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

2021-2022

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.

Chairman - BoS
EIE - HiCET

Dean (Academics)
HiCET

ACADEMIC COUNCIL
Chairman
COLLEGE OF ENGG & TECH

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)
Valley Campus, Pollachi Highways, 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 2021-2022 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1103	Calculus and Differential Equations	BS	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	21CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	21HE1071	Language Competency Enhancement Course-I	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
8	21HE1072	**Career Guidance Level – I** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
9	21HE1073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			Total :	**15**	**2**	**12**	**20**	**580**	**320**	**900**
As Per AICTE Norms 3 Weeks Induction Programme is Added in the First Semester as an Audit Course										

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SEMESTER II

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2102	Complex Variables and Transform Calculus	BS	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH2151	Material Science	BS	2	0	2	3	50	50	100
4	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
5	21EI2151	Circuit Theory	ES	2	0	2	3	50	50	100
6	21CS2152	Essentials of C and C++ Programming	ES	2	0	2	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices	ES	0	0	4	2	60	40	100
8	21HE2071	Language Competency Enhancement Course-II	HS	0	0	2	1	100	0	100
MANDATORY COURSES										
9	21HE2072	**Career Guidance Level – II** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			Total :	**15**	**2**	**14**	**22**	**540**	**360**	**900**

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER III

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3102	Fourier Analysis and Transforms	BS	3	1	0	4	25	75	100
2	19EI3201	Electronic Devices and Circuits	PC	3	1	0	4	25	75	100
3	19EI3202	Sensors and Transducers	PC	3	0	0	3	25	75	100
4	19ME3231	Fluid Mechanics and Thermal Engineering	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19EI3251	Electrical and Electronic Measurements	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19EI3001	Electronic	PC	0	0	3	1.5	50	50	100

		Devices and Circuits Laboratory								
7	19EI3002	Sensors and Transducers Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19MC3191	Indian Constitution	MC	2	0	0	0	100	0	100
9	19HE3072	**Career Guidance Level – III** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total				**19**	**2**	**8**	**20**	**550**	**450**	**1000**

SEMESTER IV

S.No	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA4101	Numerical Methods	BS	3	1	0	4	25	75	100
2	19EI4201	Electrical Machines	PC	3	1	0	4	25	75	100
3	19EI4202	Integrated Circuits and Its Applications	PC	3	0	0	3	25	75	100
4	19EI4203	Industrial Instrumentation – I	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19EI4251	Digital Logic Circuits	PC	2	1	2	4	50	50	100
PRACTICAL										
6	19EI4001	Electrical Machines Laboratory	PC	0	0	3	1.5	50	50	100
7	19EI4002	Integrated Circuits Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
8	19MC4191	Essence of Indian tradition knowledge/ Value Education	MC	2	0	0	0	100	0	100
9	19HE4072	**Career Guidance Level – IV** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE4073	Ideation Skills	EEC	1	0	0	0	100	0	100
			Total	**19**	**3**	**8**	**21**	**550**	**450**	**1000**

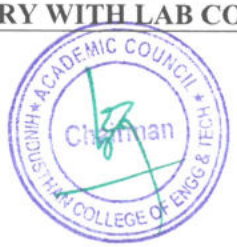
For the students admitted during the academic year 2019-2020 and onwards

SEMESTER – V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19EI5201	Industrial Instrumentation – II	PC	3	0	0	3	25	75	100
2	19EI5202	Control Systems	PC	3	1	0	4	25	75	100
3	19EI5203	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100
4	19EI5204	Analytical Instrumentation	PC	3	0	0	3	25	75	100
5	19EI53XX	**Professional Elective -I**	PE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
6	19EI5251	Programmable Logic Controllers and SCADA	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19EI5001	Industrial Instrumentation Laboratory	PC	0	0	3	1.5	50	50	100
8	19EI5002	Microprocessors and Microcontrollers Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	19HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
		Total		**19**	**1**	**8**	**24**	**475**	**525**	**1000**

SEMESTER – VI

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19EI6181	Industrial Safety Management	HS	3	0	0	3	25	75	100
2	19EI6201	Process Control	PC	3	0	0	3	25	75	100
3	19EI6202	Discrete Time and Signal Processing	PC	3	0	0	3	25	75	100
4	19EI63XX	**Professional Elective - II**	PE	3	0	0	3	25	75	100
5	19XX64XX	**Open Elective– I**	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										



6	19EI6251	Embedded Systems	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19EI6001	Process Control Laboratory	PC	0	0	3	1.5	50	50	100
8	19EI6002	Virtual Instrumentation Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19EI6701	Internship Training	EEC	0	0	0	1	0	100	100
10	19HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
11	19HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			Total	**19**	**0**	**8**	**24**	**475**	**625**	**1100**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE I										
1	19EI5301	Power Plant Instrumentation	PE	3	0	0	3	25	75	100
2	19EI5302	Communication Theory	PE	3	0	0	3	25	75	100
3	19IT5331	Fundamentals of Java Programming	PE	3	0	0	3	25	75	100
4	19EI5303	Industrial Chemical Process	PE	3	0	0	3	25	75	100
5	19EI5304	Operating Systems	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE II										
1	19EI6301	VLSI Design	PE	3	0	0	3	25	75	100
2	19EI6302	Micro Electro Mechanical Systems	PE	3	0	0	3	25	75	100
3	19EI6303	Industrial Data Communication	PE	3	0	0	3	25	75	100
4	19EI6304	Digital Image Processing	PE	3	0	0	3	25	75	100
5	19EI6305	Introduction to Soft Computing	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES

ELECTRONICS AND INSTRUMENTATION ENGINEERING										
S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
1	19EI6401	Smart Sensors for Engineering Applications	OE	3	0	0	3	25	75	100

REGULATION-2016

For the students admitted during the academic year 2018-2019 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**

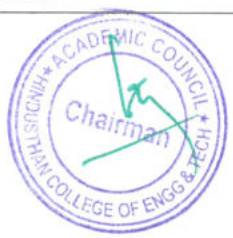
SEMESTER – VIII

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	26	25	23	24	25	25	23	16	**187**

CREDIT DISTRIBUTION – R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	**165**

Chairman, Board of Studies

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EIE - HiCET

Dean – Academics

Dean (Academics)
HiCET

Principal

PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

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Chairman
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SYLLABUS

SEMESTER I

Programme	Course Code	Name of the Course	L	T	P	C
B.E	21HE1101	TECHNICAL ENGLISH (COMMON TO ALL BRANCHES)	2	1	0	3

Course Objective

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 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.

R2- Raymond Murphy, "English Grammar in Use"- 4th editionCambridge 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.	21MA1103	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.	21PH1151	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 bending 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	**FIBER 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
BE/B.Tech	21CY1151	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=9
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 precipitation titration using $BaCl_2$ and Na_2SO_4. Estimation of Ferrous iron by Potentiometry.**	6+9 =15
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 – principle – 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**

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. N. Madudeswaran and B.Jeyagowri, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, Chennai (2019).
T2 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCE BOOKS

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.	21CS1151	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: To find the Greatest Common Divisor (GCD) of two numbers, Fahrenheit to Celsius, Perform Matrix addition.*	7+2(P)
II	**DATA, EXPRESSIONS, STATEMENTS** Data Types, Operators and precedence of operators, expressions, statements, comments; Conditionals: Boolean values and operators, conditional (if), alternative (if -else), chained conditional (if –elif-else); Iteration: state, while, for, break, continue, pass; *Simple algorithms and programs: Area of the circle, check the given year is Leap year or not, Factorial of a Number.*	7+2(P)
III	**FUNCTIONS, STRINGS** Functions, parameters and arguments; Fruitful functions: return values, local and global scope, function composition, recursive functions. Strings: string slices, immutability, string functions and methods, string module. *Illustrative programs: Perform Linear Search, Selection sort, Sum of all elements in a List, Pattern Programs.*	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: List Manipulation, Finding Maximum in a List, String processing.*	5+4(P)
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, modules, packages *Illustrative programs: Reading writing in a file, word count, Handling Exceptions*	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.	21ME1152	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	21HE1071	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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Programme	Course code	Course title	L	T	P	C
B.E.	21HE1072	CAREER GUIDANCE LEVEL I PERSONALITY, APTITUDE AND CAREER DEVELOPMENT	2	0	0	0

Course Objectives:

- Introduce students to building blocks of Logical reasoning and Quantitative Aptitude [SLO 1]
- Train students on essential grammar for placements [SLO 2]
- Introduce students on scientific techniques to pick up skills [SLO 3]
- Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind [SLO 4]

Expected Course Outcome:

Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Student Learning Outcomes (SLO): 1, 2, 3 and 4

Module:1 Lessons on excellence **2hours** **SLO:3**

Skill introspection, Skill acquisition, consistent practice

Module:2 Logical Reasoning **11 hours** **SLO:1**

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3 Quantitative Aptitude **11 hours** **SLO:1**

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

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Algebra and functions

Module:4 Recruitment Essentials **2hours** **SLO:4**

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5 Verbal Ability **4hours** **SLO:2**

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

Total Lecture hours: 30hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE1073	ENTREPRENEURSHIP & INNOVATION	1	0	0	0

Course Objective`

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5: To make students understand organizational performance and its importance.

Module	Description	Instructional Hours
1.	Entrepreneurial Thinking	
2.	Innovation Management	
3.	Design Thinking	
4.	Opportunity Spotting / Opportunity Evaluation	
5.	Industry and Market Research	
6.	Innovation Strategy and Business Models	
7.	Financial Forecasting	
8.	Business Plans/ Business Model Canvas	
9.	Entrepreneurial Finance	
10.	Pitching to Resources Providers / Pitch Deck	
11.	Negotiating Deals	
12.	New Venture Creation	
13.	Lean Start-ups	
14.	Entrepreneurial Ecosystem	
15.	Velocity Venture	
	Total Instructional Hours	**15**

Course Outcome

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
CO3: Remember effectively and efficiently the potential of new business opportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..
CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment.

TEXT BOOKS:

T1: Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition(2016).

REFERENCE BOOKS:

R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition 2007
R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second (2017).
R3: Jonahan Wilson "Essentials of Business Research", Sage Publication, First Edition, (2010).

WEB RESOURCES:

W1: https://blof.forgeforward.in/tagged/startup-lessons
W2: https://blof.forgeforward.in/tagged/entrepreurship
W3: https://blof.forgeforward.in/tagged/minimum-viable-product
W4: https://blof.forgeforward.in/tagged/minimum-viable-product
W5: https://blof.forgeforward.in/tagged/innovation
W6:https://www.youtube.com/watch?v=8vEyL7uKXs&list=PLmP9QrmTNPqBEvKbMSXvwlwn7fd

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SEMESTER II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE2101	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.	21MA2102	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",10th Edition, 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.	21PH2151	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 fiber**.	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.	21CY2151	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 beverages**.	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: Realise 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

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.

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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", 3rdedition, Pearson Education, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21CS2152	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** **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 number. 2. Write a C program to count no. of positive numbers, negative numbers and zeros in the array. 3. Write a C program to find sum of two numbers 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**: 1. Suppose you have a Piggie Bank with an initial amount of $50 and you have to add some more amount to it. Create a class 'AddAmount' with a data member named 'amount' with an initial value of $50. Now make two constructors of this class as follows:* *i - without any parameter - no amount will be added to the Piggie Bank* *ii - having a parameter which is the amount that will be added to the Piggie Bank* *Create an object of the 'AddAmount' class and display the final amount in the Piggie Bank.* *2.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**: 1. Using Function Overloading in C++, write a program to add numbers.* *Method i: takes 2 input as integer data type* *Method ii: takes 2 input as float data type* *Method iii: takes 3 input of type integer and float mixed with each other* *2. Write C++ Program to Subtract Complex Number Using Operator 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 members 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)**

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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.

TEXT BOOKS:

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

T2 - E.Balagurusamy, "Object Oriented Programming with C++", 7thEdition, 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, 2ndEdition, 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.	21EI2151	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	21ME2001	ENGINEERING PRACTICES (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.	21HE2071	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, PublicSpeaking, 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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Programme	Course code	Course title	L	T	P	C
B.E.	21HE2072	CAREER GUIDANCE LEVEL II Personality, Aptitude and Career Development	2	0	0	0

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]

Expected Course Outcome:

Enable students to solve questions on Verbal, Logical and Quantitative Aptitude of placement level

Student Learning Outcomes (SLO): 6, 7, 8

Module:1 Logical Reasoning **8 hours** **SLO:**6

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2 Quantitative Aptitude **12 hours** **SLO:**7

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3 Verbal Ability **10hours** **SLO:**8

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

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Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

Total Lecture hours: 30hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA3102	FOURIER ANALYSIS AND TRANSFORMS (EEE, ECE, E&I, AGRI, BIO MEDICAL & FOOD TECHNOLOGY)	3	1	0	4

Course Objectives

1. Analyze Fourier series which is central to many applications in engineering.
2. Apply the effective tools for the solutions of one dimensional boundary value problems.
3. Apply the effective tools for the solutions of two dimensional heat equations.
4. Apply Fourier transform techniques in various situations.
5. Analyze Z transform techniques for discrete time systems.

