.6	1.8	1	2.6	1.4	1.4	1.4	-	-	2.2	3	3

16EI7306-Micro Electro Mechanical Systems

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	3	-	3	3	3
CO2	3	2	2	-	3	-	-	-	-	3	-	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3
CO4	3	3	1	3	3	-	1	-	-	3	-	2	3	3
CO5	3	3	2	3		-	-	-	-	3	-	2	3	3
Avg	3	2.6	2	2	3	-	0.2	-	-	3	-	2.6	3	3

16EI7307-Non-Linear Control System

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	3	-	-	-	2	2	3	1	3	3
CO2	3	3	2	3	2	-	-	-	2	2	3	3	3	3
CO3	3	3	1	2	3	-	1	-	2	2	1	2	3	3
CO4	3	3	3	3	3	-	-	1	2	2	3	2	3	3
CO5	3	3	1	3	3	-	-	1	3	1	3	2	3	3
Avg.	3	3	2.2	2.8	2.8	-	0.2	0.4	2.2	1.8	2.6	2	3	3

16EI7308-Sensor Technology

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	3	-	3	3	3
CO2	3	3	2	-	3	-	-	-	-	3	-	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	2	3
CO4	3	3	1	3	3	-	1	-	-	3	1	2	3	3
CO5	3	3	2	3	-	-	1	-	-	3	-	2	3	3
Avg	3	3	2	2	3	-	0.4	-	-	3	0.2	2.6	2.8	3

SEMESTER VIII

16EI8901 - Project Work

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	3	-	2	-		-	-	-	-	3	3
CO2	3	2	1	-	-	3	-	-	-	-	-	2	3	3
CO3	3	2	-	-	-	-	-	-	3	-	1	1	2	3
CO4	3	2	1	1	-	1	-	3	2	3	3	-	2	2
CO5	3	2	-	2	-	-	-	-	2	-	-	3	3	3
Avg	2.6	2	1	1.2	-	1	-	0.6	1.4	0.6	0.8	1	2.6	2.8

16EI8301-Instrumentation System Design

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3		-	-	-	3	1	-	-	-	2	3	3
CO2	3	3	2	-	-	-	3	1	-	-	-	2	3	3
CO3	3	3	2	-	-	1	2	1	-	1	-	2	2	3
CO4	3	3		-	-	1	-	1	-	1	1	2	3	3
CO5	3	3	1	3	3	-	-	1	-	-	1	2	3	3
Avg	3	3	1.2	0.6	0.6	0.4	1.2	1	-	0.4	0.4	2	2.8	3

16EI8302-Microcontroller Based System Design

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	-	-	-	3	1	-	-	-	2	3	3
CO2	3	3	2	-	-	-	3		-	-	-	2	3	3
CO3	3	3	2	-	-	1	2	1	-	1	-	2	2	3
CO4	3	3		-	-	1	-		-	1	1	2	3	3
CO5	3	3	1	3	3	-	-		-	-	1	3	3	3
Avg	3	3	1.4	0.6	0.6	0.4	1.2	0.4	-	0.4	0.4	2.2	2.8	3

16EI8303-Robotics and Automation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	2	1	-	-	3	3	3	3
CO2	3	2	2	3	-	-		1	-	-	-	2	3	3
CO3	3	2		3	-	-	2	1	-	-	2	2	2	3
CO4	3	3	1	3	-	-	1	1	1	-	2	3	2	3
CO5	3	3		3	-	-		1	-	-	2	3	3	3
Avg.	3	3	0.8	3	-	-	1.2	1	0.2	-	1.8	2.6	2.6	3

16EI8304-Nuclear Power Plant Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	-	2	1	3	2	-	-	-	1	3	3
CO2	3	1	3	3	2	3	-	1	2	-	-		3	3
CO3	3	2	3	3	1	3	-	2	2	-	-	3	3	3
CO4	3	1	2	-	-	3	2	1	2	-	-	2	3	2
CO5	3	1	3	3	-	3	2	1	1	-	-		3	3
Avg	3	1.4	2.6	1.8	1	2.6	1.4	1.4	1.4	-	-	1.2	3	3

