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. ELECTRICAL AND ELECTRONICS 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.

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EEE - HiCET

HINDUSTHAN ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

VISION AND MISSION OF THE DEPARTMENT

VISION

To manifest itself as a valuable global resource for industry and society with strong foundation. Abetting the students with innovative ethical and creative talents of endeavoring young professionals in Electrical and Electronics Engineering.

MISSION

M1. Educate the students to acquire knowledge in recent advancement of Electrical and Electronics Engineering and prepare the students for Professional career and higher studies.

M2. Inculcate the students to develop innovation for the societal needs through research oriented teaching and creative skill enhancement training.

M3. Enunciate the students with better skills to meet the challenges of the technical world and intensify the skills towards the practical approach

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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. Graduates will acquire the knowledge of design, performance & testing of static & dynamic Electrical Machines, Electrical Drives, Power Electronics applicable in core and related fields.

PSO 2. Graduates will attain knowledge and acquire skills by applying modern software tools for design, simulation and analysis of Electrical Systems to successfully adapt in multi-disciplinary environments.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1. Graduate will be able to execute the principles of basic science, mathematics and engineering fundamentals necessary to formulate, solve and analyze engineering problems.

PEO 2. Graduate will be able to accrete the knowledge for pursuing advanced degrees in Engineering, Science, Management, Research and Development.

PEO 3. Graduate will be able to effectuate professionalism, leadership qualities, self and continuous learning and concern for environment to meet the societal needs.

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CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

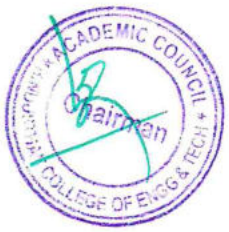
CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. ELECTRICAL AND ELECTRONICS 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	Name of the Course	Course 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 & 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										
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**



SEMESTER II

S.No	Course Code	Name of the Course	Course 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 & 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	21CS2152	Essentials of C & C++ Programming	ES	2	0	2	3	50	50	100
6	21EE2151	Circuit Theory	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	Name of the Course	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3102	Fourier Analysis and Transforms	BS	3	1	0	4	25	75	100
2	19EE3201	Electronic Devices and Circuits	PC	3	1	0	4	25	75	100
3	19EE3202	Electrical Machines I	PC	3	0	0	3	25	75	100
4	19EE3203	Field Theory	PC	3	0	0	3	25	75	100
THEORY & LAB COMPONENT										
5	19EE3251	Electrical and Electronic Measurements	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19EE3001	Electronic Devices and Circuits Laboratory	PC	0	0	3	1.5	50	50	100
7	19EE3002	Electrical Machines Laboratory I	PC	0	0	3	1.5	50	50	100
MANDATORY										

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 Credits	**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	19EE4201	Electrical Machines II	PC	3	1	0	4	25	75	100
3	19EE4202	Integrated Circuits and its Applications	PC	3	0	0	3	25	75	100
4	19EE4203	Digital Signal Processing	PC	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19EE4251	Digital Logic Circuits	PC	2	1	2	4	50	50	100
PRACTICAL										
6	19EE4001	Electrical Machines Laboratory II	PC	0	0	3	1.5	50	50	100
7	19EE4002	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	19EE5201	Design of Electrical Machines	PC	3	1	0	4	25	75	100
2	19EE5202	Renewable and Non-Renewable Energy Sources	PC	3	0	0	3	25	75	100
3	19EE5203	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100
4	19EE5204	Transmission and Distribution	PC	3	0	0	3	25	75	100
5	19EE53XX	**Professional Elective -I**	PE	3	0	0	3	25	75	100

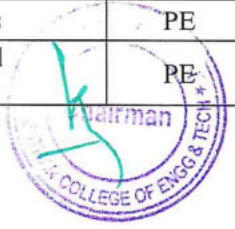
THEORY WITH LAB COMPONENT										
6	19EE5251	Control Systems Engineering	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19EE5001	Control and Instrumentation Laboratory	PC	0	0	3	1.5	50	50	100
8	19EE5002	Microprocessors and Microcontrollers Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	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	19EE6181	Industrial Safety Management	HS	3	0	0	3	25	75	100
2	19EE6201	Power Electronics	PC	3	0	0	3	25	75	100
3	19EE6202	Power System Analysis	PC	3	0	0	3	25	75	100
4	19EE63XX	**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 COMPONENTS										
6	19EE6251	Embedded Systems	PC	2	0	2	3	50	50	100
PRACTICALS										
7	19EE6001	Power Electronics Laboratory	PC	0	0	3	1.5	50	50	100
8	19EE6002	Control Wiring and Circuit Design Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	19EE6701	Internship/Industrial 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	19EE5301	Fibre Optics and Laser Instruments	PE	3	0	0	3	25	75	100
2	19EE5302	Biomedical Instrumentation	PE	3	0	0	3	25	75	100
3	19IT5331	Fundamentals of Java Programming	PE	3	0	0	3	25	75	100
4	19EE5304	Computer Networks	PE	3	0	0	3	25	75	100
5	19EE5305	Control of Electrical Apparatus	PE	3	0	0	3	25	75	100



PROFESSIONAL ELECTIVE II										
1	19EE6301	Industrial Automation	PE	3	0	0	3	25	75	100
2	19EE6302	Electric Vehicle Mechanics and Control	PE	3	0	0	3	25	75	100
3	19EE6303	Flexible AC Transmission Systems	PE	3	0	0	3	25	75	100
4	19EE6304	Electrical Estimation and Costing	PE	3	0	0	3	25	75	100
5	19EE6305	Principles of Robotics	PE	3	0	0	3	25	75	100

OPEN ELECTIVE									
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	19EE6401	Fundamental of Solar Photovoltaic Systems	3	0	0	3	25	75	100

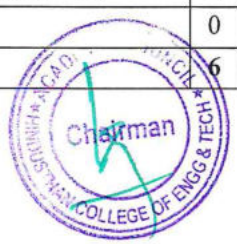
For the students admitted during the academic year 2018-2019 and onwards

SEMESTER VII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16EE7201	Solid State Drives	3	0	0	3	25	75	100
2	16EE7202	Electrical Energy Utilization and Conservation	3	0	0	3	25	75	100
3	16EE7203	Power System Operation and Control	3	0	0	3	25	75	100
4	16EE73XX	Professional Elective – III	3	0	0	3	25	75	100
5	16EE73XX	Professional Elective - IV	3	0	0	3	25	75	100
6	16XX74XX	Open Elective - II	3	0	0	3	25	75	100
PRACTICALS									
7	16EE7001	Drives and Control Laboratory	0	0	4	2	50	50	100
8	16EE7701	Technical Seminar	0	0	4	2	0	100	100
9	16EE7702	Industrial Training / Internship	0	0	0	1	0	100	100
		Total Credits:	**18**	**0**	**8**	**23**	**200**	**700**	**900**

SEMESTER VIII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16EE83XX	Professional Elective – V	3	0	0	3	25	75	100
2	16EE83XX	Professional Elective - VI	3	0	0	3	25	75	100
3	16EE8901	Project Work	0	0	20	10	100	100	200
Total			**6**	**0**	**20**	**16**	**150**	**250**	**400**



LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
ELECTIVE III									
1	16EE7301	Microcontroller Based System Design	3	0	0	3	25	75	100
2	16EE7302	Micro Electro Mechanical Systems	3	0	0	3	25	75	100
3	16EE7303	Solar Photo Voltaic Fundamentals & Applications	3	0	0	3	25	75	100
4	16EE7304	Professional Ethics	3	0	0	3	25	75	100
ELECTIVE IV									
1	16EE7305	Advanced Control Theory	3	0	0	3	25	75	100
2	16EE7306	Intelligent Control Techniques	3	0	0	3	25	75	100
3	16EE7307	Communication Engineering	3	0	0	3	25	75	100
4	16EE7308	Special Electrical Machines	3	0	0	3	25	75	100
ELECTIVE V									
1	16EE8301	Application of Power Electronics for Renewable Energy Systems	3	0	0	3	25	75	100
2	16EE8302	Biomedical Instrumentation	3	0	0	3	25	75	100
3	16EE8303	Power System Dynamics	3	0	0	3	25	75	100
4	16EE8304	Energy Management and Electrical Safety	3	0	0	3	25	75	100
ELECTIVE VI									
1	16EE8305	Computer Aided Design of Electrical Apparatus	3	0	0	3	25	75	100
2	16EE8306	Industrial Electronics	3	0	0	3	25	75	100
3	16EE8307	High Voltage Direct Current Transmission	3	0	0	3	25	75	100
4	16EE8308	Total Quality Management	3	0	0	3	25	75	100

OPEN ELECTIVE									
S.No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	16EE7401	Lab VIEW for Engineering Applications	3	0	0	3	25	75	100

(L – Lecture, T –Tutorial, P – Practical, C – Credit, CIA – Continuous Internal Assessments, ESE – End Semester Examinations)

 # Continuous Internal Assessment (CIA) only.

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**NCM (Non-Credit Mandatory Course)

$ Audit Course

(Note: Z Stands for semester, students can't choose twice the course)

Legends

BS – Basic Science Course

HS – Humanities and Social Science including Management Course

ES – Engineering Science Course

PC – Professional Core Course

PE – Professional Elective Course

OE – Open Elective Course

VA – Value Added Course

MC – Mandatory Course

EEC – Employability Enhancement Courses

CIA – Continues Internal Assessment

ESE – End Semester Examinations

CREDIT DISTRIBUTION

R2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	26	25	23	24	25	25	23	16	**187**

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 **Dean – Academics** **Principal**

HINDUSTHAN ACADEMIC COUNCIL Chairman HINDUSTHAN COLLEGE OF ENGG & TECH

Dr.MAGUDESWARAN P.N
Dean-Academics
Hindusthan College of
Engineering and Technology
COIMBATORE-641 032.