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.	12
II	**BOUNDARY VALUE PROBLEMS** Classification of PDE - Solutions of one dimensional wave equation - One dimensional equation of heat conduction (excluding insulated edges).	12
III	**TWO DIMENSIONAL HEAT EQUATIONS** Steady state solution of two dimensional equation of heat conduction in infinite plate and semicircular plate.	12
IV	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier sine and cosine transforms – Properties - Transforms of Simple functions – Convolution Theorem (Statement only) – Parseval's identity(Statement only).	12
V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS** Z- Transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem (excluding proof)– Solution of difference equations using Z – transform.	12
	Total Instructional Hours	**60**

Course Outcome

CO1: Understand the principles of Fourier series which helps them to solve physical problems of engineering.
CO2: Employ Fourier series in solving the boundary value problems.
CO3: Understand Fourier series in solving the two dimensional heat equations.
CO4: Apply Fourier transform techniques which extend its applications.
CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems.

TEXT BOOKS:

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

T2 Bali. N.P and Manish Goyal & Watkins, "Advanced Engineering Mathematics", 7th Edition, Laxmi Publications Pvt. Ltd, 2007

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 Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi,2018

R4 Ramana. B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI3201	ELECTRONIC DEVICES AND CIRCUITS (COMMON TO EIE AND EEE)	3	1	0	4

Course Objective

1. Recall the basics about the 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, Ideal diode, Diode Current Equation, Application of Diode - Rectifiers: Half Wave and Full Wave Rectifier, with capacitive filters, Display devices – LED, laser diodes, Zener Diode: Characteristics, Zener as Regulator	12
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.	12
III	**DESIGN AND ANALYSIS OF SMALL SIGNAL AMPLIFIER** BJT - Transistor Modeling, Hybrid Equivalent Circuit, Small Signal Analysis - Low Frequency Model: CE, CB, CC configurations, Darlington connections, Differential Amplifier - A.C and D.C Analysis, Single Tuned Amplifiers.	12
IV	**LARGE SIGNAL AMPLIFIERS** Classification of Power Amplifiers, Efficiency of Class A Amplifier, Class B Complementary – Symmetry and Class C - operation, Push - Pull Power Amplifiers- Calculation of Power Output, Efficiency and Power Dissipation - Crossover Distortion.	12
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.	12
	Total Instructional Hours	**60**

Course Outcome

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

TEXT BOOKS:

T1 - David A. Bell, "Electronic Devices and Circuits", 5th Edition, Prentice Hall Publications, 2008.
T2-S.Salivahanan, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw-Hill Education, 2012.

REFERENCE BOOKS:

R1-Rashid, "Microelectronic Circuits: Analysis & Design" 2nd Edition , CL Engineering publishers, 2010.
R2-A P Godse, U A Bakshi, "Electronic Devices and Circuits", Technical Publications,2017.
R3-Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI3202	SENSORS AND TRANSDUCERS	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	**IMPACT OF MEASUREMENTS AND CHARACTERISTICS OF MEASUREMENTS** Generalized Measurement system - Methods of measurements - Units and standards - Errors in measurement - Characteristics of Transducer - Calibration methods - Statistical error analysis. Classification of Transducers - 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, Thermistor, Resistance Temperature Detector, Thermocouple, Hot Wire Anemometer.	9
III	**INDUCTIVE TRANSDUCERS** Inductance transducer- Principle of operation, construction, characteristics and application of LVDT, RVDT, Synchros, 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-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, 2011.
T2 - Renganathan. S, "Transducer Engineering", Allied Publishers, Chennai, 2003.

REFERENCE BOOKS:

R1 - Ernest O.Doebelin, "Measurement systems", 6thEdition, 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.	19ME3231	FLUID MECHANICS AND THERMAL ENGINEERING	3	0	0	3

Course Objective

1. To learn the fundamentals of fluids and its flow.
2. To gain knowledge on hydraulic equipments.
3. To impart knowledge basics of thermodynamics and its laws.
4. To study the concepts of gas and vapour power cycles.
5. To learn about thermal equipments.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FLUIDS** Dimensions - Properties of fluids– Equation of continuity, Momentum equation and Bernouli equation. Flow through pipes, Major and Minor loss, Flow measurements. Simple problems on flow losses and flow measurements.	9
II	**FLUID MACHINES** Pumps-types, performance, applications, selection, simple problems on power calculations. Hydraulic turbines- types, performance, applications and calculations.	9
III	**FUNDAMENTALS OF THERMODYNAMICS** Basic concepts - Zeroth law of thermodynamics. First Law and second Law of Thermodynamics- Application of laws for closed and open systems. Simple problems on energy calculations.	9
IV	**GAS AND VAPOUR POWER CYCLES** Gas cycles- Otto, Diesel, Semi Diesel and joule cycles. Vapour cycles- Rankine cycle, Reheat cycle. Simple problems on cycle analysis.	9
V	**THERMAL EQUIPMENTS** Boiler, steam turbines, compressors, fans, blowers, chillers, cooling Towers – Types and working principle.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the fluid properties and its applications.
CO2: Quantify the energy conversion in various hydraulic systems.
CO3: Understand the thermodynamic principles and its applications.
CO4: Understand the process of air standard cycles.
CO5: Understand about the performance of Thermal and fluid machineries.

TEXT BOOKS:

T1 -Bansal R.K., —Fluid Mechanics and Hydraulic Machines, 10thEd, Laxmi Publications, Delhi, 2018.
T2 -Rajput R.K, "Thermal Engineering", 10thEdition, Laxmi Publication, Delhi, 2018.

REFERENCE BOOKS:

R1 -Yahya S.M., "Turbines, Compressors and Fans", 4thEdition, McGraw-Hill Education 2017.
R2 -Nag P.K., "Basic and Applied Thermodynamics", 2ndEdition, Tata McGraw Hill Publication, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI3251	ELECTRICAL AND ELECTRONIC MEASUREMENTS (COMMON TO EIE AND EEE)	2	0	2	3

Course Objective

1. Understand the Basics of Electrical Measuring Instruments.
2. Examine the Various Bridges used for Measuring Electrical Parameters.
3. Describe the Analog and Digital Electronic Instruments and it's Working
4. Illustrate the function of Cathode Ray oscilloscope and Signal Generators.
5. Outline Smart Instrumentation and Display Devices.

Unit	Description	Instructional Hours
I	**MEASUREMENT SYSTEM AND MEASURING INSTRUMENTS** Generalized Measurement system, Classification of instruments, Error in measurement, Classification of errors. Principle, Construction, Operation of Moving Coil and Moving Iron Instruments - Ammeters and Voltmeters - Single phase Watt meters and Energy Meters - D.C & A.C Potentiometers - Instrument Transformers- Instruments for Measurement of Frequency and Phase-**Calibration of watt meter.**	6+3
II	**MEASUREMENT OF R,L,C USING BRIDGES** D.C Bridges: Wheatstone - Kelvin double bridge- Megger – A.C Bridges: Anderson Bridge – Maxwell Bridge- Hay's Bridge and Schering bridge -**Measurement of Unknown Capacitance using Schering Bridge**.	6+3
III	**ELECTRONIC INSTRUMENTS** Analog Meters: D.C Ammeter and Voltmeters - Multimeter - Q meter - True RMS Meter - Vector Impedance Meter - RF Voltage and Power Measurements - Instrumentation Amplifier. Digital Meters: Digital Tachometer – DMM-ADC: Successive Approximation, Dual Slope – DAC:Weighted Resistor, R-2R Ladder type- Digital Frequency Counters - LCR meter-**Calibration of DC Ammeter and DC Voltmeter.**	6+3
IV	**DIGITAL STORAGE OSCILLOSCOPE AND SIGNAL GENERATORS** Analog Storage Oscilloscope - Sampling Oscilloscopes - Digital Storage Oscilloscopes - Sine Wave Generator - Sweep Frequency Generator, Pulse and Square Wave Generator - Wave Analyzer: Harmonic Distortion Analyzer - Spectrum Analyzer-**Measurement of frequency and voltage at different ac inputs using DSO.**	6+3
V	**SMART INSTRUMENTS AND RECORDERS** Serial, Parallel ports, USB–IEEE 488- Applications of Digital Instruments- Elements of Data Acquisition - Smart Sensor. **Acquiring and Generating Signals using DAQ Card.** Recording Devices: X-Y Plotters, Magnetic Tape Recording - Data Loggers- Display Devices: LED, LCD.	6+3
	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 – Measurement and Instrumentation", 19th Edition, Dhanpat Rai & Sons, 2014.

T2 - Albert D. Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2008.

REFERENCE BOOKS:

R1 - J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, 2003.

R2 - Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill, 2010.

R3 - Doebelin. E, "Measurement Systems: Application and Design", 6th Edition, Tata McGraw Hill Private Limited, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI3001	ELECTRONIC DEVICES AND CIRCUITS LABORATORY (COMMON TO EIE AND EEE)	0	0	3	1.5

Course Objective
1. Apply the knowledge gained in designing basic electronic circuits
2. Develop feedback amplifiers and oscillators
3. Construct and test the power supply circuits.

Expt. No.	Description of the Experiments
1.	Characteristics of a. Semi conductor diode b. Zener diode
2.	Characteristics of a NPN Transistor under a. Common Emitter Configuration b. Common Collector Configuration c. Common Base Configurations
3.	Characteristics of JFET& SCR
4.	Characteristics of UJT
5.	Implementation of Relaxation Oscillator
6.	Frequency response characteristics of a Common Emitter amplifier
7.	Construct and analyze the Current series Feedback Amplifier.
8.	Develop and testing of transistor RC phase shift oscillator
9.	Characteristics of photo diode and photo transistor
10.	Construct and testing of Single Phase half-wave rectifier
11.	Construct and testing Single Phase full wave rectifier
	Total Practical Hours 45

Course Outcome
CO1: Understand the characteristics of semiconductor devices.
CO2: Develop various electronic circuit configurations.
CO3: Demonstrate the frequency response of amplifiers.
CO4: Examine the current series feedback amplifier and RC phase shift oscillator.
CO5: Construct and testing the of rectifier circuits.

REFERENCES:

R1. Poornachandra Rao S. and Sasikala B., —Handbook of experiments in Electronics and Communication Engineering|, Vikas Publishing House Pvt. Ltd., New Delhi, 2007.
R2.Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI3002	SENSORS AND TRANSDUCERS LABORATORY	0	0	3	1.5

Course Objective

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

Expt. No.	Description of the Experiments
1.	Characteristics of Potentiometric Transducer
2.	Characteristics of Strain Gauge.
3.	Characteristics of Load cell.
4.	Characteristics of Thermocouple.
5.	Characteristics of RTD.
6.	Characteristics of Thermistor
7.	Characteristics of LVDT.
8.	Characteristics of Photoelectric or Photo Voltaic Transducer
9.	Characteristics of Light Dependent Resistor.
10.	Characteristics of Hall Effect Transducer.
11.	Characteristics of Piezo-Electric Transducer.
	Total Practical Hours **45**

Course Outcome

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

REFERENCES:

R1-John P. Bentley, "Principles of Measurement Systems", Pearson Education, Third Edition, 2009.
R 2- Laboratory manual prepared by the Department of Electronicsand Instrumentation Engineering, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC3191	INDIAN CONSTITUTION	2	0	0	0

Course Objective

1. Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

Unit	Description	Instructional Hours
	BASIC FEATURES AND FUNDAMENTAL PRINCIPLES	
I	Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.	4
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.	4
	PARLIAMENTARY FORM OF GOVERNMENT	
III	The constitution powers and the status of the president in India. – Amendment of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.	4
	LOCAL GOVERNANCE	
IV	Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article21 – scope of the right to life and personal liberty under article 21.	4
	INDIAN SOCIETY	
V	Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	4
	Total Instructional Hours	**20**

Course Outcome

CO1: Understand the functions of the Indian government
CO2: Understand and abide the rules of the Indian constitution.

TEXT BOOKS:

T1- Durga Das Basu, "Introduction to the Constitution of India", Prentice Hall of India, New Delhi, 2197.
T2- R.C.Agarwal, "Indian Political System", S.Chand and Company, New Delhi.2197.
T3-Maciver and Page, " Society: An Introduction Analysis", Laxmi Publications,2007.
T4-K.L.Sharma, "Social Stratification in India: Issues and Themes",SAGE Publications Pvt. Ltd, 2197.

REFERENCE BOOKS:

R1-Sharma, Brij Kishore, " Introduction to the Constitution of India", Prentice Hall of India, New Delhi,2017.
R2-U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar,2198.
R3-R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.2182.

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Course code	Course title	L	T	P	C
19HE3072	CAREER GUIDANCE LEVEL III Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite	None	Syllabus version 1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Display good writing skills while dealing with essays [SLO 12]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 12

Module:1 Logical Reasoning **6 hours** **SLO:6**

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2 Quantitative Aptitude **7 hours** **SLO: 7**

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership
- Averages
- Weighted average

Module:3 Verbal Ability **5 hours** **SLO: 8**

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

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Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4 **Writing skills for placements** **2 hours** **SLO:** 12

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE3073	LEADERSHIP MANAGEMENT SKILLS	1	0	0	0

Course Objective`

1. To know about the leadership skills that is to be acquired for success.
2. To become a teamwork expert, real world problem solver, your views will be challenged
3. To gain global perspective and becoming an effective communicator
4. To understand about learning, negotiation and decision making
5: To get first hand information about the skills we possess and to work on improvement.