16EI8305-Environmental Instrumentation

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-	2	1	-	-	3	3	3	3
CO2	3	2	2	3	-	-		1	-	-	-	2	3	3
CO3	2	2		3	-	-	2	1	-	-	2	2	2	3
CO4	3	3	1	3	-	-	1	1	1	-	2	1	2	3
CO5	3	3		3	-	-		1	-	-	2	1	3	3
Avg.	2.8	3	0.8	3	-	-	1.2	1	0.2	-	1.8	2.2	2.6	3

16EI8306-Safety Instrumentation System

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	-	-			-	-	2	3	3	3
CO2	3	2	2	3	-	-			-	-	2	2	3	3
CO3	3	2		3	-	-	1		-	-	2	2	3	3
CO4	3	3	1	3	-	-	1		1	-	2	3	3	3
CO5	3	3		3	-	-			-	-	2	3	3	3
Avg.	3	3	0.8	3	-	-	0.4		0.2	-	2	2.6	3	3

16EI8307-Instrumentation Systems for Disaster Management

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	2	-	-	-	1	-	-		2	3	2
CO2	3	3	-	-	-	-	2	1	3	-	1	2	3	2
CO3	3	3	1	2	3	-	-	1		-	-	2	3	3
CO4	3	3	-	-	-	-	-	1	3	-	-	2	3	3
CO5	3	2	1	2	-	-	-	1		-	2	2	3	3
Avg	3	2.6	0.4	1.2	0.6	-	0.4	1	1.2	-	0.6	2	3	2.6

16EI8308-Professional Ethics in Engineering

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3				2	2	3	1	2		2	3	3
CO2	3	3				2	2	3	1	2		2	3	3
CO3	3	3	2			2	2	3	2	2		3	3	3
CO4	3	2				3	3	3	3	3		2	3	3
CO5	3	2	1			3	2	3	2	3		2	3	3
Avg	3	2.6	0.6			2.4	2.2	3	1.8	2.4		2.2	3	3

OPEN ELECTIVE

16EI7402-Electrical Energy Management

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	1	-	-	-	-	3	3
CO2	3	3	-	1	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	1	-	-	-	1	-	-	2	3	3	3
CO4	3	2	3	1	-	-	1	1	1	-		3	3	3
CO5	3	2	1	-	-	2	1	-	-	-	2	-	3	3
Avg.	3	2.6	1.4	1	-	0.4	0.4	0.6	0.4	-	2	1.2	3	3

Chairman Board of Studies

Dean - Academics

REGULATIONS 2019

B.E ELECTRONICS AND INSTRUMENTATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the programme B E Electronics and Instrumentation Engineering will

PEO 1. Graduates would have strong foundation in basic science and mathematics to formulate, analyze and solve electronics and instrumentation problems.

PEO 2. Graduates shall have good knowledge of instrumentation systems and their applications to design control and safety systems for industrial process.

PEO 3. Graduates exhibit professionalism with ethics, communication and team work to satisfy the needs of the society.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Ability to apply concepts of measurement and sensor to design, calibrate and control various process instruments using industrial automation.

PSO 2. Ability to analyze advanced electronics and instrumentation concepts required for industrial and research pursuits.

MAPPING OF CO'S, PO'S & PSO'S

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
I	3	3	3	3	3	3	3	3	3	3	3	3	3	3
II	3	3	3	3	3	3	3	3	3	3	3	3	3	3
III	3	3	3	3	3	3	3	3	3	3	3	3	3	3
IV	3	3	3	3	3	3	3	3	3	3	3	3	3	3
V	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Hindusthan College of Engineering And Technology
Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Coimbatore - 641032

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

REGULATIONS 2019

Mapping of Course Outcome and Programme Outcome:

Year	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	I	19HE1101 - Technical English	1	1.4	1	1.2	1	1.4	1.2	1.2	1.8	3	1	2.2	2.4	2.4
		19MA1103- Calculus and Differential Equations	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
		19PH1151 - Applied Physics	3	2.2	2	1.6	2	1.3	-	-	-	-	-	1	2.4	2.4
		19CY1151 -Chemistry for Engineers	3	2	2	2	2	1	1	-	-	-	-	1	1	1
		19CS1151 - Python Programming and Practices	2	3	3	-	2	-	-	-	2	-	-	2	2	2
		19ME1152 - Engineering Drawing	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4
		19HE1071 - Language														