PRINCIPAL
Hindusthan College Of Engineering & Technology
COIMBATORE - 641 032.

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 Objectives

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

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

Course Outcomes

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

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate", Cambridge University Press, 2016
T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2021.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.
R2- Raymond Murphy, "English Grammar in Use"- 4th edition Cambridge University Press, 2004
R3- Kamalesh Sadanan "A Foundation Course for the Speakers of Tamil-Part-I &II", Orient Blackswan, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21MA1103	CALCULUS AND DIFFERENTIAL EQUATIONS (COMMON TO EEE, ECE, EIE AND BIO MEDICAL)	3	1	0	4

Course Objectives

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 Outcomes

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 Objectives

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

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

Course Outcomes

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	2	0	2	3

Course Objectives

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 strategiesfor developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert acard in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;variables, expressions, statements, tuple assignment, precedence of operators, comments;modules and functions, function definition and use, flow of execution, parameters and arguments. **Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance B.E.tween two points.**	7+2
III	**CONTROL FLOW, FUNCTIONS** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: returnvalues, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. **Illustrative programs: square root, gcd, exponentiation, sum an array of numB.E.rs, linear search, binary search.**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; **Illustrative programs: selection sort, insertion sort, merge sort, histogram.**	3+6
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages. **Illustrative programs: word count, copying file contents.**	5+4
	Total Instructional Hours	**45**

Course Outcomes

- 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 3.2, Network Theory Ltd., 2017.

T2 - S.Annadurai, S.Shankar, I.Jasmine Selvakumari Jeya, M.Revathi, Fundamentals of Python Programming, McGraw Hill Publications, 2021.

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 Pythonl, 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 Objectives

1. Understand the Engineer's language of expressing complete details about objects and construction of conics and special curves.
2. Understand the orthogonal projections of straight lines and planes.
3. Understand the projections of simple solid objects in plan and elevation.
4. Understand the projection of sections of solids and development of surfaces of solids.
5. Understand the isometric projections and the perspective views 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.	6
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 object method (First angle projections only).	6
III	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane and objects inclined to both the planes by rotating object method.	6
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. Intersection of solids-cylinder vs cylinder.	6
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. Perspective projection of solids in simple position using visual ray method.	6
	Total Instructional Hours	**30**

Course Outcomes

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- 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

- ✓ To enhance student language competency
- ✓ To identify individual students level of communication skills
- ✓ To develop English Vocabulary and spoken communication skills.
- ✓ To revive the fundamentals of English Grammar.

Unit	Description	Instructional Hours
I	**Listening** Language of Communication- English listening- Hearing Vs Listening- Verbal and Non-verbal communication – Listening strategies-Sounds of English.	3
III	**Reading** English Language Enhancement – Indianism in English – Role of Reading in effective communication – Techniques for good reading (skimming and scanning) Reading articles from newspaper, magazine. Reading and interpreting a passage.	3
III	**Speaking** Common errors in Pronunciation – Signposts in English (Role play) – Public Speaking skills – Social Phobia – Eliminating fear – Common etiquette of speaking - Debate and Discuss.	3
IV	**Writing** Writing genre – Enhancement of basic English Vocabulary; Parts of Speech, Noun, Verbs, and Tenses – combining sentences, sentence formation and completion.	3
V	**Art of Communication** Communication process – Word building and roleplay – Exercise on English Language for various situations through online and offline activities.	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.

REFERENCE BOOKS :

1. Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
2. Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
3. High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
4 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.	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

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=PLmP9QrmTNPqBEvKbMSXvwlwn7fdnXe

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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 Objectives

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 Outcomes

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

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 BM)	3	1	0	4

Course Objectives

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 (with out proof) – Solution of linear ODE of second order with constant coefficients using Laplace transforms.	12
	Total Instructional Hours	**60**

Course Outcomes

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, "Engineering 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 Objectives

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

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

Course Outcomes

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 Objectives

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	**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 –	6
II	**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
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+9
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry-Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones-**Determination of pH in B.E.verages.**	6+3
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)-GIS-remote sensing-role of information technology in environment and human health-**Estimation of heavy metal ion (copper) in effluents by EDTA.**	6+3
	Total Instructional Hours	**45**

Course Outcomes

CO1: Develop an understanding of different natural resources including renewable resources.
CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.
CO3: Understand the causes of environmental pollution and hazards due to manmade activities.
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 - Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2021.

T2 – S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018.

REFERENCES:

R1 - Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015.

R2 - G.Tyler Miller, Jr and Scott E. Spoolman "Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

R3 - Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21CS2152	ESSENTIAL OF C AND C++ PROGRAMMING	2	0	2	3

Course Objective

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

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

Course Outcomes

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

TEXT BOOKS:

T1 - E.Balagurusamy, "Programming in ANSI C", 7th Edition, McGraw Hill Publication, 2016.
T2 - E.Balagurusamy, "Object Oriented Programming with C++", 7th Edition, McGraw Hill Publication, 2017.

REFERENCE BOOKS:

R1 - Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
R2 - RohitKhurana, "Object Oriented Programming with C++", Vikas Publishing, 2nd Edition, 2016.
R3 - B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	21EE2151	CIRCUIT THEORY	2	0	2	3

Course Objective

1. Understand electric circuits and solve complex circuits.
2. Impart knowledge on various network theorems in DC circuits.
3. Provide knowledge on resonance phenomenon and analyze coupled circuits.
4. Impart knowledge on transient response to RL,RC and RLC circuits.
5. Understand the concepts of three phase circuits and three phase power measurement.

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	**30+15**

Course Outcomes

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: Evaluate the three phase power measurement in balanced circuits.

TEXT BOOKS:

T1 William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 8th edition, New Delhi, 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, Tata McGraw-Hill, 2013.

R2 Chakrabarti A, "Circuit Theory - Analysis and Synthesis Dhanpat 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)

CIVIL AND MECHANICAL ENGINEERING PRACTICES

S.No	Description of the Experiments
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)

ELECTRICAL ENGINEERING PRACTICES

S.No	Description of the Experiments
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 Outcomes

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	VALUE ADDED COURSE – II: LANGUAGE COMPETENCY ENHANCEMENT COURSE- II	0	0	2	1

(COMMON TO ALL BRANCHES)

Course Objective

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

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

Course Outcome

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

REFERENCE BOOKS :

1. Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
2. Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
3. High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
4. **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

NumB.E.r 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

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)

SYLLABUS

SEMESTER III

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.	19EE3201	ELECTRONIC DEVICES AND CIRCUITS (*COMMON TO EIE AND EEE*)	3	1	0	4

Course Objectives

1 call the basics about the electronic devices.
2 erpret the structure, operation and characteristics of transistors.
3 alyze various configurations of BJT amplifiers.
4 er 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 amplifiers, 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 Outcomes

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

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.
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.	19EE3202	ELECTRICAL MACHINES I	3	0	0	3

Course Objectives

1. Recall the usage of magnetic materials in magnetic-circuits and their properties.
2. Familiarize the constructional details, the principle of operation, prediction of performance, the methods of testing the transformers.
3. Explains the working principles of electrical machines using the concepts of electromechanical energy conversion principles
4. Practice the working principles of DC machines as Generator types, and their no-load / load characteristics.
5. Estimate the various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance, starting methods and speed control of DC motors

Unit	Description	Instructional Hours
I	**MAGNETIC CIRCUITS AND MAGNETIC MATERIALS** Magnetic circuits - Flux linkage, Inductance and energy - Statically and Dynamically induced EMF - Torque – Properties of magnetic materials, Hysterisis and Eddy Current losses - AC excitation, introduction to permanent magnets-Transformer as a magnetically coupled circuit.	9
II	**TRANSFORMERS** Construction and Working - Parts of a Transformer - Emf equation - Transformation ratio - Ideal and Practical Transformer on No load and Load - Phasor diagrams - Equivalent circuit parameters - Losses and Efficiency - Tests: Open circuit and Short circuit – Sumpner's test – Condition for maximum efficiency and All day Efficiency – Auto transformer: Construction and theory – Three phase transformer and connections – Applications.	9
III	**ELECTROMECHANICAL ENERGY CONVERSION** Electro Mechanical energy conversion - Force and Torque equations in magnetic system -Energy in magnetic field system - Field energy and Co-energy - Singly and multiply excited magnetic field systems.	9
IV	**D.C GENERATORS** Construction - Principle of operation - Types of D.C Armature windings - EMF equations Types of D.C Generators - Losses in D.C Machine – Principles of Armature reaction and commutation - Methods of improving commutation- Characteristics of DC Generators - Applications.	9
V	**D.C MOTORS** Principle and Working of D.C Motors - Types of DC Motors - Back emf - Equations – Voltage , Power, Speed and Torque - Efficiency - D.C Motor characteristics – Applications. Speed control of DC motors - Necessity of starters - three point and four point starter – Testing of D.C Machines - Swinburne's test and Brake test.	9
	Total Instructional Hours	**45**

Course Outcomes

CO1:Describe the coupled coil calculate the self and mutually induced emf
CO2:Analyze the operation of transformer in different loading condition
CO3:Explain the concept of field energy and co-energy in single and multiple excited systems
CO4:Demonstrate the construction of D.C machines and operation of DC Generator
CO5:Derive the performance equation of D.C motor under various load condition

TEXT BOOKS:

T1 Nagrath I. J and Kothari D. P. "Electric Machines", Fourth Edition, Tata McGraw Hill Publishing Company Ltd, 2010

T2 B.L Thereja "A Text Book of Electrical Technology", Volume II, S.Chand publications, 2006

REFERENCE BOOKS:

R1 Rohit Mehta & V K Mehta., 'Principles of Electrical Engineering', S. Chand Publishing, 2003.