Module	Description	Instructional Hours
1.	Strategic thinking skills	
2.	Planning and Delivery skills	
3.	People management skills (Delegation)	
4.	Change management and Innovation skills	
5.	Communication skills	
6.	Persuasion and influencing skills	
7.	Learning Agility	
8.	Motivation	
9.	Personality	
10.	Emotions	
11.	Perception	
12.	Negotiation	
13.	Decision making	
14.	Problem solving	
15.	Building trust	
	Total Instructional Hours	**15**

Course Outcome

CO1: To practice essential leadership skills in day to day operations
CO2: To work on leadership skills in the study environment
CO3: To understand and develop the skills consciously.
CO4: To know about the real worth of all the skills for success
CO5: To Analyze the real worth of the person and suggestion for improvement

TEXT BOOKS

T1: A REVIEW OF LEADERSHIP THEORY AND COMPETENCY FRAMEWORKS, Bolden, R., Gosling, J., Marturano, A. and Dennison, P. June 2003

T2: LEADING FROM WITHIN: Building Organizational Leadership Capacity-David R. Kolzow, PhD, 2014

REFERENCE BOOKS

R1: Seven habits of highly effective people – Stephen R.Covey

R2: The Art of Business Leadership: Indian Experiences – G.Balasubramaniam

R3: DEVELOPING the LEADER WITHIN YOU-JOHN C. MAXWELL

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SEMESTER IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA4101	NUMERICAL METHODS (COMMON TO AERO, AUTO, MECH, MCTS,EEE & EIE)	3	1	0	4

Course Objectives

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Analyze various methods to find the intermediate values for the given data.
3. Explain concepts of numerical differentiation and numerical integration of the unknown functions.
4. Explain single and multi-step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of Algebraic and Transcendental equations: Newton Raphson method . Solution of linear system: Gauss Elilmination - Gauss Jordan method -Gauss seidel method. Matrix inversion by Gauss Jordan method.	12
II	**INTERPOLATION** Interpolation - Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals.	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation: Newton's forward and backward interpolation formulae for equal intervals –Newton's divided difference formula for unequal intervals. Numerical integration: Trapezoidal and Simpson's 1/3 rule - Double integration using Trapezoidal and Simpson's rules.	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods for solving first order equations: Taylor's series method – Euler and Modified Euler methods – Fourth order Runge-kutta method -Multi step method: Milne's predictor and corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution of second order ordinary differential equation by Finite difference method – Solution of partial differential equation: one dimensional heat equation by Bender schmidt method – One dimensional Wave equation by Explicit method– Poisson Equations by Finite difference method.	12
	Total Instructional Hours	**60**

Course Outcomes

CO1: Solve the system of linear algebraic equations which extends its applications in the field of engineering
CO2: Apply various methods to find the intermediate values for the given data.
CO3: Identify various methods to perfrom numerical differentiation and l integration
CO4: Classify and solve ordinary differential equations by using single and multi step methods.
CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

T1 - Erwin Kreyszig,"Advanced Engineering Mathematics",10th Edition,Wiley India Private Ltd., New Delhi, 2018.
T2 - Kreyszig.E."Advanced Engineering Mathematics", Tenth Edition, John Wiley and sons (Asia) limited,2017

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REFERENCE BOOKS :

R1 - M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Engineering Computation", Fifth Edition, New Age International publishers 2010.

R2- Grewal B.S. and Grewal J.S. "Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2015.

R3 - S.K.Gupta, Numerical Methods for Engineers", New Age International Pvt.Ltd Publishers, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI4201	ELECTRICAL MACHINES	3	1	0	4

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. Outline the phasor diagram of Various Machines
5. Illustrate the function of various 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 of D.C. Motor.	12
II	**TRANSFORMERS** Principle - Theory of ideal transformer - EMF equation - Construction details of shell and core type transformers - Tests on transformers - Equivalent circuit - Phasor diagram - Regulation and efficiency of a transformer - Introduction to three-phase transformer connections.	12
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.	12
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 - Single Phase Induction Motors - Introduction to Induction Generators.	12
V	**SPECIAL ELECTRICAL MACHINES (QUANTITATIVE TREATMENT ONLY)** Repulsion Type Motor - Universal Motor - Hysteresis Motor - Switched Reluctance Motor - Brushless D.C Motor - Stepper Motor.	12
	Total Instructional Hours	**60**

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.	19EI4202	INTEGRATED CIRCUITS AND ITS 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's and DAC's.
4. Impart the basic knowledge of regulator circuits and special function IC's
5. Summarize internal functional blocks of special function IC's.

Unit	Description	Instructional Hours
I	**IC FABRICATION** Introduction - IC classification - chip size and circuit complexity - fundamental of monolithic IC technology - Silicon wafer preparation - Epitaxial growth – Oxidation - Photolithography - diffusion - Ion Implantation-Isolation Techniques-Metallization-Assembly Processing and packaging - Fabrication FET and CMOS.	9
II	**CHARACTERISTICS OF OP-AMP** Basic information of OP-AMP – The Ideal OP-AMP characteristics - DC characteristics - AC characteristics - frequency response of OP-AMP - Slew Rate- Inverting and Non-inverting Amplifiers -Voltage Follower-Differential amplifier - Basic OP-AMP applications:Summer - Differentiator and Integrator - V/I & I/V converters- S/H circuit.	9
III	**APPLICATIONS OF OP-AMP** Instrumentation amplifier - First order LPF - First order HPF - First order BPFand Band reject filters - Comparators - Multivibrators –Triangular wave generator – clippers – clampers - peak detector- - D/A converter : R- 2R ladder and weighted resistor types - A/D converters : Successive Approximations- Dual Slope.	9
IV	**SPECIAL IC's** Functional block- characteristics & 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 - 723 General purpose regulator - switching regulator - Opto Coupler IC's- IC8038 function generator.	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, Shail B. Jain, "Linear Integrated Circuits", 5th Edition, New Age Publishers,2018.
T2-S Salivahanan, V S Kanchana Bhaaskaran," Linear Integrated Circuits",2nd Edition, TMH,2017.

REFERENCE BOOKS:

R1-RamakantA.Gayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education, 2015.
R2-Robert F.Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", PHI Learning, 6th Edition, 2000.
R3-Floyd ,Buchla,"Fundamentals of Analog Circuits", Pearson, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI4203	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	**PRESSURE MEASUREMENT** Terminologies–Units - Manometer types – Elastic elements: Bourdon tube-Bellows- Diaphragm. Electrical Methods: elastic elements with LVDT and strain gauges-capacitive type pressure gauge -piezo resistive pressure sensors- Low pressure measurement: McLeod gauge-thermal conductivity gauges-Ionization gauge-Cold cathode and hot cathode types – Testing and calibration of pressure gauges: Dead weight tester.	9
II	**LEVEL MEASUREMENT** Units - Sight glass – dip stick - Float type - level measurement in open and closed head tanks - bubbler method- differential pressure method- Mounting Issues - Purge system - Electrical methods of level measurement using resistance, capacitance, nuclear radiation and ultrasonic sensors - radar- tuning fork and displacer methods - Level switches.	9
III	**TEMPERATURE MEASUREMENT** Units - Filled-in systems: Different types, sources of errors and their compensation, Bimetallic thermometer, Electrical methods of temperature measurement: RTD –Types of RTDs - 3 wire and 4 wire RTDs, thermistor – linearization, Diode type sensors - Integrated circuit sensors – Temperature switches and thermostats.	9
IV	**THERMOCOUPLES AND RADIATION PYROMETERS** Thermocouple – Laws and types of thermocouple - fabrication of industrial thermocouples, signal conditioning, cold junction compensation, Thermocouple burnout detection, special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement: Radiation fundamentals - Radiation pyrometers – Total radiation pyrometers, optical radiation pyrometers – ultrasonic thermometers – fiber optic temperature measurement.	9
V	**MEASUREMENT OF VISCOSITY, HUMIDITY, DENSITY AND MOISTURE** Units-Viscosity -terminologies - Say bolt viscometer – rotameter type viscometer – humidity terms – dry and wet bulb psychrometers - hotwire electrode type hygrometer-dew cell – electrolysis type hygrometer – density measurement using weight, buoyancy, hydrostatic head and radiation-moisture measurement – electrical methods.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret the measurement of pressure in instrumentation
CO2: Choose the instruments used for the measurement of level.
CO3: Identify the methods used for the measurement of temperature
CO4: Choose the High temperature measuring instruments
CO5: Classify the Instruments used for measurement of Viscocity,Humidity, Density and Moisture

TEXT BOOKS:

T1 - E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill Ltd., 2011.
T2 - R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS:

R1 - D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw Hill Ltd.,2011.
R2 - A.K. Sawhney and P. Sawhney, "A Course on Mechanical Measurements, Instrumentation and Control", Dhanpat Rai and Co, 2011.
R3 - S.K. Singh, "Industrial Instrumentation and Control", Tata McGraw Hill, 2011.
R4- K.Krishnaswamy and S.Vijayachitra," Industrial Instrumentation", New Age International (P) Limited Publishers 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI4251	DIGITAL LOGIC CIRCUITS (COMMON TO EIE AND EEE)	2	1	2	4

Course Objective

1. To understand different methods used for the simplification of Boolean functions
2. To study combinational circuits
3. To learn synchronous sequential circuits.
4. To infer the concepts of asynchronous sequential circuits and Programmable Logic Devices
5. To interpret the fundamentals of HDL.

Unit	Description	Instructional Hours
I	**MINIMIZATION TECHINIQUES AND LOGIC GATES** Boolean algebra and laws – Demorgan's Theorem—Minimization of Boolean Expressions. Minterm - Maxterm- Sum of Product (SOP) – Product of Sum(POS) - Karnaugh map minimization - Don't care conditions. Simplification of Boolean expressions using logic gates: NAND and NOR - Implementation of Boolean Functions using K-map.	9+3
II	**COMBINATIONAL CIRCUITS** Analysis and design of combinational circuits- Adders, Subtractors, Multiplier, -Code converters – Magnitude comparator – Decoder and Encoder- Multiplexer and De-multiplexer - Experiment Analysis of Adder and Subtractor circuits.	9+3
III	**SYNCHRONOUS SEQUENTIAL CIRCUITS** Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering. Asynchronous and Synchronous type - counters –Modulo counters, Shift registers. Design of synchronoussequential circuits – Moore and Melay models- state diagram-state reduction- stateassignment. Implementation of Code converters: Excess-3 to BCD and vice-versa.	9+3
IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES** Analysis of Asynchronous sequential logic circuits-Transition table, flow table - race conditions, hazards and errors in digital circuits. Introduction to Programmable Logic Devices: PROM – PLA – PAL - Experimental analysis of race conditions in digital circuits.	9+3
V	**HDL** Introduction to Hardware Description Language. HDL for combinational circuits: Adders - Subtractors –Decoder and Encoder- Multiplexer and De-multiplexer. HDL for Sequential Circuits: flip-flops – counters- Registers - Implementation of Multiplexer and De-multiplexer.	9+3
	Total Instructional Hours	**60**

Course Outcome

CO1: Apply the knowledge acquired about Boolean functions.
CO2: Summarize the concepts of combinational circuits.
CO3: Transform the acquired skill in designing the synchronous sequential circuits.
CO4: Ability to understand and analyze the asynchronous sequential circuits.
CO5: Outline the concepts of HDL.

TEXT BOOKS:

T1 - Raj Kamal, 'Digital systems-Principles and Design', Pearson Education 1st Edition, 2012.
T2 - M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.

REFERENCE BOOKS:

R1-Floyd and Jain, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.
R2-Anand Kumar, Fundamentals of Digital Circuits,PHI,2013.
R3-Charles H.Roth,Jr,LizyLizy Kurian John, 'Digital System Design using VHDL, Cengage,2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI4001	ELECTRICAL MACHINES LABORATORY	0	0	3	1.5

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.	Open Circuit and Load Characteristics of Separately excited 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.	Open circuit and Short Circuit test on Single Phase Transformer.
9.	Load Test on Single Phase Induction Motor.
10.	Load Test on Three phase Induction Motor.
11.	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.

REFERENCES:

R1-Gupta B R, and Vandana Singhal, "Fundamentals of Electrical Machine", New Age International Publishers, Third Edition, 2010.
R2- Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI4002	INTEGRATED CIRCUITS LABORATORY (COMMON TO EEE AND EIE)	0	0	3	1.5

Course Objective

1. Understand the performance characteristics of Op-amp.
2. Implement of Op-amp applications.
3. Construct and test waveform generation circuits

S.No	Description of the Experiments
1.	Performance characteristics of Op-Amp IC.
2.	Implementation of inverting and non-inverting amplifiers using Op-Amp.
3.	Construct and testing of Adder andSubtractor using Op-Amp.
4.	Implementation of differential amplifier and voltage follower using Op-Amp.
5.	Implementation of Integrator and Differentiator using Op-Amp.
6.	Frequency response characteristics of first order low pass and high pass filters.
7.	Construct and testing of D/A and A/D Converter.
8.	Construct and testing Astable and Monostablemultivibrator using IC 555 timer.
9.	Implementation of Schmitt Trigger.
10	Construct and testing of Regulated DC power supply using IC 723.
11.	Study of VCO and PLL ICs.

Total Practical Hours 45

Course Outcome

CO1: Understand the performance characteristicsof Op-amp.
CO2: Implementation of various applications of Op-amp.
CO3: Understand the performance of filters and converters.
CO4: Construct multivibrator and regulated power supply circuits using IC
CO4: Assimilate the knowledge on VCO and PLL ICS.

REFERENCES:

R1- Ramakant A. Gayakwad, "Lab manual for Op-amps and Linear Integrated Circuits", Prentice Hall, 2010.
R2- Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE/ VALUE EDUCATION	2	0	0	0

Course Objective

1. The course aims at imparting basic principles of thought process, reasoning and inferencing.
2. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions,Indian linguistic tradition and Indian artistic tradition.