		Competency Enhancement Course-I														
	II	19HE2101 - Business English for Engineers	1.6	1.6	1	1	1.2	2	1.8	1.8	2.2	3	1	2.8	1	1
		19MA2102 - Complex Variables and Transform Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	1.8
		19PH2151 - Material Science	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2
		19CY2151 - Environmental Studies	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-
		19EI2151 - Circuit Theory	2.6	2.8	0.6	0.8	1	-	-	0.4	0.2	-	1.2	-	2.8	2.6
		19CS2152 - Essentials of C and C++ Programming	3	3	2	2	3	-	-	1	1	-	2	2	2.2	3
		19ME2001 - Engineering Practices	3	-	3	-	3	-	-	-	1	-	-	-	1	2
		19HE2071 - Language Competency Enhancement Course-II														
II	III	19MA3102 - Fourier Analysis and Transforms	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2
		19EI3201 - Electronic Devices and Circuits	2.6	2	1.6	1.2	-	0.2	0.4	-	0.4	0.2	-	0.8	3	2.6
		19EI3202 - Sensors and Transducers	2	1.2	2.2	1	0.4	0.4	1	-	-	0.4	-	1.4	2.8	2.6
		19ME3231 - Fluid Mechanics and Thermal Engineering	2.2	2.8	1.8	1.2	1.2	1.4	-	-	0.4	-	0.4	1	2	2.8
		19EI3251- Electrical and Electronic Measurements	2.8	2.6	2.4	0.4	0.6	-	0.2	-	0.4	-	0.2	1.4	2.2	3
		19EI3001 - Electronic Devices and Circuits Laboratory	2.8	0.4	1	-	-	1	-	-	3	-	0.5	-	1.4	2.8

		19EI3002 - Sensors and Transducers Laboratory	1.8	1.6	3	0.4	0.5	-	0.4	-	3	-	-	0.5	2.6	2.6
		19MC3191-Indian Constitution														
	IV	19MA4101 - Numerical Methods	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2
		19EI4201 - Electrical Machines	2.2	2.6	2.6	2.16	1	0.4	0.6	-	0.4	-	-	1.4	3	2.6
		19EI4202 - Integrated Circuits and Its Applications	2.5	2	2.2	2.5	-	2	-	-	-	-	-	2	3	2.6
		19EI4203- Industrial Instrumentation-I	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	1.2	2.6
		19EI4251 - Digital Logic Circuits	2	1.2	2.2	0.5	0.4	0.4	1	-	-	0.2	-	0.5	1.8	2.6
		19EI4001 - Electrical Machines Laboratory	2.8	0.8	-	0.8	-	-	-	-	3	-	-	1.2	0.6	2.8
		19EI4002 - Integrated Circuits Laboratory	2.8	0.4	2.5	0.8	0.4	-	-	-	3	-	-	1	0.6	2.8
		19MC4191-Essence of Indian tradition knowledge/ Value Education														
III	V	19EI5201 -Industrial Instrumentation – II	3	1.6	2	2	1	-	-	-	-	0.4	-	0.6	3	3
		19EI5202 – Control Systems	2	1.2	2.2	1	0.4	0.4	-	-	-	-	-	0.8	2.8	3
		19EI5203 - Microprocessors and Microcontrollers	2.4	1.2	2.2	1	0.4	0.4	1	-	-	-	-	1.4	2.4	2.6
		19EI5204 - Analytical Instrumentation	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	2.6	3
		19EI53XX -Professional Elective -I														