R2 Syed A. Nasar, "Electric Machines and Power Systems", Volume-I, McGraw Hill International Edition , January 1995.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE3203	FIELD THEORY	3	0	0	3

Course Objectives

1. Understand the basic concepts in Electrostatics
2. To acquire a complete knowledge in Electrostatics.
3. Recognize the concepts in magneto statics
4. Understand the concepts of Electro Dynamic Fields
5. To know the properties and concepts of Electromagnetic waves

Unit	Description	Instructional Hours
I	**ELECTROSTATICS – I** Electrostatic fields – Introduction to various coordinate Systems(Cartesian Coordinate, Polar Coordinates) – Vector fields –Vector Calculus Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges	9
II	**ELECTROSTATICS – II** Potential due to point charge –Electric Field Intensity- Electric field and equipotential points, Uniform and Non-Uniform field– Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.	9
III	**MAGNETOSTATICS** Magnetic field intensity (H) - Lorentz force – Biot–Savart's Law - Ampere's Circuit Law – point form of Ampere's Circuital Law– H due to straight conductors, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization,– Boundary conditions, scalar and vector potential, Magnetic force, Torque,-Inductance,- Energy density, Applications.	9
IV	**ELECTRODYNAMIC FIELDS** Self Inductance and Mutual Inductance - Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current -Maxwell's equations (differential and integral form) Relation between field theory and circuit theory –Applications	9
V	**ELECTROMAGNETIC WAVES** Electromagnetic waves propagation concepts – Plane Electromagnetic wave Equation – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and, conductors and Dielectrics – Velocity, Wave Length, Intrinsic Impedance and skin depth - Poynting Theorem	9
	Total Instructional Hours	**45**

Course Outcomes

CO1	Apply the Vector calculus application in Electromagnetics
CO2	Analyse the concepts of Electromagnetics
CO3	Evaluate the concepts of Magnetostatics
CO4	Analyse the propagation of plane Electromagnetic wave
CO5	Compare the concepts of Plane wave reflection,refraction and penetration

TEXT BOOKS:

T1 Mathew N.O.Sadiku, 'Principles of Electromagnetics',4 th Edition ,Oxford University Press Inc.First India edition, 2009

T2 K.A. Gangadhar, P.M. Ramanthan ' Electromagnetic Field Theory (including Antennaes and wave propagation', 16th Edition, Khanna Publications, 2007.

REFERENCE BOOKS:

R1 Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

R2 William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.

R3 Kraus and Fleish, "Electromagnetics with Applications" Fifth Edition, McGraw Hill International Edition,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE3251	ELECTRICAL AND ELECTRONIC MEASUREMENTS (*COMMON TO EIE AND EEE*)	2	0	2	3

Course Objectives

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	**30+15**

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.
R4 - David A Bell, "Electronic Instrumentation and Measurements", Oxford Pubilisher, Second Edition, 2010

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE3001	ELECTRONIC DEVICES AND CIRCUITS LABORATORY (*COMMON TO EIE AND EEE*)	0	0	3	1.5

Course Objectives

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 Outcomes

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 Engineeringl, 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.	19EE3002	ELECTRICAL MACHINES LABORATORY I	0	0	3	1.5

Course Objectives

1. Expose the students to operate DC machines.
2. Explore the operation and speed control of DC motor.
3. Interpret the operation and performance of single phase transformer.

EXPT.NO	Description of the Experiments
1.	Open circuit and load characteristics of DC shunt generator- critical resistance.
2.	Open circuit and load characteristics of DC compound generator
3.	Load test on DC shunt motor.
4.	Load test on DC series motor.
5.	Speed control of DC shunt motor.
6.	Swinburne's test.
7.	Load test on single phase transformer
8.	Open circuit and short circuit tests on single phase transformers.
9.	Sumpner's test on single phase transformer.
10.	Separation of no load losses in single phase transformer.
11.	Study of DC motor starters and three phase transformers connections.
	Total Practical Hours 45

Course Outcomes

- CO1 Ability to operate the DC generators and motors.
- CO2 Ability to choose the type of DC machine for specific applications.
- CO3 Determine the performance characteristics of DC motor by conducting direct and indirect tests.
- CO4 Ability to model the transformer and their application to power system.
- CO5 Determine the performance characteristics of DC shunt and Compound generator by conducting load tests.

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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
I	**BASIC FEATURES AND FUNDAMENTAL PRINCIPLES** Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.	4
II	**FUNDAMENTAL RIGHTS** 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
III	**PARLIAMENTARY FORM OF GOVERNMENT** 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
IV	**LOCAL GOVERNANCE** 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
V	**INDIAN SOCIETY** 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 CuB.E.s

- 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

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)

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

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

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.	19EE4201	ELECTRICAL MACHINES II	3	1	0	4

Course Objectives

1. Obtain the performance of three phase induction motor and draw its characteristics.
2. Understand the working of Starters and speed control techniques of three-phase induction motors
3. Discuss the basic principles and determine the performance of single phase induction motor
4. Obtain the performance of three phase synchronous generator
5. Estimate the excitation in synchronous motor at various load conditions

Unit	Description	Instructional Hours
I	**THREE PHASE INDUCTION MOTORS** Construction - Principle of operation - slip and Frequency of rotor currents - Equivalent circuit - Power across air-gap, Torque & Power output - Torque-slip characteristics - No load and Blocked rotor tests - Circle diagram (approximate) - Cogging and Crawling - Induction generator - problems - Applications.	12
II	**STARTING, BRAKING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTORS** Starting methods of three phase induction motor - Need for starting - Types of starters DOL, Rotor resistance, Autotransformer and Star-Delta starters - Braking: Plugging, dynamic braking and regenerative braking - Speed control techniques - Voltage control - Pole changing - Frequency control - Rotor resistance control – Static control -Slip power recovery schemes.	12
III	**SINGLE PHASE INDUCTION MOTORS** Single phase induction motors - Double revolving field theory - Types of single phase induction motors - Split phase motor - Capacitor start motor - Capacitor start and run motor - Shaded pole motor. No load and Blocked rotor test - Equivalent circuit - Applications.	12
IV	**SYNCHRONOUS GENERATORS** Construction - Working of synchronous machine as generator and motor- e.m.f equation - armature reaction - Synchronous reactance - Predetermination of voltage regulation using EMF, MMF, Potier method - parallel operation - Alternator on infinite bus bars - Salient pole synchronous machine - slip test.	12
V	**SYNCHRONOUS MOTOR** Principle of operation - Torque equation - Starting of Synchronous motors - torque and power developed equations - Effect of change in excitation and load on synchronous motor - V curves and inverted V curves - Hunting and suppression methods - damper windings - Synchronous condenser.	12
	Total Instructional Hours	**60**

Course Outcomes

- CO1 Analyze and draw the performance characteristics of the three phase induction motor.
- CO2 Demonstrate the starters for starting and control the speed of three phase induction motors
- CO3 State the fundamentals and evaluate the performance of single phase induction motors
- CO4 Apply different methods to obtain the regulation of synchronous generator under various load condition.
- CO5 Draw the performance characteristics of synchronous motor under different excitation conditions

TEXT BOOKS:

T1 D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2006.

T2 J.Gnanavadivel, Dr.C.Senthil Kumar, Dr.P.Maruthapandi, "Electrical Machines II" Anuradha Publications, 2017

REFERENCE BOOKS:

R1 P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

R2 K. Murugesh Kumar, 'Induction and Synchronous Machines', Vikas Publishing House Pvt. Ltd, 2009.

R3 Fitzgerald Kingsley and Umans, "Electric Machinery" 6th Edition, McGraw Hill Books co., New Delhi, 2002.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE4202	INTEGRATED CIRCUITS AND ITS APPLICATIONS *(COMMON TO EEE AND EIE)*	3	0	0	3

Course Objectives

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 BPF and 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- Duel 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 Outcomes

- 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- Ramakant A.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.	19EE4203	DIGITAL SIGNAL PROCESSING	3	0	0	3

Course Objectives

1. Classify signals and systems & their mathematical representation.
2. Analyse the discrete time systems.
3. Describe the various transformation techniques & their computation.
4. Impart knowledge on filters and their design for digital implementation.
5. Study about a programmable digital signal processor & quantization effects.

Unit	Description	Instructional Hours
	DISCRETE TIME SIGNALS AND SYSTEMS	
I	Discrete Time Signals-Discrete Time Systems classification of signals-continuous and discrete, energy and power; Classification of systems- Continuous, discrete, linear, causal, stable, dynamic, time variance- Analysis of Discrete Time linear invariant Systems-	9
	DISCRETE TIME SYSTEM ANALYSIS	
II	Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response of LTI systems - inverse systems - Deconvolution .	9
	DISCRETE FOURIER TRANSFORM & COMPUTATION	
III	Discrete Fourier Transform- properties – Linear filtering methods –Frequency analysis using FFT Algorithm Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure. Applications of FFT.	9
	IMPLEMENTATION OF DISCRETE TIME SYSTEMS	
IV	Structures for realization of discrete time systems-Structure of FIR systems, IIR systems – Quantization of filter coefficients-Parallel & cascade forms. FIR design: Windowing Techniques– Hamming window, Hanning window -Analog filter design – Butterworth and Chebyshev approximations: IIR Filters, digital design using bilinear transformation.	9
	DIGITAL SIGNAL PROCESSORS	
V	Introduction – Computer Architecture of Signal Processing –Van Numann and Harvard Architectures Features – Addressing Formats.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Classify the different types of signals and systems and Analyze a Discrete Time linear invariant Systems.
CO2: Apply z-transform and inverse Z transform and analyze discrete time systems
CO3: Apply Radix-2 Decimation in Time (DIT) and Decimation in Frequency (DIF) FFT Algorithm to Compute Discrete Fourier Transform
CO4: Realize structure and design Infinite Impulse Response (IIR) filters and Finite Impulse Response (FIR) filters.
CO5: Discuss the various architectures of Digital signal processors

TEXT BOOKS:

T1 J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003

T2 S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.