Unit	Description	Instructional Hours
I	Basic Structure of Indian Knowledge System	4
II	Modern Science and Indian Knowledge System	4
III	Yoga and Holistic Health care	4
IV	Philosophical tradition	4
V	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics),Indian artistic tradition and Case Studies.	4
	Total Instructional Hours	**20**

Course Outcome

CO1: Ability to understand the structure of Indian system of life.
CO2: Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.

REFERENCE BOOKS:

R1 -V.Sivaramakrishna (Ed.), "Cultural Heritage of India-Course Material", Bharatiya Vidya Bhavan,Mumbai, 5th Edition, 2014.

R2 - Swami Jitatmananda, "Modern physics and Vedanta", Bharatiya Vidya Bhavan,2186.

R3 - Fritjof Capra, The Tao of Physics

R4- Fritjof Capra, The wave of Life.

R5- V N Jha, Tarkasangraha of Annambhatta, Inernational Chinmaya Foundation, Velliyanad,Ernakulam.

R6- Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.

R7- GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.

R8- RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi,2016.

R9- P R Sharma (English translation), Shodashang Hridayam.

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Course code	Course title	L T P C
19HE4072	CAREER GUIDANCE LEVEL IV Personality, Aptitude and Career Development	2 0 0 0
Pre-requisite	None	Syllabus version 1

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Crack mock interviews with ease [SLO 13]
- Be introduced to problem-solving techniques and algorithms [SLO 14]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 13, 14

Module:1 Logical Reasoning **3 hours** **SLO:**6

Logical connectives, Syllogism and Venn diagrams

- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation
- Venn Diagrams - Solving

Module:2 Quantitative Aptitude **6 hours** **SLO:** 7

Logarithms, Progressions, Geometry and Quadratic equations

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
- Computation of Combination
- Probability

Module:3 Verbal Ability **2 hours** **SLO:** 8

Critical Reasoning

- Argument – Identifying the Different Parts (Premise, assumption, conclusion)
- Strengthening statement
- Weakening statement
- Mimic the pattern

Module:4 Recruitment Essentials **1 hour** **SLO:** 12

Cracking interviews - demonstration through a few mocks

Sample mock interviews to demonstrate how to crack the:

- HR interview
- MR interview
- Technical interview

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Cracking other kinds of interviews

- Skype/ Telephonic interviews
- Panel interviews
- Stress interviews

Resume building – workshop

A workshop to make students write an accurate resume

Module:5 Problem solving and Algorithmic skills 8 hours SLO: 12

- Logical methods to solve problem statements in Programming
- Basic algorithms introduced

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, Mock interviews, 3 Assessments with End Semester (Computer Based Test)

Recommended by Board of Studies

Approved by Academic Council Date

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE4073	IDEATION SKILLS	1	0	0	0

Course Objective

- To study the importance of ideation.
- To learn about the various tools for Ideation.
- To provide an insight in Prototyping and its significance.

Unit	Description	Instructional Hours
	IDEATION: INTRODUCTION TO DESIGN THINKING METHODOLOGY	
I	Design Thinking Methodology and how it can be used as a powerful tool for developing new and innovative solutions - Inspiration – Implementation - Disruptive technology.	4
	IDEATION: TOOLS FOR IDEATION	
II	Various resources to kindle new ideas for innovation. Explore the types of ideas in the past – Effect of the ideas and innovation of past on the world – Innovation Thinking – Case studies.	4
	IDEATION: INTRODUCTION TO CUSTOMER DISCOVERY	
III	Intro to Customer Discovery - development of customer discovery plan that can lead to powerful business innovation - Customer Discovery Plan	4
	PROTOTYPING AND PRODUCT IDEATION	
IV	Introduction to Prototyping - minimum viable product - High fidelity prototype vs low fidelity prototype – Prototyping tools	3
	Total Instructional Hours	**15**

Course Outcome

Upon completion of the course, students will be able to
CO1: Develop a strong understanding and importance of ideation
CO2: Learn about the different kinds of tools for Ideation.
CO3: Learn the need and significance of prototyping and its significance.

TEXT BOOKS:

T1 - Mark Baskinger and William Bardel, "Drawing Ideas: A Hand-Drawn Approach for Better Design",2013
T2 - Nigel Cross, "Design Thinking", Kindle Edition

REFERENCE BOOKS:

R1 - Kurt Hanks and Larry Belliston, "Rapid Viz : A New Method for the Rapid Visualitzation of Ideas", 2008.
R2 - Kathryn McElroy , "Prototyping for Designers: Developing the Best Digital and Physical Products", 2017.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5201	INDUSTRIAL INSTRUMENTATION-II	3	0	0	3

Course Objective

1. Understand the concepts of force and torque measurements.
2. Illustrate the principle and operation of mechanical flow meter with installation techniques.
3. Illustrate the operation of electrical and other flow meter.
4. Discuss displacement and angler measuring Instruments.
5. Outline the measurement concepts of speed, velocity,sound and overview of industrial hazards safety measures.

Unit	Description	Instructional Hours
I	**FORCE AND TORQUE MEASUREMENT** Force (Weight) Measurement: Mechanical balances- Electromagnetic balances- Mechanical load cells – Elastic deflection force transducers – Gyroscopic & Vibrating wire force measurement- Nuclear radiation weight sensor. Torque measurement: Rotating torque, stationary and proximity sensors- Prony brake torque measurement. – DC cradled dynamometer torque measurement – Torsion bar torque meter.	9
II	**MECHANICAL FLOW MEASUREMENT** Theory of fixed restriction variable head type flow meter- Orifice flow meter, Venturi tubes, Flow nozzle, Dall tube, - Installation of head flow meters.- Pitot tube - Differential pressure transmitters - Quantity meters, Inferential flow meters, Mass flow meters-Smart flow meter.	9
III	**ELECTRICAL FLOW MEASUREMENT** Electromagnetic flow meter, Ultrasonic flow meter, Laser Doppler anemometer – Purge flow regulators, Cross correlation flow meter, Solid flow measurement, Vortex shedding flow meters – Flow switches – Anemometers –Mechanical anemometer. Flow meter calibration – Flow meter	9
IV	**DISPLACEMENT & ANGLE MEASUREMENT** Classification – Plig and Snap gages, Vernier caliper, Dial indicator, Comparator, Optical Flats, Interferometer, Toolmakers microscope, Autocollimator, Coordinate autocollimator. Displacement transducer: Elastic, Sliding contact, Variable self inductance, Variable mutual inductance, LVDT, Rotational variable differential transformer. Angle measurement : Protractors, Sinebars, Goniometers, and Clinometers.	9
V	**MEASUREMENT OF SPEED, VELOCITY, SOUND AND SAFETY FOR HAZARDS.** Hand held optical, stroboscopic, Eddy current drag cup tachometer. AC and DC tachometer generator. Induction and magnetic type speed sensor. Translational velocity transducer – Mechanical fly ball angular velocity. Sound parameters- Microphone , Sound level meter-Classification of Hazards & Occupancy hazards - Hazard of contents – Methods of Fire Fighting.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify the methods of force and torque measurements
CO2: Understand the operation of mechanical flow meter.
CO3: Understand the operation of electrical and other flow meter.
CO4: Choose the instruments for displacement and angle measurement
CO5: Differentiate the speed and velocity measuring instruments. Outline sound measurement.

TEXT BOOKS:

T1 - E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill Ltd., 2011.
T2 - R.K. Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS:

R1 - K.Krishnaswamy and S.Vijayachitra "Industrial Instrumentation", New Age International, 2010.
R2 - D. Patranabis, "Principles of Industrial Instrumentation", 3rd Edition Tata McGraw Hill Ltd.,2017.
R3 -Chennakesava R.Alavala, "Principles of Industrial Instrumentation and Control Systems", Cengae 2008.
R4- Bahadori, A.. Hazardous area classification in petroleum and chemical plants: a guide tomitigating risk, CRC Press,2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5202	CONTROL SYSTEMS	3	1	0	4

Course Objective

1. Learn the basics of modeling of control systems and its components.
2. Discuss time domain system analysis.
3. Explain about frequency domain system analysis.
4. Establish methods of stability analysis and controller compensators.
5. Outline on state space and sampled data control systems.

Unit	Description	Instructional Hours
I	**CONTROL SYSTEMS MODELLING** Basic elements in control system – Open loop and closed loop systems – Transfer Function models – Mechanical andElectrical systems – Analogies: Force – voltage, Force - current & Torque – voltage, Torque - current – Synchros – AC and DC servomotors.	12
II	**TIME DOMAIN ANALYSIS** Block diagram reduction techniques – Signal flow graphs – Standard test signals – Order of a system –step, impulse response of first order systems – second order system – Time domain specifications – Static Error constants – Steady state error.	12
III	**FREQUENCY DOMAIN ANALYSIS** Frequency response –Advantages – Frequency domain specifications – Bode plot – Polar plot – **M and N Circles** -Phase margin and gain margin - Correlation between frequency and time domain specifications.	12
IV	**STABILITY AND COMPENSATOR DESIGN** Characteristics equation – Routh Hurwitz criterion – Relative and conditional stability, Root locus, construction, stability criterion - Effects of P,PI,PID controller modes– **Applications of P,PI and PID controllers** ,Compensator – Types – Lag, lead and lag-lead networks – Lag-Lead compensator design using Bode plot.	
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 –State feedback - 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 the gained 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 control systems stability and compensator design.
CO5: Develop a state models and discrete control systems for any application.

TEXT BOOKS:

T1 - Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age InternationalPublishers, 2017.
T2 - Katsuhiko Ogata, "Modern Control Engineering", PHI, 5th Edition, 2010.

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.
R4-M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/106/108106098/
2. https://nptel.ac.in/courses/108/102/108102043/

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EI5203	MICROPROCESSORS AND MICROCONTROLLERS (COMMON TO EEE AND EIE)	3	0	0	3

Course Objectives

1. Understand the fundamental components of 8085 architecture.
2. Understand the concept of peripheral's interfacing with assembly language programming.
3. Study the fundamental architecture of 8051 microcontroller and its programming concepts.
4. Understand the fundamental and programming concepts of arduino uno controller.
5. Learn the architecture study of advance microprocessors and microcontrollers.

Unit	Description	Instructional Hours
I	**Intel 8085 PROCESSOR** 8085 architecture– Pin diagram - Memory & I/O Interfacing –- Interrupts - Vendors in microprocessors - Addressing Modes - Instruction set - Stack and Subroutine Instructions - Simple Assembly Language Programming	9
II	**8085 INTERFACING** Study of Architecture and Programming of Peripheral IC's:8255 PPI, 8259 PIC, 8251 USART,8279 Keyboard Display Controller and 8253 Timer/ Counter - Interfacing with 8085:A/D & D/A converter.	9
III	**8051MICROCONTROLLER** Functional block diagram - Instruction format and addressing modes – Interrupt structure – Timer –I/O ports –Interfacing: LED – 7 segment display – Keypad - Simple programming	9
IV	**ARDUNIO UNO CONTROLLER** AVR Architecture – pin diagram – communication – Concept of digital and analogports – Arduino interfacing digital and analog and Sensors - Programming concepts IDE: Arduino data types – Variables and constants – Arrays and strings- Functions –Simple programming examples.	9
V	**MICROCONTROLLER APPLICATIONS** Keyboard and Display interfacing, Closed Loop Control of Servo Motor, Stepper Motor and Washing Machine Control - Arduino based Control of Street Lights, Home Automation System and temperature controller-Introduction to Raspberry pi.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Study the architecture of 8085 microprocessor and programming concept involved in 8085.
- CO2 Understand the commonly used peripheral/ interfacing IC's with its programming.
- CO3 Understand the architecture and programming concepts of 8051 microcontroller.
- CO4 Learn the advanced controller fundamentals and programming.
- CO5 Understand the applications and role of advanced microcontrollers.

TEXT BOOKS:

T1 R. S. Gaonkar, "Microprocessor Architecture Programming and Application", Penram International Publishing Private limited, 6th edition, Oct 2013.

T2 Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry", John Wiley & Sons, Inc.2nd Edition, Oct 2019.

REFERENCE BOOKS:

R1 Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.Mckinlay, "The 8051 microcontroller and embedded systems using assembly and C", 2nd Edition, Pearson Education, 2011.

R2 Krishna Kant, "Microprocessors and Microcontrollers", Prentice –Hall of India, New Delhi, 2017.

R3 J. M. Hughes, "Arduino: A Technical Reference", 1st Edition, O'Reilly Media, Inc, USA, 2016.

Simon Monk, "Programming Arduino Getting Started with Sketches", 1st Edition, McGraw-Hill Education, USA, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5204	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. Interpret the fundamentals of industrial Gas Analyzers .
4. Infer the knowledge about pH meters and safety Measures.
5. Gain knowledge about Microscopic techniques.

Unit	Description	Instructional Hours
I	**SPECTROPHOTOMETERS** Elements of Analytical Instruments - Beer-Lambert law - Single and double beam instruments- - FTIR spectrophotometers - Flame photometers - Atomic absorption spectrophotometers – Raman Spectrometer- Sources and Detectors- UV, Visible, IR, FTIR spectrophotometers.	9
II	**CHROMATOGRAPHY** Gas chromatography - Basic parts - Chromatographic column - Sources – Detectors – Liquid Chromatography - Types - Column chromatography- Thin layer Chromatography - Paper partition Chromatography-Applications - High pressure liquid chromatography.	9
III	**INDUSTRIAL GAS ANALYZERS** Types of gas analyzers – Paramagnetic oxygen analyzer – Electrochemical methods – Infrared gas analyzers – Thermal conductivity analyzers – Analyzers based on gas density – Method based on ionization of gases-Sodium analyzer.	9
IV	**pH METERS AND SAFETY MEASURES** Principle of pH measurement - Hydrogen electrode, Glass electrode, Reference electrode - Selective Ion electrode, ammonia electrodes – Safety Measures: Safety in handling of industrial gases and maintenance of the associated equipment and instruments.	9
V	**NUCLEAR MAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES** Principle of NMR - Types - Construction and applications - 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 aboutindustrial gas analyzers.
CO4: Analyze pH measurements and Impart awareness on safety Measures
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 - Willard H.H., Merritt L.L., Dean J.A., and Settle F.A. "Instrumental Methods of Analysis", 7thEdition, CBS Publishing& Distribution, New Delhi, 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",6th Edition, Mc Graw Hill, 2007.