		19EI5251 - Programmable Logic Controllers and SCADA	2.2	1.2	2.2	1	-	0.4	-	-	0.4	-	-	0.6	2	2.6
		19EI5001 - Industrial Instrumentation Laboratory	2.8	0.8	0.6	0.8	0.4	-	3	-	3	-	-	1.8	1	2.8
		19EI5002- Microprocessors and Microcontrollers Laboratory	1.8	1.6	3	1	0.6	-	3	-	3	-	-	1	2.6	2.6
		19HE5071-Soft Skills - I														
		19HE5072-Design Thinking														
	VI	19EI6181 – Industrial Safety Management	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	1.8	2.6
		19EI6201 – Process Control	2	1.2	2.2	1	0.4	0.8	-	-	-	-	-	0.8	1.2	2.6
		19EI6202- Discrete Time and Signal Processing	3	2	2	2	1	-	-	0.2	-	0.4	-	-	2	2.6
		19EI63XX -Professional Elective - II														
		19XX64XX -Open Elective– I														
		19EI6251 -Embedded System	2	1.8	2.2	1	-	0.4	-	-	0.4	0.2	-	0.8	1.2	2.6
		19EI6001 – Process Control laboratory	2.4	2.2	3	1.4	1.8	-	3	-	3	-	-	2	2.8	2.8
		19EI6002 - Virtual Instrumentation Laboratory	2.8	0.4	1	0.8	0.4	-	2	-	3	-	-	1.2	0.6	2.8
		19EI6701-Internship Training														
		19HE6071-Soft Skills - II														
		19HE6072-Intellectual														

		Property Rights (IPR)														
IV	VII	19EI7201 – Computer Control of Process	2	1.2	2.2	1	0.4	0.8	-	-	-	-	-	0.8	1.2	2.6
		19EI7202 – Industrial Electronics	2	1.8	2.2		1.4	-	-	-	0.4	-	0.2	-	1.8	1.4
		19EI73XX -Professional Elective-III														
		19XX74XX -Open Elective – II														
		19EI7251-Biomedical Instrumentation	2.6	1	2	0.4	0.6	-	0.2	-	-	-	-	1.4	2.2	2.8
		19EI7001 - Computer Control of Process Laboratory	2.8	0.8	1	0.8	0.6	-	-	-	3	-		1.2	1	2.8
		19EI7002- Instrumentation System Design Laboratory	2.8	0.4	1	0.8	0.4	-	-	-	3	-	-	1.2	0.6	2.8
		19EI7901 - Project Work – Phase I	3	2.8	0.6	1	0.6	0.8	1	0.6	1.6	-	-	0.6	2.8	2.6
	VIII	19EI83XX -Professional Elective –IV														
		19EI81XX -Professional Elective- V														
		19EI8901-Project Work – Phase II	3	2.8	1	1.2	-	0.8	-	0.6	1.4	0.6	0.8	1	2.6	2.8

PROFESSIONAL ELECTIVE COURSES

Elective	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	V	19EI5301 - Power Plant Instrumentation	1.2	1.4	1.8	0.6	1	1	1	0.2	0.4	0.2	0.4	0.2	2	2
		19EI5302 - Communication Theory	3	2.4	2.4	2.4	0.8	0.8	1	3	1	1.8	0.4	0.6	2	2
		19IT5331 - Fundamentals of Java Programming	2.4	2.2	2	2	0.4	0.8	1	0.4	0.4	0.4	0.6	0.2	1	2
		19EI5303 - Industrial Chemical Process	3	0.2	1.6	-	0.6	0.4	0.2	-	0.4	-	0.4	0.6	2	1.8
		19EI5304 - Operating Systems	3	2.6	2.6	2	1.8	-	0.4	-	0.6	3	-	2.2	3	3
II	VI	19EI6301 - VLSI Design	3	2	3	2.8	2	-	-	0.6	-	0.2	0.6	-	3	2.8
		19EI6302 - Micro Electro Mechanical Systems	3	3	2	2	3	-	-	-	-	3	-	3	3	3
		19EI6303 - Industrial Data Communication	3	1.2	3	-	0.4	-	3	-	-	0.4	0.6	-	3	2
		19EI6304 - Digital Image Processing	3	3	2.8	2.8	2	-	2	-	0.2	0.4	-	2.8	3	2.8
		19EI6305 - Introduction to Soft Computing	2.6	2.2	2.2	2	-	0.2	0.2	1	-	1	-	2.6	2.8	3
III	VII	19EI7301 - Non-Linear Control System	2.8	3	2.8	2.8	2.8	-	0.2	0.4	2.2	1.8	2.6	2	2.2	2.8
		19EI7302 - Industrial IoT	1.6	1	1	1.5	1.5	1	1	1	2	3	1	1	2.8	3
		19EI7303 - Robotics and Automation	3	2.6	2.8	3	-	-	1.5	1	0.2	-	1.8	2.6	3	3
		19EI7304- Microcontroller Based System Design	2.6	1	1.6	0.4	0.6		0.2		0.4	-	-	1.4	2.2	3