REFERENCE BOOKS:

R1 Nagoorgani.A digital signal processing, Mcgraw hill Education(India) Private Limited, New delhi,2015.

R2 Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE4251	DIGITAL LOGIC CIRCUITS (COMMON TO EIE AND EEE)	2	1	2	4

Course Objectives

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 synchronous sequential circuits – Moore and Melay models- state diagram-state reduction- state assignment. **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 Outcomes

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.	19EE4001	ELECTRICAL MACHINES LABORATORY II	0	0	3	1.5

Course Objectives

1. Determine the losses and performance characteristics of single phase and three phase Induction Motor using proper tests.
2. Study the operation and speed control of AC Machines and Starters.
3. Determine the regulation of synchronous machines using various methods.

EXPT.NO	Description of the Experiments
1.	Load test on three-phase Squirrel cage induction motor/ Slip ring induction motor.
2.	No load and blocked rotor test on three-phase induction motor. (Determination of equivalent circuit parameters).
3.	Speed control of three phase Slip ring Induction Motor.
4.	Determination of performance parameters of induction motor using Circle diagram.
5.	Load test on single-phase induction motor.
6.	No load and blocked rotor test on single-phase induction motor.
7.	Regulation of three phase alternator by pessimistic and optimistic method.
8.	Regulation of three phase alternator by ZPF or Potier triangle method.
9.	Determination of X_d an X_q for three phase salient pole alternator by slip test.
10.	V and Inverted V curves of Three Phase Synchronous Motor.
11.	Study of Induction motor starters (DOL, Automatic Star/Delta & 3 Phase Autotransformer)
	Total Practical Hours

Course Outcomes

- CO1 Perform load test on Induction motors and comment their performance characteristics.
- CO2 Predetermine the regulation of three phase alternator by EMF, MMF, and ZPF and Slip test.
- CO3 Draw the performance characteristics of three phase synchronous motor.
- CO4 Execute no load and blocked rotor test on induction motors to determine the internal parameters of three phase induction motor through an equivalent circuit.
- CO5 Analyze and calculate the losses of three phase induction motor.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE4002	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 and Subtractor 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 Monostable multivibrator 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 characteristics of 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

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

SEMESTER V

Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5201	DESIGN OF ELECTRICAL MACHINES	3	1	0	4

Course Objective

1. Interpretthe fundamentals of specific loading and ratings of electrical machines.
2. Design armature and field systems of D.C. machines.
3. Analyze and design core, yoke, windings and cooling systems of transformers.
4. Design stator and rotor of induction machines.
5. Outline the behavior of synchronous machines and design stator and rotor.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Major considerations in Electrical Machine Design – Electrical Engineering Materials – Choice of Specific Electrical and Magnetic loadings – Thermal considerations, Rating of machines – Different types of cooling methods.	9
II	**DC MACHINES** Output Equations – Main Dimensions – Choice of Specific Electric and Magnetic Loading – Magnetic Circuits Calculations – Carter's Coefficient – Net length of Iron –Real & Apparent flux densities –Selection of number of poles – Design of Armature – Design of commutator and brushes.	9
III	**TRANSFORMERS** Output Equations – Main Dimensions – kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – No load current – Temperature rise in Transformers – Design of Tank – Methods of cooling of Transformers.	9
IV	**INDUCTION MOTORS** Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Magnetizing current – Short circuit current.	9
V	**SYNCHRONOUS MACHINES** Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Design of field winding – Design of turbo alternators – Rotor design.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply the knowledge acquired from Specific loading and rating of electrical machines.
CO2: Understand the design concepts and apply to design the Main dimensions of DC Machine.
CO3: Provide the solutions for Transformer cooling.
CO4: Understand the design concepts and apply to design the Main dimensions of Induction Machine
CO5: Analyze and design the Main dimensions of Synchronous machines.

TEXT BOOKS:

T1 Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 1984.
T2 M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.

REFERENCE BOOKS:

R1 A.ShanmugaSundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
R2 R.K.Agarwal" Principles of Electrical Machine Design" Esskay Publications, Delhi, 2002.
R3 Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishir Co. Pvt. Ltd., New Delhi, 1987.
R4 Upadhyay, K G "Design of Electrical Machines" New Age International Pvt. Ltd., Reprint, 2018

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE5202	RENEWABLE AND NON-RENEWABLE ENERGY SOURCES	3	0	0	3

Course Objective

1. Provide knowledge on fundamentals of solar photovoltaic power generation.
2. Recognize the various components and operation of wind power generation.
3. Diagnose the role of other renewable energy sources in the power generation.
4. Describe the layout and various components of thermal power plants.
5. Illustrate the layout and various components of hydro and nuclear power generation system.

Unit	Description	Instructional Hours
I	**SOLAR ENERGY** Renewable & Non-renewable energy sources-comparison- Installed capacity of solar power generation in India-Energy available from Sun - Solar constant. Solar Collectors–Flat plate and Concentrating collectors-solar photo voltaic conversion: solar cell, classification- construction of module, panel and array- Standalone and grid connected Solar PV power generation.	9
II	**WIND ENERGY CONVERSION SYSTEM** Installed capacity of wind power generation in India -Energy available from wind-power equation-Definition: cut-in, saturation and cut-off wind speed- TSR- Basic principle of wind energy conversion system- Horizontal axis and Vertical axis rotors – pitch and Yaw control mechanism-Wind generators-Types- Working of PMSG.	9
III	**OTHER RENEWABLE ENERGY SOURCES** Fuel Cell: Principle of working- various types – construction and applications. Tidal and wave energy conversion & Working principle- Geothermal Energy: Resources, types - Dry steam plants- Flash steam plants and Binary cycle plants- Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants.	9
IV	**THERMAL POWER GENERATION** Energy scenario & Installed capacity of thermal power generation in India- Base load power plants-Selection of site for thermal power plant- General layout of coal based thermal power generation-construction and working- Environmental hazards of thermal power generation.	
V	**HYDRO AND NUCLEAR POWER GENERATION:** Installed capacity of Hydro and nuclear power generation in India- Selection of site for hydel power plant-Classifications of hydel power plant-Layout and working-Pumped storage scheme-Selection of site for nuclear power plant- Layout and subsystems of Nuclear Power Plants- Working of Nuclear Reactors.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the concepts and operation of solar photovoltaic power generation
CO2: Articulate the construction and working of the components used in wind power generation
CO3: Comprehend the concept of power generation using fuel cell, geothermal and ocean energy sources.
CO4: Demonstrate the concepts of the components used in coal based thermal power plants.
CO5: Exhibit the concepts of the components used in Hydro and Nuclear power plants.

TEXT BOOKS:

T1 Dipak Kumar Mandal , Somnath Chakrabarti , Arup Kumar Das , "Power Plant Engineering: Theory and Practice", Wiley Pvt.ltd.,2019

T2 S.Rao & Dr.B.B.Parulker, "Energy Technology-Non Conventional, Renewable & Conventional", 3rd edition, Khanna Publishers, 2017.

REFERENCE BOOKS:

R1 Nag P.K., "Power Plant Engineering", 4th Edition, Tata-McGraw Hill Education, New Delhi, 2014

R2 R.K. Rajput, "A Text Book of Power Plant Engineering", 4th Edition, Laxmi Publications, 2013

D.P.Kothari,K.S.Singal, Rakesh Ranjan," Renewable Energy Sources and Engineering Technologies, Second edition ,PHI Learning pvt.ltd.,2011.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5203	MICROPROCESSORS AND MICROCONTROLLERS *(COMMON TO EEE AND EIE)*	3	0	0	3

Course Objectives

1 derstand the fundamental components of 8085 architecture.
2 derstand the concept of peripheral's interfacing with assembly language programming.
3 dy the fundamental architecture of 8051 microcontroller and its programming concepts.
4 derstand the fundamental and programming concepts of arduino uno controller.
5 arn 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.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5204	TRANSMISSION AND DISTRIBUTION	3	0	0	3

Course Objective

1. Develop expressions for the computation of transmission line parameters.
2. Obtain the equivalent circuits for the transmission lines based on distance and operating voltage.
3. Improve the voltage profile of the transmission system.
4. Analyses the voltage distribution in insulator strings and cables and methods to improve the same.
5. Understand the operation of the different distribution schemes

Unit	Description	Instructional Hours
	STRUCTURE OF POWER SYSTEM	
I	Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors –interconnection – EHVAC and HVDC transmission - Introduction to FACTS.	9
	TRANSMISSION LINE PARAMETERS	
II	Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines, corona discharges.	9
	MODELLING AND PERFORMANCE OF TRANSMISSION LINES	
III	Classification of lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation, real and reactive power flow in lines, surge impedance loading, methods of voltage control; Ferranti effect.	9
	INSULATORS AND CABLES	
IV	Insulators - Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable, D.C cables.	9
	MECHANICAL DESIGN OF LINES AND GROUNDING	
V	Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers, SLD of 110/11kV and 230/33kV Substation Layout, Methods of grounding.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Differentiate the types of transmission and distribution systems and illustrate the structure of power system.
CO2: Develop the expressions for calculation of transmission line parameters and their effects.
CO3: Evaluate the performance of transmission line using T and π method.
CO4: Analyze the voltage distribution in insulator strings and cables; identify methods to improve the voltage distribution.
CO5: Analyze and design tower distance in transmission line by computing sag and tension of line conductor.