R3 -Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore,2006.

R4-Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

WEB REFERENCE:

https://nptel.ac.in/courses/103/108/103108100/

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EI5251	PROGRAMMABLE LOGIC CONTROLLERS AND SCADA	2	0	2	3

Course Objectives

1. Understand the basics of PLC and its components.
2. Infer the knowledge on developing PLC logical programs for various conditions.
3. Introduce on various PLC program instruction sets.
4. Establish the communication protocols used in PLC's.
5. Cite the applications of PLC's in industrial automation.

Unit	Description	Instructional Hours
I	**INTRODUCTION** History and Evolution of PLC – need for PLC – PLC sizes – Scan time –PLC architecture – Hardware components: Analog and Discrete I/O modules – power supply –memory - PLC Interlocking – Latching relays.	6
II	**PROGRAMMING OF PLC** Basics of PLC programming – types: Ladder logics(LD),Functional block diagram(FBD),Sequential function chart(SFC),Structured Text(ST) and Instruction List(IL) PLC Timers: ON Delay, OFF Delay and Retentive Timers- Counters: UP Counter, DOWN Counter and UP DOWN Counters - ladder examples-**Construct a PLC ladder program for parking garage counting.**	6+3
III	**PLC INSTRUCTIONS** Program control instructions – Data handling and Data manipulation instructions - Math instructions - Sequencer and shift register – program subroutines - motor controls - Use of PC as PLC - programming examples - **Construct a ladder diagram for Celsius temperature to Fahrenheit conversion- Construct PLC ladder logic to control temperature of Oven.**	6+6
IV	**PLC COMMUNICATION, SCADA AND DCS** PLC communication ports – serial communications – RS232– communication between several PLCs – PLC field bus– PLC troubleshooting - Introduction to Supervisory control and data acquisition systems (SCADA) – RTU and Master station - DCS – architecture – DCS programming.	6
V	**APPLICATIONS OF PLC IN INDUSTRIAL AUTOMATION** PLC traffic light control – stepper motor control – Elevator control – Bottle filling system – Pneumatic Stamping system – PLC in process control systems. Need for automation in industries – Role of PLC and SCADA in industrial automation - **Develop a PLC Program for automating bottle filling systems, Develop PLC ladder logic program to control the Speed of a motor.**	9+3
	Total Instructional Hours	**45**

Course Outcomes

CO1	Describe the architecture of PLCs with the analogy of relay logic components
CO2	Develop ladder logic program for any applications
CO3	Characterize the different instructions available in PLC and implement them.
CO4	Explain on SCADA, DCS and its networking with PLC.
CO5	Summarize the impact on PLC and SCADA for various industrial automation processes.

TEXT BOOKS:

T1 - Frank D. Petruzella, "Programmable Logic Controllers", McGraw-Hill, 3rdEdition, March 2013
T2 - John W. Webb and Ronald A.Reis, "Programmable Logic Controllers – Principles and Applications", Prentice Hall Inc., New Jersey, 5th Edition, 2002.

REFERENCE BOOKS:

R1 –John R. Hackworth and Frederick D. Hackworth Jr, "Programmable Logic Controllers", Pearson, 2004.
R2- David Bailey, Edwin Wright, "Practical SCADA for Industry", Elsevier, 2003.
R3 – Michael P. Lukas, "Distributed Control Systems: Their Evaluation and Design", Van Nostrand, 1986
R4 -R KRajput, "Robotics and Industrial Automation", S Chand Publishers, Revised edition 2014.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108/105/108105088/
2. https://electrical-engineering-portal.com/resources/plc-programming-training

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EI5001	INDUSTRIAL INSTRUMENTATION LABORATORY	0	0	3	1.5

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
	Total Practical Hours 45

Course Outcome

CO1: Illustrate the characteristics of Pressure, Temperature, flow, level, density andviscosity 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.

REFERENCES:

R1-William C. Dunn, "Fundamentals of Industrial instrumentation and Process Control, Mc-Graw Hill, Professional, Second Edition,2018.
R2- Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2017.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EI5002	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY (COMMON TO EEE AND EIE)	0	0	3	1.5

Course Objective

1. Understand the assembly language programming with simple examples using 8085.
2. Study the concept of peripheral's interfacing with assembly language programming using 8085.
3. Learn the assembly language programming with simple examples using 8051.
4. Practice the basic programming concept and interfacing sensor of Arduino.
5. Propose the concepts of Industrial drive interfacing concepts with programming.

Expt. No.	Description of the Experiments
1.	Arithmetic operations using 8085 microprocessor: 8-bit Basic Arithmetic operations.
2.	8085 Programming: Sorting Operations & Max / Min of numbers.
3.	A/D interfacing and D/A interfacing with microprocessor.
4.	Keyboard and 7-segment display interface with 8279 Interfacing.
5.	Programming demonstration of basic function with 8051 microcontroller execution.
6.	Simple basic programming of Arduino microcontroller.
7.	Digital and Analog interfacing using Arduino microcontroller.
8.	Interface the stepper motor to perform clockwise and anti-clock wise rotation.
9.	Traffic light control interfacing with 8051.
10.	Study on Raspberry pi.

Total Practical Hours 45

Course Outcome

CO1: Understand the 8085architecture and its programming execution.
CO2: Learn interfacing knowledge with different applications.
CO3: Study the simple and interfacing programming concepts of 8051.
CO4: Understand the Interfacing and basic programming concept of Arduino.
CO5: Understand the industrial application of microcontroller by various programming concepts.

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE5071	SOFT SKILLS - I	1	0	0	1

Course Objectives:

1.To employ soft skills to enhance employability and ensure workplace and career success.
2.To enrich students' numerical ability of an individual and is available in technical flavor.
3.To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**Introduction to Soft Skills:** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self Management-Critical Thinking-Reflective thinking and writing- p2p Interaction	3
II	**Art of Communication:** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non-Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve nonverbal Communication - Importance of feelings in communication - dealing with feelings in communication.	4
III	**World of Teams:** Self Enhancement - importance of developing assertive skills- developing self-confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	3
IV	**Quantitative Aptitude:** Averages - Profit and loss - Partnerships - Time and work - Time, Speed and Distance - Problems based on trains - Problems based on boats and streams	3
V	**Logical Reasoning:** Clocks - Calendars - Direction Sense - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	2

Course Outcome:

CO1: Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.
CO2: Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others
CO3: Students will understand how teamwork can support leadership skills
CO4: Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.
CO5: Students will demonstrate an enhanced ability to draw logical conclusions and implications to solve logical problems.

REFERENCE BOOKS:

R1: Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
R2: How to prepare for data interpretation for CAT by Arun Sharma.
R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.
R4: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali
R5: Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE5072	DESIGN THINKING	1	0	0	1

Course Objective

1. To expose students to the design process
2. To develop and test innovative ideas through a rapid iteration cycle.
3. To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
	DESIGN ABILITY	
I	Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	4
	DESIGNING TO WIN	
II	Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
	DESIGN TO PLEASE AND DESIGNING TOGETHER	
III	Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
	DESIGN EXPERTISE	
IV	Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert. Critical Thinking – Case studies: Brief history of Albert Einstein, Isaac Newton and Nikola Tesla	3
	Total Instructional Hours	**15**

Course Outcome

Upon completion of the course, students will be able to
CO1: Develop a strong understanding of the Design Process
CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.
CO3: Develop teamwork and leadership skills

TEXT BOOKS:

T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, "Creative Confidence", 2013.
R2 - 3. Tim Brown, "Change by Design", 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6181	INDUSTRIAL SAFETY MANAGEMENT (COMMON TO EEE AND EIE)	3	0	0	3

Course Objective

1. Educate on Engineering Safety.
2. Understand the basics of Safety measures.
3. Enumerate about industrial accident investigation.
4. Illustrate on safety performance analysis.
5. Outline on safety Instrumentation systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SAFETY ENGINEERING** Evolution of modern safety concept – Need for safety - Introduction to Safety systems Engineering(SSE) - safety standards – types - safety audit – reason, benefits ,audit programs – safety performance monitoring; Important Acts: factories act 1948, Environment act 1986; Safety in industries : machine guarding, welding process, cold and hot working process and its	9
II	**SAFETY MANAGEMENT** Functions of safety management – safety organizing, controlling – safety management principles – "The permit- to- work" system – management responsibilities – safety versus health - safety life cycle (SLC):concept, types, examples -safety policy – OSHA Regulations – standards , OSHA inspection – IEC61508 & ISA84.01 standards -safety inspection,computers and safety.	9
III	**ACCIDENT INVESTIGATION** Cause of Accidents in industries – Learning from accidents - Accident ratio - reportable and non reportable accidents, Accident recall – methods, recall aids - NEMIRR systems – benefits - Supervisory role - Overall accident investigation process –Major Disasters: The Bhopal disaster 1984 - The Flixborough disaster 1974 – HAZOP(Qualitative treatment only).	9
IV	**.SAFETY PERFORMANCE ANALYSIS, TRAINING** Safety performance monitoring – roles – performance and review, evaluation – Recordkeeping, inspection of records, maintenance –Incident rate, accident rate - Fatal Accident rate (FAR) – problems. Importance of training - occupational safety and health training – Personal protective equipment (PPE), types, breathing and respiratory protection - "In-situ" safety training – Brainstorming - motivation, communication.	9
V	**SAFETY INSTRUMENTATION SYSTEMS(SIS)** Electrical office hazards, prevention of office hazards, fire prevention – managing fire safety – fire safety design - Electrical safety checklist – OSHA regulation for Portable (power operated) and Electrical equipment safety. Safety Instrumentation Systems (SIS): Alarms – regulations and standards – Safety integrity level - Emergency shutdown	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Explain the concepts of Engineering Safety and its acts.
CO2: Understand and applythe various industrial safety standards and regulations.
CO3: Appraise the accident investigation strategies for an industry.
CO4: Summarize the various Safety performance monitoring and apply them.
CO5: Elaborate the various electrical hazards prevention systems and its methods.

TEXT BOOKS:

T1 – Ron C.McKinnon " Safety management Near miss identification" CRC press 2012.
T2 - L M Deshmukh, "Industrial safety management", Tata McGraw Hill, 2010.

REFERENCE BOOKS:

R1 -Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic MethodsIncluding Layer of Protection Analysis", ISA, 2002.
R2 - "The Factories Act 1948", Madras Book Agency, Chennai, 2000.
R3 – "Relevant India Acts and Rules", Government of India.
R4 - King, R "Safety in the process industries". Elsevier,2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6201	PROCESS CONTROL	3	0	0	3

Course Objective

1. Understand the basics of mathematical modeling of any physical process.
2. Observe the characteristics of various controllers 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 – systems with dead time- Mathematical model of Flow, Level, Pressure and Thermal processes - Interacting and non-interacting systems - Continuous and batch processes - Self regulation - Servo and regulatory operations - Linearization of nonlinear systems.	9
II	**CONTROL ACTIONS AND CONTROLLERS** Characteristic of on-off, floating, proportional, integral and derivative controllers – Composite Control: P+I,P+D and P+I+D control modes – Electronic PID controller, controller design problems - PID Bumpless,Auto/manual transfer–Reset Wind-up - Proportional and Derivative kick - Practical forms of PID.	9
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: ISA S 75.01 – valve sizing calculations - Cavitation and flashing - Selection of control valves.	9
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.	9
V	**MULTILOOP PROCESS CONTROL** Feed-forward control - Cascade control - Ratio control - Split-range control – Averaging control - Inferential control and Introduction to multivariable control - MIMO systems, Examples - IMC - MPC - Adaptive control. Case Studies: Distillation column - Boiler drum level control - P&ID diagram.	9
	Total Instructional Hours	**45**

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

REFERENCE BOOKS:

R1 –Johnson .C.D, "Process Control Instrument Technology", 8th Edition, Pearson Education, 2006.
R2 – D.E. Seborg, T.F. Edger, "Process Dynamics and Contro"', John Wiley and Sons, 2nd Edition, 2004.
R3 – Krishnaswamy.K, "Process Control", New Age International Publishers, 2015.
R4-Thomas E. Marlin, "Process Control – Designing Processes and Controlsystems for Dynamic Performance", Mc-Graw-Hill, 2000.

WEB REFERENCE:

https://nptel.ac.in/courses/103/103/103103037/

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6202	DISCRETE TIME AND SIGNAL PROCESSING	3	0	0	3

Course Objective

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 - 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 Outcome

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 associatedstructures.
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", Second Edition,Pearson Education, 2009.