		19EI7305 - Neural Networks and Fuzzy Systems	2	1.6	0.6	0.6	-	0.4	-	1.6	-	1.6	0.2	2	3	2.2
IV	**VIII**	19EI8301- Fiber Optics and Laser Instruments	2.2	1.2	2	1	-	-	-	0.4	-	0.4		0.6	2	3
		19EI8302 - Instrumentation in Petrochemical Industries	2	2	1.8	1	-	0.6	-	0.2	0.4	-	0.8	2	3	2
		19EI8303 - Instrumentation System Design	3	2.6	2.2	0.6	0.6	0.4	-	1	-	0.2	0.4	2	3	2.6
		19EI8304 - Artificial Intelligence and Machine Learning	3	2	0.6	3	0.2	0.4	2	1	-	3	2	0.4	3	2.6
		19EI8305 - Instrumentation and Control in Paper Industry	2.8	2.4	2.6	1.8	1	2.6	1.4	1.4	1.4	-	-	2.6	3	2.8
V		19EI8181 - Disaster Management	3	2.6	0.4	1.2	0.6	-	0.4	1	1.2	-	0.6	2	3	2.6
		19EI8182 - Total Quality Management	1.8	1.6	0.4	0.6	0.6	0.4	0.2	0.2	0.8	0.6	0.2	0.4	2.2	2.6
		19EI8183 - Professional Ethics for Engineers	3	1.6	0.6	-	-	2.4	2.2	3	1.8	2.4	-	2.2	3	2.8
		19EI8184 - Principles of Management	2.2	2.8	1.6	-	0.8	-	0.4	-	0.6	0.6	0.2	-	2	2.6
		19EI8185 - Patent, Copyright and Competition Law	2.8	2.8	1.8	2.6	2.6	0.2	0.8	-	2.4	0.2	1.4	1	2.6	13

OPEN ELECTIVE COURSES

Elective	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	VI	19EI6401- Smart Sensors for Engineering Applications	3	2.8	3	2.8	3	0.4	-	1.8	-	0.2	-	3	2.6	3
		19EI6402- Electrical Energy Management and Audit	1.8	2	1.4	1	-	0.4	-	0.6	0.4	-	2	1.2	3	2.6
II	VII	19EI7401- Introduction to Programmable Logic Controllers	3	2.4	2.2	0.6	1	0.4	-	1.4	-	1	1.2	2	3	2.6

1-Low, 2-Medium, 3-High, - No Correlation

Chairman Board of Studies

Dean - Academics

REGULATIONS 2016

B.E ELECTRONICS AND INSTRUMENTATION ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the programme B E Electronics and Instrumentation Engineering will

PEO 1. Graduates would have strong foundation in basic science and mathematics to formulate, analyze and solve electronics and instrumentation problems.

PEO 2. Graduates shall have good knowledge of instrumentation systems and their applications to design control and safety systems for industrial process.

PEO 3. Graduates exhibit professionalism with ethics, communication and team work to satisfy the needs of the society.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1. Ability to apply concepts of measurement and sensor to design, calibrate and control various process instruments using industrial automation.

PSO 2. Ability to analyze advanced electronics and instrumentation concepts required for industrial and research pursuits.

MAPPING OF CO'S, PO'S & PSO'S

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
I	3	3	3	3	3	3	3	3	3	3	3	3	3	3
II	3	3	3	3	3	3	3	3	3	3	3	3	3	3
III	3	3	3	3	3	3	3	3	3	3	3	3	3	3
IV	3	3	3	3	3	3	3	3	3	3	3	3	3	3
V	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Hindusthan College of Engineering And Technology
Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Coimbatore - 641032

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

REGULATIONS 2016

Mapping of Course Outcome and Programme Outcome:

Year	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	I	16MA1101-Engineering Mathematics-I	3	3	3	2	2	-	-	-	-	-	-	2	2	2
		16PH1101-Engineering Physics	3	2	3	2	2.6	-	2	-	-	-	-	-	1.2	1.2
		16CY1101-Engineering Chemistry	3	2	2	2	2	1	-	-	-	-	-	1	1	1
		16HE1101R -Essential English for Engineers – I	1	1	1	1.3	-	1.8	1	-	2	3	-	1.6	1	1
		16GE1101-Computer Programming	3	2	2	0.4	2	1	0.2	-	-	-	-	2	3	3
		16ME1201-Basics of Civil and Mechanical Engineering	3	1	1	-	-	1	-	-	-	-	-	1	3	2
		16GE1001 -Computer Programming Lab	3	2	2	0.6	2	1	2.4	-	-	0.2	-	2	2	3
		16GE1002-Engineering Practices Laboratory	3	-	3	-	3	-	-	-	1	-	-	-	1	2
		16GE1003 - Language														

		Competency Enhancement Course-I														
	II	16MA2102 - Engineering Mathematics-II	3	3	3	2	2	-	-	-	-	-	-	2	1	2
		16PH2102-Physics of Materials	3	2.4	1.2	1.8	1.8	0.6	0.4	-	-	-	-	-	1.8	1.4
		16CY2102-Environmental Science	2	0.6	0.8	-	-	2	3	3	2	-	2	2	2	1.2
		16HE2102R -Essential English for Engineers – II	2	1.3	2	1	1	2	-	-	1.6	2.8	-	2	1.2	1
		16GE2102-Engineering Graphics	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4
		16EI2201 - Electrical Circuit Theory	3	2.8	0.6	0.8	1	-	0.4	0.4	0.2	-	1.2	-	2.8	3
		16EI2001-Electrical Circuit Laboratory	3	2.8	0.6	0.8	1	-	0.4	0.4	0.2	-	1.2	-	2.8	3
		19HE2071 - Language Competency Enhancement Course-II														
II	III	16MA3103-Fourier Analysis and Statistics	3	2	3	1	2	-	-	-	-	-	-	2	3	1
		16EI3201- Electronic Instrumentation	3	2.2	1.6	1.2	-	0.2	1.4	-	0.4	0.2	-	1.2	3	3
		16EI3202 - Electronic Devices and Circuits	2.6	2.8	1.6	1.2	-	0.2	1.4	-	0.4	0.2	-	0.8	2.8	3
		16EI3203 - Measurements and Instrumentation	3	3	2.2	1	0.4	0.4	1	0.2	-	0.4	0.2	1.4	3	3
		16EI3204 - Transducer Engineering	3	2.8	2.2	1	0.4	0.4	1	-	-	0.4	-	1.4	2.8	3
		16ME3231 - Fundamentals of Thermodynamics and	2.6	3	1.8	1.2	1.2	1.4	0.2	-	0.4	-	0.4	1	2.2	2.8

		Fluid Dynamics														
		16EI3001 - Transducer and Measurements Laboratory	2	1.6	3	0.4	0.5	-	0.4	-	3	-	-	0.5	3	2.6
		16EI3002 - Electronic Devices and Circuits Laboratory	2.8	1.2	1	-	-	1	-	-	3	-	0.5	-	1.6	2.2
	IV	16MA4107 – Numerical Methods	3	3	3	3	2.6	-	-	-	-	-	-	2	2	1.2
		16EI4201 - Electrical Machines	2.8	3	2.6	2.2	1	0.4	0.6		0.4		0.2	1.4	2.2	3
		16EI4202 - Linear Integrated Circuits and Applications	3	2.2	2.2	2.5	-	2	0.4	-	-	-	-	2	2.2	3
		16EI4203 - Digital Logic Circuits	2	1.2	2.2	0.5	0.4	0.4	1	-	-	0.2	-	0.5	1.8	2.6
		16EI4204-Power Plant Instrumentation	1.2	1.4	1.8	0.6	1	1	1	0.2	0.4	0.2	0.4	0.2	2	2
		16EI4205- Industrial Instrumentation-I	2	1.2	2.2	1	-	0.4	-	0.2	0.4	-	-	0.8	1.2	2.6
		16EI4001 - Electrical Machines Laboratory	3	1.2	-	0.8	-	-	0.2	-	3	-	-	1.2	1.2	3
		16EI4002 - Linear and Digital Integrated Circuits Laboratory	2.8	0.4	2.5	0.8	0.4	-	-	-	3	-	-	1	0.6	2.8
III	**V**	16EI5201 -Industrial Instrumentation – II	3	2.2	2	2	1	-	0.4	-	-	0.4	-	0.6	2.6	3
		16EI5202 - Analytical Instrumentation	2	1.2	2.2	1	-	0.4	1.2	-	-	0.2	-	0.8	2.6	3
		16EI5203 - Microprocessors and Microcontrollers	2.6	1.2	2.2	1	0.4	0.4	1	-	0.2	-	-	1.4	2	2.6
		16EI5204 – Control Systems	3	2.4	2.2	1	0.4	0.4	0.2	-	-	0.2	-	1.2	2.8	3
		16IT5231 - Object Oriented Programming	2.2	1.2	2.2	1	-	0.4	-	-	0.4	-	-	0.6	2	2.6