TEXT BOOKS:

T1 S.N. Singh, Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

T2 B.R.Gupta, S.Chand, Power System Analysis and Design'New Delhi, Fifth Edition, 2008.

REFERENCE BOOKS:

R1 C.L.Wadhwa, Electrical Power Systems', New Academic Science Ltd, 2009.

R2 D.P.Kothari , I.J. Nagarath, Power System Engineering', Tata McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.

R3 V. K. Mehta and R. Mehta, Principles of Power Systems, S. Chand Publishing, New Delhi 4th edition,2009.

R4 R.K.Rajput, 'A Textbook of Power System Engineering', Published by Laxmi Publications (P) Ltd., New Delhi, 2015.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5251	CONTROL SYSTEMS ENGINEERING	2	0	2	3

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 and Electrical systems – Analogies – Synchros – AC and DC servomotors.	9
II	**TIME DOMAIN ANALYSIS** Block diagram reduction techniques – Signal flow graphs – Standard test signals – Order of a system – step response of first order systems – second order system – Time domain specifications –Static Error constants – Steady state error. **Simulation of Time response of Second order system using MATLAB**	9
III	**FREQUENCY DOMAIN ANALYSIS** Frequency response –Advantages – Frequency domain specifications – Bode plot – Polar plot – M and N circles – Correlation between frequency and time domain specifications – Phase margin and gain margin. **Simulation of Bode plot using MATLAB, Simulation of Polar plot using MATLAB**	9
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 – Compensator – Types – Lag, lead and lag-lead networks – Lag-Lead compensator design using Bode plot. **Simulation of Root Locus using MATLAB.**	9
V	**STATE MODELS AND SAMPLED DATA SYSTEMS** Concept of state and state models – State models for linear and time invariant Systems – State model of Armature and Field control system – Concept of Controllability and Observability. Introduction to digital control system, Introduction of basic Digital Controllers. **Problem simulation in MATLAB using state model.**	9
	Total Instructional Hours	**45**

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

REFERENCE BOOKS :

R1 Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall of India, 2012.
R2 Dr. S. Salivahanan ,R.Rengaraj ,G.R.VenkataKrishnan "Control Systems Engineering" Pearson Edu,India, 2015.
R3 Nagoor Kani A " Control Systems Engineering," RBA publications, Chennai, 2014.
R4 Nagoor Kani A " Advanced Control Theory," RBA publications, 2nd ed.Chennai, May 2018.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5001	CONTROL AND INSTRUMENTATION LABORATORY	0	0	3	1.5

Course Objective

1. Compare P, PI and PID controllers on linear systems.
2. Understand the concepts of Lag, Lead Compensators.
3. Gain knowledge of different types of bridges.
4. Verify the principles and characteristics of various transducers.

S. No.	Description of the Experiments
	CONTROLSYSTEMS:
1.	Estimate the effect of P, PI, PD and PID Controllers on the Linear system.
2.	Design and implementation of Lag, Lead and Lag-Lead Compensators.
3.	Transfer Function of Separately Excited D.C Shunt Generator.
4.	Transfer Function of Armature Controlled D.C Motor.
5.	Control the position of servo motor using PI controller.
	INSTRUMENTATION:
6.	DC Bridges: Wheatstone bridge and Kelvin double bridge.
7.	AC Bridges: Anderson bridge and Schering bridge.
8.	Measurement of temperature using Thermocouple and RTD.
9.	Measurement of displacement and pressure.
10.	Characteristics of light dependent resistor (LDR).
11.	Measurement of Power and Energy.
12.	Implementation of Instrumentation Amplifier.

Total Practical Hours **45**

Course Outcome

CO1: Estimate the effect of P, PI, PID controllers for the given system specifications.
CO2: Design and implement the compensation techniques.
CO3: Derive the transfer functions of D.C machines.
CO4: Construct the AC and DC bridges.
CO5: Analyze the performance characteristics of various transducers.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5002	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

OBJECTIVES:

- To expose students to the design process
- To develop and test innovative ideas through a rapid iteration cycle.
- 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	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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SEMESTER VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE6181	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. Understand the methods of safety education and training.

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 hazards.	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 analyze on Safety Management levels.
CO3: Appraise the investigation strategies for an industry.
CO4: Summarize the various Safety performance monitoring and apply them.
CO5: Elaborate the safety education and its various training 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 Methods Including 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.	19EE6201	POWER ELECTRONICS	3	0	0	3

Course Objective

1. Study the different types of power semiconductor devices and their characteristics.
2. Understand the operation, characteristics and performance parameters of controlled rectifiers
3. Study the operation, switching techniques and basics topologies of DC-DC switching regulators.
4. Learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5. Study the operation of AC voltage controller and cycloconverters.

Unit	Description	Instructional Hours
I	**POWER SEMI-CONDUCTOR DEVICES** Study of switching devices – Construction and working of power semiconductor devices: Diode, SCR, TRIAC, GTO, BJT, MOSFET and IGBT – Steady state and switching characteristics of SCR and IGBT - Triggering and commutation circuit for SCR- Snubber circuit.	9
II	**PHASE-CONTROLLED CONVERTERS** Principle of phase controlled converter – Single phase half wave converter, semi converter, full converter with R and RL load – Freewheeling diode – Three phase semi and full converter with RL load- Effect of source inductance of full converter - Single phase dual converters.	9
III	**DC TO DC CONVERTER** Step-down and step-up chopper-control strategy– four quadrant chopper –Voltage commutated, Current commutated, Load commutated choppers- Buck, Boost, buck-boost converter - Introduction to Resonant Converters	9
IV	**INVERTERS** Single Phase inverters - Three phase voltage source inverters (both120 modeand180 mode)–Voltage & harmonic control-PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - Multiple PWM –Introduction to space vector modulation –Capacitor commutated Current source inverter.	9
V	**AC TO AC CONVERTERS** Single phase and Three phase AC voltage controllers–Control strategy: Phase control, ON and OFF control, integral cycle control -Multistage sequence control -Single phase step up and step down cycloconverter - Three phase to single phase cycloconverters –Types of UPS-Tap Changer-Battery Charger.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Articulate the Power semiconductor switches in various circuits.
CO2: Understand the various converters.
CO3: Plan and operate the DC-DC Converters on real time applications.
CO4: Understand the inverters and Pulse width Modulated Inverter.
CO5: Understand AC to AC converters and apply the UPS for specific applications.

TEXT BOOKS:

T1 Muhammad H.Rashid, "Power Electronics: Devices, Circuits and Applications", Pearson Education, Fourth Edition, New Delhi, Nov 2017.

T2 P.S.Bimbhra, "Power Electronics",Khanna Publishers, Fifth Edition, 2014.

REFERENCE BOOKS:

R1 Ned Mohan, Tore. M. Undel and, William. P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and sons, Third edition,2018.

R2 M.D. Singh and K.B. Khanchandani, "Power Electronics", Mc Graw Hill India, 2013.

R3 Daniel.W.Hart, "Power Electronics", Indian Edition,Mc Graw Hill Edition, 2011.

R4 P.C. Sen, "Principles of Electrical Machines and Power Electronics", McGraw Hill Education Pvt. Ltd. 2013.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6202	POWER SYSTEM ANALYSIS	3	0	0	3

Course Objective

1. Analyze the different aspects of modeling of power system components.
2. Estimate the steady state operation of large scale power systems.
3. Solve the power flow problems using efficient numerical methods suitable for computer simulation.
4. Identify the concept of symmetrical and unsymmetrical faults in power system studies.
5. Analyze the dynamics of power system for small signal and large signal disturbances.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Need for power system analysis in planning and operation of power systems - Basic Components of a power system and its modeling- Single line diagram – per phase and per unit analysis – formulation of Y-Bus matrix by direct Inspection and Singular transformation method - formulation of Z-Bus matrix by bus building algorithm.	9
II	**POWER FLOW ANALYSIS** Importance of Power flow analysis - statement of power flow problem - classification of buses - development of power flow model in complex variables form - iterative solution using Gauss-Seidel method - Q-limit check for voltage controlled buses – power flow model in polar form - iterative solution using Newton-Raphson method.	9
III	**SYMMETRICAL FAULT ANALYSIS** Need for short circuit analysis - assumptions in fault analysis - Symmetrical short circuit analysis –Thevenin's equivalent representation - fault calculations using bus impedance matrix.	9
IV	**UNSYMMETRICAL FAULT ANALYSIS** Fundamentals of symmetrical components – sequence impedances - sequence networks analysis of single line to ground, line to line and double line to ground faults.	9
V	**STABILITY ANALYSIS** Classification of power system stability- development of swing equation – solution of swing equation by modified Euler method - Equal area criterion - determination of critical clearing angle and time.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Develop knowledge on mathematical model of power system components.
CO2: Interpret the mechanisms to address load flow problems in power system.
CO3: Create computational models for analysis symmetrical conditions in power systems.
CO4: Develop sequential models for the unsymmetrical fault conditions in power systems
CO5: Analyze the stability of the Power System.

TEXT BOOKS:

T1 Nagrath I.J. and Kothari D.P., 'Modern Power System Analysis', McGraw-Hill Education India, Fourth Edition, 2011.