WEB REFERENCE:

https://nptel.ac.in/courses/117/102/117102060/

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6251	EMBEDDED SYSTEMS (COMMON TO EEE AND EIE)	2	0	2	3

Course Objective

1. Understand the general purpose system and embedded system.
2. Describe the components and compilation techniques in an embedded system.
3. Impart Knowledge in Various processor scheduling algorithms.
4. Differentiate the RTOS concepts to design and develop real time projects.
5. Develop Process flow to design and implement an embedded system using case studies.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO EMBEDDED SYSTEM** Basics of Developing and Functional building block of embedded system - Characteristics of embedded system applications - Structural units in Embedded processor -Challenges in embedded system design.**-PCB Designing of simple electronic circuits**	6+3
II	**ARCHITECTURE OF EMBEDDED SYSTEM** PIC Microcontroller – Architecture of PIC 16F8xx -Supervisor mode, Exceptions & Traps, Co-processors, - CPU bus - Memory devices - I/O devices -Assembly and linking - Basic compilation techniques – Program optimization – FSR – Reset action – Oscillatory Circuit**-Interfacing Of LED and LCD**	9
III	**OS FOR EMBEDDED SYSTEMS** Introduction to RTOS, Multiple tasks and multiple processes - Context switching - Operating system - Scheduling policies - Task communication,Inter process communication mechanisms -Introduction to µC/ OS II**-Sending And Receiving Messages By Using Zig Bee Module.**	9
IV	**DEVELOPMENT ENVIRONMENT AND PERFORMANCE ISSUSES** Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modeling of EDLC; issues in Hardware-software Co-design, Energy and power - Evaluating operating system performance -Real time kernels- issues in real time kernel-Structure of a real-time kernel– **Design of Traffic Light Controller.**	9
V	**REAL TIME APPLICATIONS&IMPLEMENTATION** Development and debugging –Testing - Program validation and Testing, - Distributed embedded architecture Design examples: Cell phones, Digital Still Cameras, Elevator Controller, Smart card applications**-Creation of Mailbox.**	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand The Basic Structure of Embedded Processors.
CO2: Acquire the knowledge in the architecture of Embedded System.
CO3: Articulate the knowledge in operating systems for embedded process.
CO4: Outline RTOS concepts and issues in embedded system design process.
CO5: Demonstrate the design and implementation process of real time products

TEXT BOOKS:

T1 - J.Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Reed Elsevier Publications, Gurgaon, Haryana, 2008
T2 - Rajkamal, "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill, New Delhi, 2010

REFERENCE BOOKS:

R1 –David E Simon, "An Embedded Software Primer", Pearson Education India, New Delhi, 2004.
R2 – Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill,2012.
R3 – Ajay V Deshmukh," Microcontroller Theory and Applications" Tata McGraw Hill,2012.
R4 -K.V.K..Prasad,"Embedded Real-Time Systems: Concepts, Design and Programming" Dream tech 2012.

WEB REFERENCE:

https://nptel.ac.in/courses/108/102/108102045/

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6001	PROCESS CONTROL LABORATORY	0	0	3	1.5

Course Objective

1. Apply the knowledge gained in control of various physical systems.
2. To be exposed for 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. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process.
5. Wireless remote monitoring of process control plant using IoT

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

6. (i) Study of a Process Control systems and Piping & Instrumentation diagram of a plant.
   (ii) Study the characteristic of Step and Impulse response of Interacting and Non-interacting Systems.
7. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
8. (i)Closed loop control of Level process for Servo and Regulator Operation.
   (ii) Closed loop control of Flow process for Servo and Regulator Operation.
9. Closed loop control of Pressure process for Servo and Regulator Operation.
10. Closed loop control of ON/OFF controlled Thermal process.
11. (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

REFERENCES:

R1-George Stephanopoulos, Chemical Process Control: An Introduction to theory and Practice, Pearson 2008.
R2- Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6002	VIRTUAL INSTRUMENTATION LABORATORY	0	0	3	1.5

Course Objective

1. Observe the basic graphical programming knowledge using LabVIEW 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.	Program to control Temperature by using Thermocouple and DAQ.
11.	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.

REFERENCES:

R1-Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Pvt. Ltd., 2010
R2- Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2017.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6701	INTERNSHIP TRAINING	0	0	0	1

Course Objectives

1. Apply the gained knowledge and skills 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 **minimum of 3 weeks** Internship / Industrial Training from third semester to sixth semester. The Internship / Industrial Training shall carry 100 marks and shall be evaluated at end semester examination.

At the end of Sixth semester, a three member Departmental Committee constituted by Controller of Examinations will evaluate the report, conduct Viva Voce Examination and award credit points.

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 Controller of Examinations.

Course Outcomes

CO1: Employ 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: Define and Visualize the impact of engineering solutions to the society.

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE6071	SOFT SKILLS-II	1	0	0	1

Course Objectives:

1. To make the students aware of the importance, the role and the content of softskills through instruction, knowledge acquisition, demonstration and practice.
2. To learn everything from equations to probability with a completely different approach.
3. To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	**Group Discussion & Presentation Skills:** GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	4
II	**Interview Skills and Personality Skills:** Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	3
III	**Business Etiquette & Ethics:** Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	3
IV	**Quantitative Aptitude:** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**Logical Reasoning:** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

Course Outcome:

CO1: Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.
CO2: Students will Actively participate meetings, Group Discussions / interviews and prepare & deliver presentations
CO3: Students will define professional behavior and suggest standards for appearance, actions and attitude in a Business environment
CO4: Students will be able to apply quantitative reasoning and mathematical analysis methodologies to understand and solve problems.
CO5: Students will excel in complex reasoning.

REFERENCE BOOKS:

R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young Talent- Bruce Tulgan
R2: Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha
R3: How to crack test of Reasoning - Jaikishan and Premkishan
R4: The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE6072	INTELLECTUAL PROPERTY RIGHTS (IPR)	1	0	0	1

Course Objectives:

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. To disseminate knowledge on copyrights and its related rights and registration aspects.
4. To disseminate knowledge on trademarks and registration aspects.
5. To disseminate knowledge on Design, Geographical Indication (GI) and their registration aspects.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
II	**PATENTS** Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	3
III	**COPYRIGHTS** Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
IV	**TRADEMARKS** Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks - Registration of Trademarks.	3
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks -Procedure for registration.	3

Course Outcome:

CO1: Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2: Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.

CO3: Identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing.

CO4: Identify different types of trademarks and procedure for registration

CO5: Recognize the concept of design, geographical indication and procedure for registration

TEXT BOOKS:

T1- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
T2- V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt. Ltd, 2012.

REFERENCE BOOKS:

R1- Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
R2-Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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PROFESSIONAL ELECTIVE I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5301	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	**POWER PLANT INSTRUMENTATION BASICS** Methods of power generation :– hydro, thermal, nuclear, solar and wind power Piping and instrumentation diagram of a thermal power plant, basic process of a boiler, Fuel measurement-review of pressure and temperature measurement steam and water flow measurement – instrument applications in power stations: review of indicating and recording instruments, for power stations-instrument maintenance aspects.	9
II	**MEASUREMENTS IN POWER PLANTS** Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement – Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.	9
III	**BOILER CONTROL – I** Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Control of deaerator – Drum level control – Single, two and three element control – Furnace draft control – implosion – flue gas dew point control – Trimming of combustion air – Soot blowing.	9
IV	**BOILER CONTROL – II** Burners for liquid and solid fuels – Burner management – Furnace safety interlocks – Coal pulverizer control – Combustion control for liquid and solid fuel fired boilers – air/fuel ratio control – fluidized bed boiler – Cyclone furnace.	9
V	**CONTROL OF TURBINE** 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: 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 burner and furnace management for boilers.
CO5: Outline the operation of turbines.

TEXT BOOKS:

T1 - Sam Dukelow. G "The control of Boilers", Instrument Society of America, 1991.
T2 - Krishnaswamy.K and Ponnibala.M., "Power Plant Instrumentation", PHI Learning Pvt.Ltd.,2013.

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- P.K.Nag, "Power Plant Engineering", Tata McGraw-Hill Education, 4th edition, 2014.
R4-Tamilmani, "Power Plant Instrumentation", Sams Publishers, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5302	COMMUNICATION THEORY	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 evolution of communication systems.

Unit	Description	Instructional Hours
I	**AMPLITUDE MODULATION** 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** Phase and Frequency Modulation – Narrow and Wide band FM –Generation of FM Waves - 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** Spread Spectrum and Multiple Access Techniques : FDMA - TDMA - CDMA - SDMA - Applications in Wire and Wireless Communication.	9
V	**EVOLUTION OF COMMUNICATION TECHNOLOGY** Evolution of communication technologies:2G,3G,4G,5G, Global System for Mobile Communications (GSM), GPS –Satellite Communication – Optical Communication	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 - Simon Haykin, "An Introduction to Analog and Digital Communication Systems", 2nd Edition, Wiley,2012.
T2-Theodore S Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.

REFERENCE BOOKS:

R1 – Simon Haykin, "Communication Systems", 4thEdition, John Wiley & Sons, 2014.
R2 – Taub H and Schilling D.L, "Principles of Communication Systems", 4th Edition, Tata McGraw Hill, 2014.
R3 –B.Sklar "Digital communications: Fundamentals and Applications", 2nd Edition, Pearson Education, 2012.
R4 -B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19IT5331	FUNDAMENTALS OF JAVA PROGRAMMING	3	0	0	3

Course Objective

1. To understand Object Oriented Programming concepts and basic characteristics of Java
2. To know the principles of packages, inheritance and interfaces
3. To define exceptions and use I/O streams
4. To understand multithread programming logic
5. To design and build simple Graphical User Interfaces

Unit	Description	Instructional Hours
I	**INTRODUCTION** Object oriented programming concepts – objects-classes- methods and messages-abstraction and encapsulation-inheritance- abstract classes- polymorphism-Benefits of OOP, Application of OOP-Java Evolution-Features of Java-Difference of Java from C and C++.	9
II	**OVERVIEW OF JAVA LANGUAGES** Basics of Java programming, Data types, constants -Variables and Arrays, Operators and expressions , Decision making and branching –looping –Classes, Objects and Methods- access specifiers – static members –Constructors-this keyword-finalize method	9
III	**PACKAGES AND INTERFACES** Java API Packages –Naming conventions-creating, accessing, using Packages-Inheritance– Method Overriding- Abstract class Interfaces: Multiple inheritance-defining, extending, implementing interfaces- -final keyword	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 - Creating Threads- Extending thread class-Stopping and Blocking Thread-Life cycle –Using Thread-Thread Exceptions-Thread priority-Synchronization-Runnable Interface-Inter thread communication	9
V	**EVENT DRIVEN PROGRAMMING** Graphics programming – Frame – Components – working with 2D shapes – Using color, fonts, andimages – Basics of event handling – event handlers – adapter classes – actions – mouse events – AWT event hierarchy	9
	Total Instructional Hours	**45**

Course Outcome

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

- CO1 Understand the concepts of OOPs
- CO2 Remember the syntax, semantics and classes in Java language
- CO3 Understand object inheritance and its use.
- CO4 Understand various types of Exception handlingand the use of multithreaded programming.
- CO5 Understand to build simple Graphical User Interfaces.

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, James Rumbaugh, "Object-Oriented Modeling and Design With UML", Second Edition, Pearson Education, 2008.
R3 - C. Thomas Wu, "An introduction to Object-oriented programming with Java", Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5303	INDUSTRIAL CHEMICAL PROCESS	3	0	0	3

Course Objective

1. Study the unit operation involved for transportation of solids and liquids.
2. Understand the basic operations on Industrial combustion process
3. Gain adequate knowledge on other processes involved in chemical plant.
4. Impart knowledge on various process industrial operations.
5. Infer the various control operation and mechanisms involved in refineries.

Unit	Description	Instructional Hours
I	**UNIT OPERATIONS** Operation on Solids: General characteristics of solids, storage and conveying of solids. Operation on Liquids: Transport of liquids, solids and gases adjusting particle size of bulk solids – Mixing processes – Separation: Electrostatic and magnetic separators– Chemicals from petroleum products.	9
II	**COMBUSTION PROCESSES** Combustion processes – fluidized bed combustion - Heat exchangers – Energy balance - Material balance – Evaporators – Crystallization.	9
III	**OTHER OPERATIONS** Drying – Distillation - Absorption – Filtration – Refrigeration process – pH measurement and control – Chemical reactions.	9
IV	**CASE STUDY – I** Operations in the manufacture of paper, pulp and sugar – Operations in steel industry - Fertilizer industry.	9
V	**CASE STUDY – II** Operations in thermal power plant – Operations in pharmaceutical industry - Petroleum and leather industry.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the gained knowledge on solids and fluids to handle raw materials.
CO2: Explain the various combustion techniques and its advantages
CO3: Identifies the contemporary technologies used for drying, distillation and refrigeration processes in chemical plants.
CO4: Analyze chemical processes and economics involved in the paper, pulp and fertilizer industries.
CO5: Analyze and formulate the relevant mechanism to control of refineries.

TEXT BOOKS:

T1 - McCabe W.L. and Smith J.C. "Unit operations in Chemical Engineering", McGraw Hill, 2014
T2- Balchen J G and Mumme K I, "Process Control Structures and Applications",Van Nostrand Reinhold Co.,New York, 1995.

REFERENCE BOOKS:

R1– Liptak B G, "Instrument Engineers Handbook: Process Measurement and Analysis", Butterworth Heinemann, 2003.
R2 – Luyben W C, "Process Modelling, Simulation and Control for Chemical Engineers", McGraw Hill, 1990.
R3 –Austin G T, "Shreve's Chemical Process Industries", McGraw Hill, 1985
R4- Waddams A L, "Chemicals from Petroleum", John Murray Publishers, 1978.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI5304	OPERATING SYSTEMS	3	0	0	3

Course Objective

1. Outline the basic concepts and structure of operating systems.
2. Illustrate the different processes, scheduling algorithms and deadlocks.
3. Interpret various memory management schemes.
4. Classify I/O management and file systems.
5. Outline the characteristics of distributed operating systems.