		Using Java														
		16EI53XX - Professional Elective – I														
		16EI5001- Microprocessors and Microcontrollers Laboratory	2	1.6	3	1	0.6	-	3	-	2.3	-	-	1	2.6	2.8
		16EI5002 - Industrial Instrumentation Laboratory	2.8	1.2	0.6	0.8	0.4	-	3	-	3	-	0.2	1.8	1.2	2.8
		16IT5031- Object Oriented Programming Laboratory	2.2	2	3	1	1	-	3	-	2.3	-	-	1	2.6	3
	VI	16EI6201 – Process Control	3	2.2	2.2	1	0.4	0.8	0.4	-	0.2	0.6	-	0.8	2.2	3
		16EI6202-Applied VLSI Design	3	2	3	2.8	2	-	-	0.6	-	0.2	0.6	-	3	3
		16EI6203- Discrete Time and Signal Processing	3	2	2	2	1	-	-	0.2	-	0.4	-	-	2	2.6
		16EI6204 -Embedded System	2.8	2.2	2.2	1	-	0.4	-	0.2	0.4	0.2	-	0.8	2.2	3
		16EI63XX - Professional Elective – II														
		16XX64XX -Open Elective - I														
		19EI6001 – Process Control laboratory	3	2.2	3	1.4	1.8	-	3	-	3	-	-	2	2.8	3
		16EI6002 - Virtual Instrumentation Laboratory	2.8	0.6	1	0.8	0.4	-	2	-	3	-	0.2	1.2	1.2	2.8
		16EI6701-Technical Seminar	2.8	1.2	1	0.8	0.6	-	2	-	3	-	0.4	1.2	2	2.6

IV	VII	16EI7201-Computer Control of Process	2.6	1.2	2.2	1	0.4	0.8	0.4	-	0.4	-	-	0.8	2.2	2.6
		16EI7202-Industrial Data Networks	2.2	1.8	2.2	-	1.4	-	0.8	-	0.4	-	0.2	-	2	2.4
		16EI7203-Programmable Logic and Distributed Control System	2.8	2.2	2	0.4	0.6	-	0.2	-	0.4	-	-	1.4	2	2.8
		16EI73XX - Professional Elective - III														
		16EI73XX - Professional Elective - IV														
		16XX74XX -Open Elective - II														
		16EI7001-Computer Control of Process and Simulation Laboratory	2.8	1.2	1	0.8	0.6	-	0.4	-	3	-	-	1.2	1.2	2.8
		16EI7002-Instrumentation System Design Laboratory	2.8	1.2	1	0.8	0.4	-	0.4	-	2.6	-	-	1.2	1	2.8
		16EI7701-Internship / Industrial Training	3	2.8	0.6	1	0.6	1	1	0.6	1.6	-	0.2	0.8	2.8	2.2
	VIII	16EI83XX - Professional Elective - V														
		16EI83XX - Professional Elective - VI														
		16EI8901-Project Work	2.6	2	1	1.2	-	1	-	0.6	1.4	0.6	0.8	1	2.6	2.8