T2 John J. Graingerand William D. Stevenson, Jr, 'Power System Analysis', McGraw Hill Education India, First Edition, 2017.

REFERENCE BOOKS:

R1 J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ' Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.

R2 Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

R3 AbhijitChakrabarti, SunithaHalder, 'Power System Analysis Operation and Control', PHI Learning Private Limited, Third Edition, 2010

R4 Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-HillPublishing Company Ltd., New Delhi, Third Edition, 2014.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6251	EMBEDDED SYSTEMS *(COMMON TO EEE AND EIE)*	2	0	2	3

Course Objectives

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 EMB.E.DDED 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 - **Experimental study**-PCB Designing of simple electronic circuits	9
II	**ARCHITECTURE OF EMB.E.DDED 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. **Experimental study-**Interfacing Of LED and LCD.	9
III	**OS FOR EMB.E.DDED 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-**Experimental study** -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 **Experimental study-**Design Of Traffic Light Control.	9
V	**REAL TIME APPLICATIONS&IMPLEMENTATION** Development and debugging –Testing - Program validation and Testing - Distributed embedded architecture Design examples: Cell phones, Digital Still Cameras, Smart card applications. **Experimental study-**Mailbox	9
	Total Instructional Hours	**45**

Course Outcomes

- 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 Rajkamal, "Embedded Systems – Architecture, Programming and Design", Tata McGraw-Hill, New Delhi, 2017.

T2 Sangiovanni-Vincentelli,"Embedded Systems Development From Functional Models To Implementations",springer 2019

REFERENCE BOOKS:

R1 Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2016

R2 Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", Reed Elsevier Publications, Gurgaon, Haryana, 2013.

R3 Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2013.

R4 Kenneth J. Ayala," The 8051 Microcontroller Architecture, Programming, And Applications", Western Carolina University, 2018.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6001	POWER ELECTRONICS LABORATORY	0	0	3	1.5

Course Objective

1. Acquire knowledge in various characteristics of Power Electronics Devices.
2. Understand the operation of AC/DC and AC/AC converter.
3. Provide hands on experience with power electronic converter testing.

S.No.	Description of the Experiments
1	Gate Pulse Generation using UJT.
2	Characteristics of SCR.
3	Characteristics of Triac.
4	Characteristics of MOSFET
5	Characteristics of IGBT
6	AC to DC Half controlled converter
7	AC to DC Fully controlled Converter
8	Step down and step up MOSFET/IGBT based choppers
9	Single phase Cycloconverter.
10	Single phase AC Voltage controller
11	Simulation of PE circuits(1 phase and 3 phase semiconverter,1 phase and 3 phase full converter)
12	Simulation of PE circuits(DC-DC converters)
	Total Instructional Hours 45

Course Outcome

CO1: Understand the applications of Power electronic devices and circuits.
CO2: Operate the AC/DC in real time applications.
CO3: Understand the working of AC/AC Converters.
CO4: Plan and Operate the control of DC/DC converters.
CO5: Develop and Simulate various Power Electronics circuits using MATLAB.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE6002	CONTROL WIRING AND CIRCUIT DESIGN LABORATORY	0	0	3	1.5

Course Objective

1. Develop control circuits to control and protect the induction motor.
2. Conduct experiments to prevent single phasing and reversal of motor.
3. Test the Control circuits for different ac starter.
4. Develop the voltage control circuits using Solid state Components.
5. Understand and analyze the working of Inverter.

S. No.	Description of the Experiments
1.	Construct and test the control circuit for dynamic braking of cage motor.
2.	Construct and test the control circuit for jogging in cage induction motor.
3.	Develop and test the control circuit for single phase preventer.
4.	Develop and test the control circuit for forward and reverse operation of a motor.
5.	Construct a control Circuit to safely start a Single phase Motor.
6.	Devise and test the control circuit for automatic star –delta starter for cage Induction Motor.
7.	Test the control circuit for rotor resistance starter for Slip ring Induction Motor.
8.	Test the Voltage control Circuit for Speed control of AC motor using SCR /MOSFET.
9.	Construct and test the design of the fixed dc power supply for various applications using LM7805.
10.	Construct and test the design of the variable dc power supply for various applications using LM317.
11.	Design and estimate the Solar based Inverter.
	Total Practical Hours 45

Course Outcome

CO1: Construct and test the different control circuits of induction motor.
CO2: Provide control circuit for single phasing and reversal of motor.
CO3: Experimentally verify the control circuit for starters.
CO4: Develop the voltage control circuits using electronic components.
CO5: Understand the various components and working of an inverter.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE6701	INTERNSHIP / INDUSTRIAL TRAINING	0	0	0	1

Course Objectives

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

The student shall undergo Internship / Industrial Training and the credits earned will be indicated in the grade sheet. The student is allowed to undergo 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 Industrial Training / Internship, 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	Course Title	L	T	P	C
B.E.	19HE6071	SOFT SKILL-II	1	0	0	1

Course Objectives:

1. To make the students aware of the importance, the role and the content of soft skills 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.	19EE5301	FIBER OPTICS AND LASER INSTRUMENTS	3	0	0	3

Course Objectives

1. Understand the properties of optical fibers
2. Correlate the industrial applications of optical fibers.
3. Recall the fundamentals and types of laser.
4. Summarize the industrial applications lasers.
5. To learn about holography and medical applications of lasers.

Unit	Description	Instructional Hours
I	**OPTICAL FIB.E.RS AND THEIR PROPERTIES** Principles of light propagation through a fiber - Different types of fibers and their properties, fiber characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fiber termination – Optical sources – Optical detectors	9
II	**OPTICAL FIB.E.RS AND THEIR PROPERTIES** Principles of light propagation through a fiber - Different types of fibers and their properties, fiber characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fiber termination – Optical sources – Optical detectors	9
III	**LASER FUNDAMENTALS** Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor 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, gynecology and oncology.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Enumerate the properties of optical fibers.
- CO2 Apply the optical fibers for industrial applications.
- CO3 Apply the optical fibers for industrial applications.
- CO4 Choose the lasers for industrial applications
- CO5 Illustrate holography and medical applications of lasers.

TEXT BOOKS:

T1 R.P.Khare, Fiber Optics and Optoelectronics, Oxford university press, 2008.

T2 C.K.Sarkar, Optoelectronics and Fiber Optic Communication, New Age International (pvt) Ltd,

REFERENCE BOOKS:

R1 Asu Ram Jha, Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems, PHI learning Pvt. Ltd, 2009.

R2 Anuradha De, Optical Fiber and laser principles and applications, Anuradha Agencies, 2004.

R3 John F. Read, Industrial Applications of Lasers, Academic Press, 1978.

R4 Dr.R.Senthil, R.Manikandan, K.Samba Siva Rao."Fiber Optics and Laser Instruments," Sai Publications. 2016.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE5302	BIOMEDICAL INSTRUMENTATION	3	0	0	3

Course Objectives

1. Introduce the Fundamentals of Biomedical Engineering
2. Review the communication mechanics in a biomedical system with few examples
3. Impact knowledge on measurement of certain important electrical and non-electrical parameters
4. Understand the basic principles in imaging techniques
5. Gain knowledge in life assisting and therapeutic devices

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF BIOMEDICAL ENGINEERING** Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals – Basic components of a biomedical system- Cardiovascular systems- Respiratory systems – Kidney and blood flow – Biomechanics of bone – Physiological signals and transducers – Transducers – selection criteria – Piezo electric,ultrasonic transducers – Temperature measurements – Fibre optic temperature sensors.	9
II	**NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES** Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gasanalysers, pH of blood –measurement of blood pCO2, pO2, Oxymeter.	9
III	**ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS** Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes – Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers –Isolation amplifier – ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms	9
IV	**IMAGING MODALITIES AND ANALYSIS** Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems – Retinal Imaging – Imaging application in Biometric systems – Analysis of digital images.	9
V	**LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES** Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lungmachine – Audio meters – Dialysers – Lithotripsy – ICCU patient monitoring system – Nano Robots –Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Ability to understand the basics of biomedical Engineering
- CO2 Explain various technique for non-electrical physiogical measurements
- CO3 Illustrate different electrode placement for various physiological recordings
- CO4 Differentiate the different imaging techniques.
- CO5 Demonstrate different techniques for life assisting and therapeutic devices

TEXT BOOKS:

T1 Leslie Cromwell, Biomedical Instrumentation and measurementl, 2nd edition, prentice hall of India, New Delhi, 2015

T2 John G. Webster, Medical Instrumentation Application and Designl, 4th edition, Wiley India Pvt Ltd,New Delhi, 2015

REFERENCE BOOKS:

R1 Khandpur R.S, —Handbook of Biomedical Instrumentationl, 3rd edition, Tata McGraw-Hill New Delhi, 2014

R2 Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011

R3 Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007

R4 M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003

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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 basic characteristics of Java
2. To understand Object Oriented Programming concepts and inheritance
3. To know the principles of polymorphism and interfaces
4. To define exceptions and use I/O streams
5. To develop a java application with threads and generics classes

Unit	Description	Instructional Hours
I	**INTRODUCTION TO JAVA FUNDAMENTALS** Introduction to java programming-Features of Java Language-JVM -The Java Environment-Fundamental Programming Structures in Java – Comments -Primitive Data types-variables-operators - control statements- arrays- Packages-defining package-access protection-importing packages- JavaDoc comments	9
II	**INTRODUCTION TO OOP AND INHERITANCE** Object Oriented Programming – Class and Objects - Constructor - Inheritance – Super classes-sub classes –Protected members – constructors in sub classes- the Object classes- Method overloading -method over riding –Abstract class and Method – Encapsulation-Garbage collection- static –final keyword.	9
III	**INHERITANCE AND INTERFACES** Polymorphism-Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces – Object cloning -inner classes, Array Lists – Strings	9
IV	**EXCEPTION HANDLING AND I/O** Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files	9
V	**MULTITHREADING AND GENERIC PROGRAMMING** Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.	9
	Total Instructional Hours	**45**

Course Outcome

CO1:Understand basic Java programs with concepts
CO2:Develop Java programs using OOP principles and inheritance
CO3:Develop Java programs with the concepts interfaces
CO4:Build Java applications using exceptions and I/O streams
CO5:Develop Java applications with threads and generics classes

TEXT BOOKS:

T1 Herbert Schildt, Java The complete referencel, 8th Edition, McGraw Hill Education, 2011

T2 Cay S. Horstmann, Gary cornell, Core Java Volume I Fundamentalsl, 9th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

R1 Paul Deitel, Harvey Deitel, Java SE 8 for programmers, 3rd Edition, Pearson, 2015.