Unit	Description	Instructional Hours
I	**OPERATING SYSTEMS OVERVIEW** Introduction –operating systems overview- Evolution of Operating System.- Computer System Organization-Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.	9
II	**PROCESS MANAGEMENT** Processes-Process Concept, Process Scheduling, Inter-process Communication; Threads- Overview, Multicore Programming, Multithreading Models. Process Synchronization - Critical Section Problem, Mutex Locks, Semaphores, Monitors; CPU Scheduling and Deadlocks.	9
III	**STORAGE MANAGEMENT** Main Memory-Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory- Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory.	9
IV	**FILE SYSTEM IMPLEMENTATION & MASS STORAGE STRUCTURE** Mass Storage Structure- Overview, Disk Scheduling and Management; File System Storage-File Concepts, Directory and Disk Structure, Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management.	9
V	**CASE STUDY: LINUX** Linux system – History- Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – File Systems – Input and output – Inter-process Communication- Network Structure – Security-Virtualization- Basic Concepts.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the basic concepts and structures of operating systems
CO2: Design various Scheduling algorithms and deadlock prevention and avoidance algorithms.
CO3: Contrast various memory management schemes.
CO4: Understand different prototype file systems.
CO5: Demonstrate the distributed operating systems.

TEXT BOOKS:

T1 - Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
T2- Tom Adelstein, Bill Lubanovic , "Linux System Administration Solve Real-life Linux Problems Quickly", 2nd Edition, O'Reilly Media, 2009.

REFERENCE BOOKS:

R1 –Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition , Pearson Publications, 2014.
R2 – Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill, 1996.
R3 –D M Dhamdhere, "Operating Systems: A Concept-Based Approach", 2nd Edition, Tata McGraw-Hill 2007.
R4– Harvey M.Deitel-Operating systems,3rd Edition, Pearson/Prentice Hall,2004.

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PROFESSIONAL ELECTIVE II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6301	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	**VHDL PROGRAMMING** RTL Design - Combinational Logic Types - Operators - Packages - Sequential circuits - Subprograms - Test Benches (Adders, Flip Flop, Counters, FSM, Multiplexer, Demultiplexer).	9
V	**IMPLEMENTATION STRATEGIES** Full custom and Semi Custom Design, Standard Cell Design and Cell Libraries -FPGA Building Block Architecture - FPGA Interconnect Routing Procedures.	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: Build VHDL programming for digital circuits.
CO5: Establish digital system using FPGA.

TEXT BOOKS:

T1 - N. H. Weste, Principles of CMOS VLSI Design4th Edition, Pearson , 2017.
T2 - Charles. H, Roth, "Digital System Design using VHDL", Thomson learning, 2004.

REFERENCE BOOKS:

R1 – Weste and Harris,"CMOS VLSI Design", Pearson Education,4th Edition,2005
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.
R4-M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6302	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3

Course Objective

1. Infer the basic concepts 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 polymer and optical 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	**POLYMER AND OPTICAL MEMS** Polymers in MEMS - Polimide - SU-8 - Liquid Crystal Polymer (LCP) - PDMS -PMMA - Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors, Actuators for Active 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 polymer and optical 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, Editor, " 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.	19EI6303	INDUSTRIAL DATA COMMUNICATION	3	0	0	3

Course Objective

1. Understand the fundamentals of data networks.
2. Interpret MODBUS and HART standards.
3. Impart knowledge about the importance of FIELD BUS and PROFIBUS.
4. Analyze the characteristics of interface and Ethernet.
5. Illustrate the use of wireless communication in various applications.

Unit	Description	Instructional Hours
I	**DATA NETWORK FUNDAMENTALS** ISO/OSI Reference model - TCP/IP Protocol Stack- EIA 232 interface standard – EIA 485 interface standard - Media access protocol: Command/response, CSMA/CD — IEEE 802.3 Ethernet standard Bridges –Routers – TCP/IP - Gateways – Standard ETHERNET Configuration.	9
II	**MODBUS AND HART** Evolution of industrial data communication standards - MODBUS:- Protocol structure, Function codes - HART communication protocol, Communication modes, HART Networks, HART commands, HART applications & Troubleshooting.	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 - 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: Appraise about MODBUS and HART protocol in networking
CO3: Understand the importance of FIELD BUS and PROFIBUS in networking.
CO4: Associate appropriate internetworking standards for data transfer.
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 – Behrouz Forouzan, "Data Communication & Networking", Tata McGraw Hill, Third edition, 2006.

REFERENCE BOOKS:

R1 - Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", PHI, Fifth Edition. 2011.
R2 – Lawrence, M. Thompson and Tim Shaw, "Industrial Data Communications", 5th Edition ISA Press, 2015.
R3 - Theodore S Rappaport, "Wireless Communication: Principles and Practice", PHI,2nd Edition, 2001.
R4 - William Stallings, "Wireless Communication & Networks", Prentice Hall of India, Second Edition, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6304	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 restoration and segmentation technique.
4. Analyze the wavelets and image reconstruction process.
5. Infer the image representation and Recognition technique.

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 RESTORATION AND SEGMENTATION** Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation-Morphological processing- erosion and dilation.	9
IV	**WAVELETS AND IMAGE COMPRESSION** Wavelets – Subband coding - Multiresolution expansions - Compression: Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression Standards.	9
V	**IMAGE REPRESENTATION AND RECOGNITION** Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Summarize the fundamentals of digital image processing.
CO2: Apply the spatial and multispectral enhancement techniques in an image.
CO3: Construct the segmentation algorithm for restoration of digital image.
CO4: Establish the image compression techniques.
CO5: Assess the image Representation and Recognition techniques.

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 2016.

REFERENCE BOOKS:

R1 - S.Jayaraman, E.Esakkirajan and T.Veerkumar, "Digital Image Processing" Tata McGraw Hill Education Private Ltd, 2009.
R2 - William K. Pratt, "Digital Image Processing: PIKS Scientific Inside", Wiley Student Edition, 2010.
R3- Munesh.C.Trivedi and Dr. Sanjay. M. Shah, "Digital Image Processing", Khanna publications, 2012.
R4 - Kenneth R Castleman "Digital Image Processing", Pearson education 2007.

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2. https://nptel.ac.in/courses/117/105/117105079/

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EI6305	INTRODUCTION TO SOFT COMPUTING	3	0	0	3

Course Objective

1. Basics of artificial neural network.
2. Concepts of modelling and control of neural and fuzzy control schemes
3. Impart knowledge of fuzzy set theory
4. Methods of modelling and control of fuzzy control schemes
5. Features of hybrid control schemes.

Unit	Description	Instructional Hours
I	**ARTIFICIAL NEURAL NETWORK** Review of fundamentals – Biological neuron, artificial neuron, activation function- single layer perceptron – Limitation – Multi layer perceptron – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, – Reinforcement learning.	9
II	**NEURAL NETWORKS FOR MODELING AND CONTROL** Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller- other neural nets – Neo cognition.	9
III	**FUZZY SET THEORY** Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions.	9
IV	**FUZZY LOGIC FOR MODELING AND CONTROL** Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Decision making logic – Defuzzification – Adaptive fuzzy systems - Design of Fuzzy logic control systems using MATLAB	9
V	**HYBRID CONTROL SCHEMES** Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the concepts of ANN, different features of fuzzy logic and their modelling, control aspects and different hybrid control schemes
CO2: Understand the basics of artificial neural network.
CO3: Remember the modelling and control of neural network
CO4: Remember on modelling and control of fuzzy control schemes.
CO5: Acquire knowledge on hybrid control schemes.

TEXT BOOKS:

T1 - Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood Cliffs, N.J., 1992.
T2 - Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 2000.

REFERENCE BOOKS:

R1 - Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc. 1989.
R2 - Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 1992.
R3-EthemAlpaydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)', MIT Press, Second Edition, 2010.

WEB REFERENCES:

1. https://nptel.ac.in/courses/127/105/127105006/
2. https://nptel.ac.in/courses/106/105/106105173/

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OPEN ELECTIVE

Programme	Course code	Name of the Course	L	T	P	C
B.E.	19EI6401	SMART SENSORS FOR ENGINEERING APPLICATIONS	3	0	0	3

Course Objective

1. Interpret the basic concepts of sensors and measurements.
2. Infer the basics of strain and pressure measurement
3. Summarize the concepts of motion and light radiation sensors.
4. Impart the working of heat and thermal sensor
5. Interpret the functions of electronic sensors.

Unit	Description	Instructional Hours
I	**MEASURING SYSTEM** Sensor Systems- Classification of sensors- Factors in making the measurements-accuracy, precision, resolution, repeatability, reproducibility, hysteresis, sensitivity, range, selection and standard of sensors – SI Units – Base units of SI - Errors in Measurement – Types of errors - Calibration techniques	9
II	**STRAIN AND PRESSURE MEASUREMENT** Resistance strain gauge, Piezoelectric pressure gauge, characteristics- Electronic circuits for strain gauge, Load cells Interferometer, Fibre optic methods- Pressure gauges, Aneroid Capacitance pressure gauge, Ionization gauge - Transducer Applications.	9
III	**MOTION AND RADIATION SENSORS** Motion Sensors: Capacitor plate sensor, inductive sensors, LVDT accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders. Light Radiation: Light flux, Photo sensors, Photomultiplier, Photo resistor and Photoconductors, Photodiodes, Phototransistors, Photovoltaic Devices, Fiber-optic applications	9
IV	**HEAT AND TEMPERATURE SENSORS** Heat and Temperature: Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, Thermistors, PTC thermistors, Thermostat, Bolometer, Pyroelectric detector.	9
V	**ELECTRONIC SENSORS** Proximity detectors: Inductive and capacitive, ultrasonic, photo beam detectors reed switch, magnet and Hall-effect units, doppler detectors, liquid level detectors, flow sensors, smoke sensors, Biosensor.	9
	Total Instructional Hours	**45**

Course Outcome

CO1:Describe the concept and characteristics involved in sensors and measurements.
CO2:Explain the methods for the measurement of strain and pressure.
CO3:Describe the methods of measurement for motion and radiation
CO4:Identify and select suitable measurement instruments for measuring heat and temperature.
CO5: Elaborate the functions of electronic sensors

TEXT BOOKS:

T1 - Doeblin. E. O., "Measurement Systems: Applications and Design", McGraw-Hill Publications., 2008.
T2 - Ian R Sinclair, "Sensors and Transducers", Third Edition, Newnes publishers, 2001.

REFERENCE BOOKS :

R1 - Patranabis. D., "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd, 2010.
R2 - Murthy. D. V. S., "Transducers and instrumentation", 2nd Edition, Prentice Hall of India Pvt. Ltd.,2010
R3 -Jack P Holman, "Experimental Methods for Engineers", Seventh Edition, McGraw Hill, USA, 2001.
R4 - Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son Ltd,2002.

WEB REFERENCES:

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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.Deshpandeand 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 Hallof 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 protocolstructure - 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 andHigh 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, NewDelhi, 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 PracticalHours **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

4. Apply the knowledge and skills which they have acquired on campus in a real-life work situation.
5. Create opportunities for practical, hands-on learning from practitioners in the students' field of study
6. 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 IV

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 -Fiberoptic 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 fiberCommunication - 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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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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PROFESSIONAL ELECTIVE IV

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 - NitaigourPremchand 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, BISAnd 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, AirHeat 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- Conceptsof 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 EmbeddedSystem",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.MazidiRollin 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.Lamarshand A.J.Baratta, "Introduction to Nuclear Engineering", 3rdEdition, 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.Glasstoneand 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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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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PROFESSIONAL ELECTIVE VI

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 - MichaelYastrebenetsky and Yuri Rozen, "Nuclear Power Plant Instrumentation and Control Systems for Safety and Security",IGI Global book series, 2014.

Chairman - BoS
EIE - HiCET

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGINEERING

Dean (Academics)
HiCET

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, Manmadeand 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 India2003.
T2- AmitaSinhal, "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 2000.

Chairman - BoS
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Chairman

Dean (Academics)
HiCET

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.