PROFESSIONAL ELECTIVE COURSES

Elective	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	V	16EI5301-Thermal Power Plant Instrumentation	3	2.6	1.8	0.6	1	1	1.2	0.2	0.4	0.2	0.4	0.2	2.6	3
		16EI5302-Digital System Design	3	2.6	1.2	0.6	0.6	0.4	1.2	1	-	0.2	0.4	2	3	3
		16EI5303-Digital Image Processing	3	2.6	2.8	2.8	2	-	1.2	-	0.2	0.4	-	2.8	3	3
		16EI5304-Communication Engineering	3	3	2.4	2.4	0.8	0.8	1.4	3	1	1.8	0.4	0.6	2.2	3
II	VI	16EI6301-Industrial Electronics	3	2.6	2.2	-	1.4	-	1.2	-	0.4	-	0.2	-	2.2	2.8
		16EI6302-Biomedical Instrumentation	3	2.6	2	0.4	0.6	-	1.2	-	-	-	-	1.4	2.2	3
		16EI6303-Advanced Control Theory	2.8	3	2.2	2.8	2.8	-	0.2	0.4	2.2	1.8	2.6	2	3	2.8
		16EI6304-Instrumentation in Petrochemical Industries	2.8	2	1.8	1	-	0.6	-	0.2	0.4	-	0.8	2	3	3
III	VII	16EI7301-Fiber Optics and Laser Instrumentation	3	2.4	2	1	-	-	0.2	0.4	-	0.4	-	0.6	2	3
		16EI7302-Adaptive Control and System Identification	3	2.1	2	1	-	-	0.4	0.4	-	0.6	-	0.6	3	3
		16EI7303-Instrumentation in Cement and Steel	2.8	2.2	1.8	1	-	0.6	0.2	0.8	0.4	-	1.2	2	2.6	3

		Industries														
		16EI7304-Telemetry and Telecontrol	3	3	2	1	-	-	0.4	0.6	-	0.4	-	0.6	2.6	3
IV		16EI7305-Instrumentation in Paper Industries	3	2.6	2.6	1.8	1	2.6	1.4	1.4	1.4	-	-	2.2	3	3
		16EI7306-Micro Electro Mechanical Systems	3	2.6	2	2	3	-	0.2	-	-	3	-	2.6	3	3
		16EI7307-Non-Linear Control System	3	3	2.2	2.8	2.8	-	0.2	0.4	2.2	1.8	2.6	2	3	3
		16EI7308-Sensor Technology	3	3	2	2	3	-	0.4	-	-	3	0.2	2.6	2.8	3
V	**VIII**	16EI8301-Instrumentation System Design	3	3	1.2	0.6	0.6	0.4	1.2	1	-	0.4	0.4	2	2.8	3
		16EI8302-Microcontroller Based System Design	3	3	1.4	0.6	0.6	0.4	1.2	0.4	-	0.4	0.4	2.2	2.8	3
		16EI8303-Robotics and Automation	3	3	0.8	3	-	-	1.2	1	0.2	-	1.8	2.6	2.6	3
		16EI8304-Nuclear Power Plant Instrumentation	3	1.4	2.6	1.8	1	2.6	1.4	1.4	1.4	-	-	1.2	3	3
VI		16EI8305-Environmental Instrumentation	2.8	3	0.8	3	-	-	1.2	1	0.2	-	1.8	2.2	2.6	3
		16EI8306-Safety Instrumentation System	3	3	0.8	3	-	-	0.4		0.2	-	2	2.6	3	3
		16EI8307-Instrumentation Systems for Disaster Management	3	2.6	0.4	1.2	0.6	-	0.4	1	1.2	-	0.6	2	3	2.6
		16EI8308-Professional Ethics in Engineering	3	2.6	0.6	-	-	2.4	2.2	3	1.8	2.4	-	2.2	3	3

OPEN ELECTIVE COURSES

Elective	Sem	Course code & Name	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
I	VI	16EI6401-Neural Networks and Fuzzy Systems	3	3	2.2	3	-	-	0.6		0.4	-	2.2	2	3	3
II	VII	16EI7402- Electrical Energy Management and Audit	3	2.6	1.4	1	-	0.4	0.4	0.6	0.4	-	2	1.2	3	3

1-Low, 2-Medium, 3-High, - No Correlation

Chairman Board of Studies

Dean - Academics