R2 Steven Holzner, Java 2 Black bookl, Dreamtech press, 2011..

R3 Timothy Budd, Understanding Object-oriented programming with Java, Updated Edition, Pearson Education, 2000

R4 Introduction to Java rogramming, 7th ed, Y Daniel Liang, Pearson

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Programme	Course Code	Name of the Course	L	T	P	C
B.E EEE	19EE5304	COMPUTER NETWORKS	3	0	0	3

Course Objective

1. Understand the protocol layering and physical level communication.
2. Analyze the performance of a network.
3. Understand the various components required to build different networks.
4. Learn the functions of network layer and the various routing protocols.
5. Familiarize the functions and protocols of the Transport layer.

Unit	Description	Instructional hours
I	**OVERVIEW & PHYSICAL LAYER** Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.	9
II	**DATA LINK LAYER** Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC– PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction –IEEE 802.11, Bluetooth – Connecting Devices.	9
III	**NETWORK AND ROUTING** Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms –Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.	9
IV	**TRANSPORT & APPLICATION LAYER** Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.	9
V	**APPLICATION LAYER & SDN** Electronic Mail (SMTP, POP3) – HTTP – Web Services – DNS – Introduction to Software Defined Networking – Working of SDN – SDN in Data Centre – SDN applications – Data Centre Networking.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify the components required to build different types of networks and aware of media access control
CO2: Understand the data communication system and the purpose of layered architecture
CO3: Analyze the concepts of Routing methods and Subnetting.
CO4: Design protocols for various functions in the network
CO5: Understand the working of protocols for various Applications.

TEXT BOOK:

T1 Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw – Hill, 2013.

T2 Paul Goransson, Chuck Black and Timothy Culver, "Software Defined Networks - A Comprehensive Approach", Second Edition, Elsevier, 2017

REFERENCES:

R1 James F. Kurose, Keith W. Ross, "Computer Networking – A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2017.

R2 Nader. F. Mir, "Computer and Communication Networks", Second Edition Pearson Prentice Hall Publishers, 2015

R3 Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Publisher, 2011.

R4 Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE5305	CONTROL OF ELECTRICAL APPARATUS	3	0	0	3

Course Objective

1. Understand the concepts of controls in electrical machinery.
2. Study about the control of circuit components
3. Understand the working of Starters of three-phase induction motors
4. Impart knowledge on Industrial control circuits
5. Outline on advanced control in electrical apparatus

Unit	Description	Instructional Hours
I	**INTRODUCTION** General Idea of Controls –Disadvantages of Manual Control-Introduction of Magnetic Control –Advantages –Semi automatic and automatic control of Modern machinery –Development of control circuit : Development of Two-wire and Three-wire Control –Remote Control Operation of a motor –Interlocking of Drives.	9
II	**CONTROL CIRCUIT COMPONENTS** Introduction –Fuses, Switches and Fuse Switch Units –MCCB and MCB .Contactors: Solenoid and Clapper types .Relays: Voltage Relays – D.C.SeriesCurrentRelay-Frequency Responsive Relay and Latching Relays. Switches: Push button switches, Limit Switches –Simple Limit Switch and Rotary Cam type Limit Switches.	9
III	**CONTROL CIRCUITS FOR 3-PHASE INDUCTION MOTOR STARTERS** Introduction-Primary Resistor Type starters: Manual primary –Semi-Automatic Stepless – Automatic Primary. Line –reactor Reduced Voltage Starter-Automatic Auto-Transformer Starter(open and closed circuit transition).Part Winding motor Starter: Two Step and Three Step Starting	9
IV	**INDUSTRIAL CONTROL CIRCUITS** Introduction –Automatic Control for a Water Pump-Battery Operated Truck-Skip hoist control-Conveyor System –Elevator.	9
V	**INTRODUCTION TO PROGRAMMABLE CONTROLLERS** Introduction –Parts of a Programmable Controller –Complete Scan Cycle –Programming Terminal –Industrial Application.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Apply basic knowledgefor electrical control apparatus.
CO2:Obtain the knowledge on control of circuit Components.
CO3:Demonstrate the Control circuit of three phase induction motor starters.
CO4: Illustrate the power control circuits for real-time applications.
CO5: Exhibit basic concepts of advanced industrial controllers.

TEXT BOOKS:

T1 S K Bhattacharya, Control Of Electrical Machines, New Age International,1996

T2 Denis O'Kelly-Performance and control of electrical machines, McGraw-Hill, 1991

REFERENCE BOOKS:

R1 Sunil S. Rao , Switchgear Protection and Power Systems,Khanna Publishers, 1999.

R2 R.K.Rajput, Electrical Machines, Lakshmi Publishers, 2006.

R3 B.V.S.Rao, Operation and Maintenance of Electrical Equipment Volume I & II, Media Promoters &Publishers Private Limited, Mumbai,1st Edition, 1st Reprint 2011.

R4 Stephen Herman,Industrial motor control, 6thEdition, Cengage Learning

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PROFESSIONAL ELECTIVE – II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19EE6301	INDUSTRIAL AUTOMATION	3	0	0	3

Course Objectives

1. Discuss the basic concepts involved in Programmable Logic Controllers
2. Interpret the Programmable Logic Controllers programming concepts
3. Cite the applications of Programmable Logic Controllers
4. Outline the basics of SCADA
5. Articulate the various SCADA communications and its applications.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO PLC** An Overview – Parts of PLC – Principles of Operation – Hardware Components – I/O Section – Discrete I/O Modules – Analog I/O Modules –CPU – Memory Types – Human Machine Interface (HMI) – Processor Memory Organization – Program Scan.	9
II	**PLC PROGRAMMING** Basics of Ladder Diagram – Mnemonic Programming Code - Fundamental PLC Programming – Advanced Programming Techniques - Wiring Techniques – Programming Using Timers And Counters.	9
III	**PLC INSTRUCTIONS AND APPLICATIONS** Program Control Instructions – Data Manipulation Instructions – Math Instructions – Sequencer And Shift Register –Case Studies in PLC.	9
IV	**INTRODUCTION TO SCADA** Evolution – Definition – Architecture - Remote Terminal Units (RTU) -Master Terminal Units (MTU) – Sensors, Actuators And Wiring - Intelligent Electronic Devices (IED).	9
V	**SCADA COMMUNICATIONS AND APPLICATIONS** Fundamentals of SCADA Communications – Basics of SCADA Protocols: DNP3, TCP/IP– Profibus. Applications: Petroleum Wellhead Pump Control – Water Purification System – Crane Control.	9
	Total Instructional Hours	45

Course Outcomes

CO1: Understand the parts and operation of Programmable Logic Controller.
CO2: Understand the PLC programming and ladder diagram.
CO3: Understand the PLC instructions and apply in various case studies.
CO4: Remember the architecture and interfaces of SCADA System.
CO5: Remember various protocols and applications of SCADA.

TEXT BOOKS:

T1 - F.D. Petruzella, 'Programmable Logic Controllers', Tata Mc-Graw Hill, Third Edition, 2010.
T2 - Stuart A. Boyer, 'SCADA- Supervisory Control and Data Acquisition', TheInstrumentationSystemsand Automation (ISA) Society, USA, Third Edition, 2004.

REFERENCE BOOKS:

R1 - Ronald L.Krutz, 'Securing SCADA Systems', Wiley Publishing Inc.2006.
R2 - David Bailey, Edwin Wright, 'Practical SCADA for Industry' Newnes -ElsevierPublications, 2003.
R3 - Gordon Clarke, Deon Reynders, 'Practical Modern SCADA protocols', Newnes -Elsevier Publications, 2004.
R4-John R.Hackworth, Frederick D.Hackworth, Jr, 'Programmable Logic Controllers: Programming Methods and Applications', Prentice Hall Publications, First Edition, 2003.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6302	ELECTRIC VEHICLE MECHANICS AND CONTROL	3	0	0	3

Course Objectives

1. To provide knowledge of the operation and dynamics of electrical vehicles
2. To impart knowledge on vehicle control for standard drive cycles of electrical vehicles (EVs)
3. To estimate the energy requirement of EVs and Hybrid Electric Vehicles (HEVs)
4. To provide knowledge about different energy sources
5. To provide energy management in HEVs to afford knowledge of supervisory control of EVs

Unit	Description	Instructional Hours
I	**ELECTRIC VEHICLE ARCHITECTURE** History of evolution of Electric Vehicles - Series parallel architecture of Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.	9
II	**MECHANICS OF ELECTRIC VEHICLES** Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of EV's - motor torque and power rating and battery capacity.	9
III	**CONTROL OF DC AND AC MOTOR DRIVES** Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives.	9
IV	**ENERGY STORAGE SYSTEMS** Battery: Principle of operation, types, models, SOC of battery, Traction Batteries and their capacity for standard drive cycles. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.	9
V	**HYBRID VEHICLE CONTROL STRATEGY** HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Understand the architecture and dynamics of EVs and HEVs
- CO2 Design an EV for standard drive cycle
- CO3 Understand the electrical motors' characteristics and its application for vehicle dynamics
- CO4 Workout the energy requirements and energy sources for EV application
- CO5 Understand the mode of operation and control architecture

TEXT BOOKS:

T1 Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press - Boca Raton London New York Washington, D.C. 2012.