Chairman - BoS
EIE - HiCET

Dean (Academics)
HiCET

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 2021-2022

REGULATIONS 2019 & 2016

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

REGULATIONS 2019 -Amendment

SEMESTER I

21HE1101-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

21MA1103- 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

21PH1151-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

21CY1151- 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

21CS1151-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

21ME1152- 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

21HE2101-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

21MA2102-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

21PH2151-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

21CY2151-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	-	-

21EI2151-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

21CS2152-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

21ME2001-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

SEMESTER III

19MA3102-Fourier Analysis and Transforms

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

19EI3201-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	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	-	-	2	-	-	2	-	-	-	3	2
CO3	3	2	--	-	-	-	-	-	-	-	-	-	3	3
CO4	3	2	2	3	-	-	1	-	-	-	-	2	3	3
CO5	1	3	3	3	-	-	1	-	-	1	-	2	3	3
Avg	2.6	2	1.6	1.2	-	0.2	0.4	-	0.4	0.2	-	0.8	3	2.6

19EI3202-Sensors and Transducers

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	-	-	-	-	1	3	2
CO3	-	1	2	2	-	-	1	-	-	-	-	1	2	3
CO4	3	-	2	-	-	-	1	-	-	1	-	2	3	3
CO5	1	3	3	3	1	-	1	-	-	1	-	2	3	3
Avg	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

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	P O6	P O7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	1	1	1	-	-	-	-	-	1	2	3
CO2	2	3	3	1	1	-	-	-	-	-	-	1	3	3
CO3	2	3	2	2	1	1	-	-	-	-	-	1	2	3
CO4	2	3	1	1	2	2	-	-	1	-	2	1	2	2
CO5	3	3	1	1	1	3	-	-	1	-	-	1	1	3
Avg	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

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
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2	3
CO3	3	2	3	-	2	-	-	-	-	-	-	1	2	3
CO4	2	2	3	2	-	-	-	-	1	-	1	1	2	3
CO5	3	2	1	-	2	-	1	-	1	-	-	2	3	3
Avg	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

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	-	2	-	-	1	-	-	3	-	2	-	2	3
CO3	3	-	3	-	-	2	-	-	3	-	1	-	2	3
CO4	3	-	1	-	-	3	-	-	3	-	-	-	-	2
CO5	3	-	-	-	-	-	-	-	3	-	-	-	3	3
Avg	2.8	0.4	1	-	-	1	-	-	3	-	0.5	-	1.4	2.8

19EI3002-Sensors and Transducers 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	3
CO2	2	3	3	3	-	-	-	-	3	-	-	-	3	3
CO3	1	3	3	-	-	-	-	-	3	-	-	-	1	3
CO4	2	1	3	2	-	-	1	-	3	-	-	-	3	2
CO5	1	-	3	-	3	-	1	-	3	-	-	3	3	2
Avg	1.8	1.6	3	0.4	0.5	-	0.4	-	3	-		0.5	2.6	2.6

SEMESTER IV

19MA4101-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

19EI4201-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	2	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	3	2
CO4	3	3	3	3	1	1	1	-	1	-	-	2	3	2
CO5	3	2	2	2	1	-	-	-	-	-	-	2	3	3
Avg	2.2	2.6	2.6	2.6	1	0.4	0.6	-	0.4	-	-	1.4	3	2.6

19EI4202-Integrated Circuits and Its 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	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	-	1	2	2	-	-	-	-	-	-	-	-	-	3
CO4	3	-	2	-	-	-	-	-	-	-	-	2	-	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3
Avg	2.5	2	2.2	2.5	-	2	-	-	-	-	-	2	3	2.6

19EI4203-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	-	-	-	-	-	-	-	-	-	-	2	-	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3
Avg	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	1.2	2.6

19EI4251-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

19EI4001-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	2	2	-	2	-	-	-	-	3	-	-	2	-	3
CO3	3	2	-	2	-	-	-	-	3	-	-	-	-	3
CO4	3	-	-	-	-	-	-	-	3	-	-	-	-	2
CO5	3	-	-	-	-	-	-	-	3	-	-	2	3	3
Avg	2.8	0.8	-	0.8	-	-	-	-	3	-	-	1.2	0.6	2.8

19EI4002-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

19EI5201 -Industrial Instrumentation – II

PO& PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	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	3	3
CO4	3	1	1	2	1	-	-	-	-	1	-	1	3	3
CO5	3	1	3	2	1	-	-	-	-	1	-		3	3
Avg	3	1.6	2	2	1	-	-	-	-	0.4	-	0.6	3	3

19EI5202 – 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	-	-	-	-	-	-	3	3
CO3	-	1	2	2	2	2	-	-	-	-	-	-	2	3
CO4	3	-	2	-	-	-	-	-	-	-	-	2	3	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	3	3
Avg	2	1.2	2.2	1	0.4	0.4	-	-	-	-	-	0.8	2.8	3

19EI5203 - 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	3	2
CO2	3	-	2	-	-	2	1	-	-	-	-	1	3	2
CO3	2	1	2	2	-	-	1	-	-	-	-	1	2	3
CO4	3	-	2	-	-	-	1	-	-	-	-	2	2	3
CO5	1	3	3	3	1	-	1	-	-	-	-	2	2	3
Avg	2.4	1.2	2.2	1	0.4	0.4	1	-	-	-	-	1.4	2.4	2.6

19EI5204 - 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	-	-	-	-	-	-	3	3
CO3	-	1	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	-	2	-	-	-	-	-	-	-	-	2	2	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	3	3
Avg	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	2.6	3

19EI5251 - Programmable Logic Controllers and SCADA

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

19EI5001 - 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	-	-	1	-	-	3	-	3	-	-	2	-	3
CO3	3	2	3	2	-	-	3	-	3	-	-	3	-	2
CO4	3	-	-	1	2	-	3	-	3	-	-	-	2	2
CO5	3	-	-	-	-	-	3	-	3	-	-	2	3	3
Avg	2.8	0.8	0.6	0.8	0.4	-	3	-	3	-	-	1.8	1	2.8

19EE5002-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	3	1	3	-	-	-	3	-	3	-	-	-	3	3
CO2	2	3	3	3	-	-	3	-	3	-	-	-	3	3
CO3	1	3	3	-	-	-	3	-	3	-	-	1	1	3
CO4	2	1	3	2	-	-	3	-	3	-	-	1	3	2
CO5	1	-	3	-	3	-	3	-	3	-	-	3	3	2
Avg	1.8	1.6	3	1	0.6	-	3	-	3	-	-	1	2.6	2.6

19EI5301 - 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

19EI5302 - Communication 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	2	2	2	1	1	1	3	1	1	-	1	2	2
CO2	3	2	2	2	1	1	1	3	1	1	-	-	2	2
CO3	3	3	3	3	1	1	1	3	1	3	-	1	2	2
CO4	3	3	3	3	-	-	1	3	1	3	1	-	2	2
CO5	3	2	2	2	1	-	1	3	1	1	-	-	2	2
Avg.	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

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	1	-	1	1	1	-	1	1	-	1	2
CO2	3	2	2	2	-	1	1	-	1	-	-	-	1	2
CO3	3	3	3	3	1	1	1	-	-	-	1	-	1	2
CO4	2	2	1	2	1	1	1	-	-	-	-	-	1	2
CO5	3	3	3	2	-	-	1	1	1	1	1	1	1	2
Avg.	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

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	-	-	-	-	1	-	-	-	-	1	2	3
CO2	3	-	2	-	-	1	-	-	1	-	-	-	2	3
CO3	3	-	2	-	2	1	-	-	-	-	2	1	2	3
CO4	3	-	2	-	-	-	-	-	-	-	-	1	2	-
CO5	3	-	2	-	1	-	-	-	1	-	-	-	2	-
Avg	3	0.2	1.6	-	0.6	0.4	0.2	-	0.4	-	0.4	0.6	2	1.8

19EI5304 - Operating 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	2	-	-	-	-	1	3	-	3	3	3
CO2	3	2	3	2	3	-	1	-	-	3	-	1	3	3
CO3	3	3	2	2	3	-	-	-	1	3	-	3	3	3
CO4	3	3	3	2	3	-	-	-	1	3	-	3	3	3
CO5	3	3	2	2		-	1	-	-	3	-	1	3	3
Avg	3	2.6	2.6	2	1.8	-	0.4	-	0.6	3	-	2.2	3	3

SEMESTER VI

19EI6201 – 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	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	-	1	2	2	2	2	-	-	-	-	-	-	-	3
CO4	3	-	2	-	-	-	-	-	-	-	-	2	-	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	-	3
Avg	2	1.2	2.2	1	0.4	0.8	-	-	-	-	-	0.8	1.2	2.6

19EI6202- 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

19EE6251 -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	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	-	1	2	2	-	-	-	-	-	-	-	-	-	3
CO4	3	-	2	-	-	-	-	-	1	-	-	2	-	3
CO5	1	3	3	3	-	-	-	-	1	1	-	2	-	3
Avg	2	1.8	2.2	1	-	0.4	-	-	0.4	0.2	-	0.8	1.2	2.6

19EI6181 – Industrial Safety 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	-	-	-	-	-	-	-	-	-	3	2
CO2	3	-	2	-	-	2	-	-	-	-	-	-	3	2
CO3	-	1	2	2	-	-	-	-	-	-	-	-	1	3
CO4	3	-	2	-	-	-	-	-	-	-	-	2	1	3
CO5	1	3	3	3	-	-	-	-	-	-	-	2	1	3
Avg	2	1.2	2.2	1	-	0.4	-	-	-	-	-	0.8	1.8	2.6

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	2
CO3	2	3	3	1	2	-	3	-	3	-	-	2	3	3
CO4	2	2	3	2	3	-	3	-	3	-	-	3	3	3
CO5	2	2	3	1	2	-	3	-	3	-	-	3	3	3
Avg	2.4	2.2	3	1.4	1.8	-	3	-	3	-	-	2	2.8	2.8

19EI6002 - 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	-	-	-	-	-	2	-	3	-	-	2	-	3
CO3	3	-	3	-	-	-	2	-	3	-	-	-	-	3
CO4	3	-	-	-	2	-	2	-	3	-	-	-	-	2
CO5	3	-	-	-	-	-	2	-	3	-	-	2	3	3
Avg	2.8	0.4	1	0.8	0.4	-	2	-	3	-	-	1.2	0.6	2.8

19EI6301 - 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	2	2	-	1	-	1	-	-	-	-	1	3	2
CO2	3	-	2	-	-	-	1	-	-	-	-	1	3	2
CO3	-	1	2	2	-	-	1	-	-	-	-	1	2	3
CO4	3	-	2	-	-	-	1	-	-	-	-	2	1	3
CO5	1	3	3	3	1	-	1	-	-	-	-	2	1	3
Avg	2	1.2	2.2	1	0.4	0.4	1	-	-	-	-	1.4	2	2.6

19EI6302 - 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	-	-	-	-	-	-	-	-	3	-	3	3	3
CO2	3	-	2	-	3	-	-	-	-	3	-	3	3	3
CO3	3	3	3	2	3	-	-	-	-	3	-	3	3	3
CO4	3	3	1	3	3	-	-	-	-	3	-	3	3	3
CO5	3	3	2	3		-	-	-	-	3	-	3	3	3
Avg	3	3	2	2	3	-	-	-	-	3	-	3	3	3

19EI6303- Industrial Data Communication

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	3

CO2	3	2	2	2	1	-	-	-	-	-	-	-	3	2
CO3	3	2	2	2	1	-	-	-	-	-	1	-	2	3
CO4	3	3	1	2	1	-	-	-	1	-	1	-	2	3
CO5	3	1	3	2	1	-	-	-	1	-	1	-	3	3
Avg	3	2	2	2	1	-	-	-	0.4	-	0.6	-	2.6	3

19EI6304 - 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	3	3	2	2	-	2	-	1	-	-	3	3	3
CO3	3	3	2	3	2	-	2	-	-	-	-	3	3	2
CO4	3	3	3	3	2	-	2	-	-	1	-	3	3	3
CO5	3	3	3	3	2	-	2	-	-	1	-	2	3	3
Avg	3	3	2.8	2.8	2	-	2	-	0.2	0.4	-	2.8	3	2.8

19EI6305 - Introduction to Soft Computing

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	2	2	-	-	-	1	-	1	-	3	2	3
CO2	2	2	2	2	-	-	-	1	-	1	-	3	3	3
CO3	3	2	2	2	-	1	-	1	-	1	-	2	3	3
CO4	3	3	3	2	-	-	1	1	-	1	-	2	3	3
CO5	3	2	2	2	-	-	-	1	-	1	-	3	3	3
AVg.	2.6	2.2	2.2	2	-	0.2	0.2	1	-	1	-	2.6	2.8	3

REGULATIONS 2016

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

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

REGULATIONS 2019 Amendment & 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	21HE1101 - 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
		21MA1103- Calculus and Differential Equations	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	2
		21PH1151 - Applied Physics	3	2.2	2	1.6	2	1.3	-	-	-	-	-	1	2.4	2.4
		21CY1151 -Chemistry for Engineers	3	2	2	2	2	1	1	-	-	-	-	1	1	1
		21CS1151 - Python Programming and Practices	2	3	3	-	2	-	-	-	2	-	-	2	2	2
		21ME1152 - Engineering Drawing	2.8	3	2.6	1	1	2	1	-	-	1	1	1	1	1.4
		21HE1071 - Language Competency														

		Enhancement Course-I														
		21HE1072-Career Guidance Level-I														
		21HE1073-Entrepreneurship & Innovation														
	II	21HE2101 - 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
		21MA2102 - Complex Variables and Transform Calculus	3	3	3	2.6	2.8	-	-	-	-	-	-	2	1.8	1.8
		21PH2151 - Material Science	3	2.4	1.2	1.8	1.8	1	2	-	-	-	-	1	2	2.2
		21CY2151 - Environmental Studies	2	1	1.7	-	-	1	2	3	2	-	-	2	-	-
		21EI2151 - Circuit Theory	2.6	2.8	0.6	0.8	1	-	-	0.4	0.2	-	1.2	-	2.8	2.6
		21CS2152 - Essentials of C and C++ Programming	3	3	2	2	3	-	-	1	1	-	2	2	2.2	3
		21ME2001 - Engineering Practices	3	-	3	-	3	-	-	-	1	-	-	-	1	2
		21HE2071 - Language Competency Enhancement Course-II														
		21HE2072-Career Guidance Level-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	2.2	2.8	1.8	1.2	1.2	1.4	-	-	0.4	-	0.4	1	2	2.8

		Engineering														
		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 -	2.4	1.2	2.2	1	0.4	0.4	1	-	-	-	-	1.4	2.4	2.6

		Microprocessors and Microcontrollers														
		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	2.8	0.4	1	0.8	0.4	-	2	-	3	-	-	1.2	0.6	2.8

		Instrumentation Laboratory														
		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