T2 Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017.

REFERENCE BOOKS:

R1 Mehrdad Ehsani, Yimini Gao & Ali emadi "Modern Electric, Hybrid Electric and Fuel cell Vehicles" Third Edition, CRC Press, 2018.

R2 Gianfranco Pistoia, "Electric and Hybrid Vehicles – Power sources, Models, Sustainability, Infrastructure and the market" Elsevier, The Netherlands – 2010

R3 James Larminie and John Lowry, "Electric Vehicle Technology Explained", Second Edition 2012.

R4 Christopher D Rahn, Chao-Yang Wang, "Battery Systems Engineering", Wiley, 2013

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6303	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3

Course Objectives

1. Study the knowledge on various reactive power control techniques.
2. Learn the modeling and design aspects of static VAR compensators and its applications
3. Understand the design and modeling of TCSC.
4. Learn various methods of Reactive Power Controls in AC Transmission Lines.
5. Understand the various FACTS Controllers interaction.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO FACTS** Review of basics of power transmission networks - Concepts of Reactive power and its control in transmission lines - Uncompensated AC Transmission line - Passive compensation (series and shunt compensation) – Need for FACTS controllers- Types and generation of FACTS controllers – Basic concepts of FACTS devices and its functions (SVC, TCSC & UPFC).	9
II	**STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS** Basics concept and working of SVC - Voltage control by SVC – Advantages of slope in dynamic Characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator (Block diagram approach) – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.	9
III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS** Block diagram and Operation of the TCSC – Different modes of operation –Bypassed Thyristor Mode, Blocked Thyristor Modes and Vernier Mode – Applications: Improvement of the system stability limit – Enhancement of system damping.	9
IV	**ENERGING FACTS CONTROLLERS** Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics - Applications: Steady state power transfer - Enhancement of transient stability - Prevention of voltage instability - SSSC - Operation of SSSC and the control of power flow.	9
V	**COMBINED COMPENSATORS & CO-ORDINATION OF FACTS CONTROLLERS** UPFC & IPFC - Operating principle (Block diagram approach) & applications - FACTS Controller interactions - Co-ordination of multiple controllers using Linear Control Techniques - Control coordination using Genetic algorithms flowchart representation - SVC - SVC interaction.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Study and describe the reactive power control techniques.
- CO2 Understand the modelling of static VAR compensators and its applications.
- CO3 Learn the modelling of TCSC and their applications.
- CO4 Acquire knowledge on VSC FACTS Controllers and Thyristor controlled series capacitors.
- CO5 Understand the various FACTS controller and apply the relevant algorithms in appropriate applications.

TEXT BOOKS:

T1 R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.

T2 Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.

REFERENCE BOOKS:

R1 A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical Engineers, UK, 1999.

R2 V.K.Sood, "HVDC and FACTS controllers – Applications of Static Converters in Power System", Kluwer Academic Publishers, 2004.

R3 K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International, 2007.

R4 Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control", Springer, 2012.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6304	ELECTRICAL ESTIMATION AND COSTING	3	0	0	3

Course Objective

1. Recognize the elements of estimation and types of house wiring
2. Know design circuits for lighting , fan, and alarm circuits
3. Be aware of electrical installations and estimates for residential buildings
4. Understand various control circuits for power and motor
5. Realize the estimates for LT, sub station, service connection and IE rules

Unit	Description	Instructional Hours
I	**ELEMENTS OF ESTIMATING AND TYPES OF HOUSE WIRING** Introduction - Purpose of Estimating and Costing - Qualities of a good Estimator; Essential Elements of Estimating and Costing – Tender- Guidelines for inviting tenders – Quotation - Factors of Estimating and Costing. **Cleat wiring - Wooden Casing and Capping Wiring** - PVC Casing and Capping - Tough Rubber sheathed wiring or batten wiring - Lead sheathed or metal sheathed wiring - conduit wiring system.	9
II	**DESIGNING OF LIGHTING, FAN AND ALARM CIRCUITS** Introduction to simple light and fan circuits – System of connection of appliances and accessories – solved examples on light and fan circuits – Introduction to simple alarm circuits without and with relays – schematic and wiring diagrams – solved examples for alarm and signal circuits without relays – alarm circuits with relays – solved examples for alarm circuits with relays.	9
III	**ELECTRICAL INSTALLATION AND ESTIMATES FOR RESIDENTIAL BUILDINGS** Electrical installation for residential buildings – Schematic and wiring diagram – sub circuits - Estimating of size and length of wires and cost of material - Solved examples on estimation of electrical installations for simple residential buildings.	9
IV	**POWER CIRCUITS, MOTOR CONTROL CIRCUITS AND ESTIMATES** Wiring of motors – important guidelines about power wiring in small industries – control panels Wiring circuits for Starting of 3-phase squirrel cage and wound rotor induction motor – stopping of motors – contactor control circuit components – Basic control circuits – Motor protection - Schematic and wiring diagrams for motor control circuits.	9
V	**ESTIMATES FOR L.T. LINE, SUB-STATION AND SERVICE CONNECTION FOR POWER, INDIAN ELECTRICITY RULES** Estimates - pole mounted sub-stations - overhead line - underground cable service connection – simple problems.Introduction to I.E. Rules – Definitions - General safety precautions – General conditions releasing to supply and use of energy – electric supply lines, systems and apparatus for low, medium and high and extra voltage - Overhead lines - standard values of voltages.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify various elements of estimation and wiring types
CO2: Design circuits for lighting, fan and alarm
CO3: Estimate electrical installation for residential buildings
CO4: Design control circuit for power and motor control
CO5: Estimate various connections for power and apply Indian electricity rules

TEXT BOOKS:

T1 Surjit Singh, "Electrical Estimating and Costing" – Second Edition Jan 2016, DhanpatRai & Co. (P) LTD.

T2 K.B.Raina, S.K.Bhattacharya, 'Electrical Design Estimating and Costing" – First Edition, Reprint 2019, New Age In Publishers.

REFERENCE BOOKS:

R1 J B Gupta. A Course in Electrical Installation, Estimating & Costing: S K Kataria & Sons.

R2 Dr.S.L.Uppal ,"Electrical Wiring, Estimating and Costing" New Age International Publishers..

R3 N.Alagappan and Ekambaram, "Electrical Estimating andCosting", Tata McGraw Hill.

R4 M. Raghunath Rao "Electrical Estimating Specification and Costing", Eastern Book Promoters Belgaum (EBPB)

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6305	PRINCIPLES OF ROBOTICS	3	0	0	3

Course Objectives

1. Explain the basics of robotics.
2. Create awareness about the different models for a given Robotic manipulator.
3. Recognize trajectory planning.
4. Classify various type of sensors and machine vision in robotics
5. Observe robot programming and languages

Unit	Description	Instructional Hours
I	**INTRODUCTION** History of Robotics-Basics of Robotics, Progressive advancement in Robots, Robot anatomy, Manipulation and control, human arm characteristics, design and control issues, Sensors and vision-programming robots, the future prospects-bio robotics and humanoid robotics.	9
II	**DIRECT KINEMATIC MODEL, INVERSE KINEMATICS AND DYNAMIC MODELING** Mechanical structure and notations, Description of links and joints, Kinematic modeling of manipulator, Denavit-Hartenberg notation, Inverse kinematics- Manipulator workspace, Solution techniques and closed form solution, Dynamic modeling of two degree of freedom manipulator.	9
III	**TRAJECTORY PLANNING** Definitions and planning tasks, Joint space techniques, Cartesian Space techniques, Continuous trajectory recording.	9
IV	**ROBOTIC SENSORS AND MACHINE VISION** Transducers and Sensors, Sensors in Robotics, Tactile Sensors, Proximity and Range Sensors, Miscellaneous Sensors and Sensor-Based System. Uses of sensors in robotics. Machine Vision, the Sensing and Digitizing function in Machine vision, Image processing and Analysis , Training the Vision system, Robotic Applications	9
V	**ROBOT PROGRAMMING AND LANGUAGES.** Method of robot programming, Lead through programming methods, A robot program as a path in space, robot languages- Generation of robot programming and languages, second generation languages, Future generation Languages, Robot language structure, constants, variables and other data objects.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Understand the basics of robotics.
- CO2 Develop different model for a given Robotic manipulator.
- CO3 Describe the trajectory planning for robotics.
- CO4 Generalize role of sensors and machine vision in Robotics.
- CO5 Study on robot programming and languages.

TEXT BOOKS:

T1 R.K.Mittal and I.J.Nagrath, Robotics and Control,Tata McGraw Hill,New Delhi,4th Reprint, 2005.

T2 G.P.Groover, M.Weiss,R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCE BOOKS:

R1 Mark W.Sponge, M.Vidyasagar, Robot dynamics and control, Wiley India, 2009.

R2 KS Fu, Ralph Gonzalez CSG Lee, Robotics, John wiley, 2002.

R3 Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.

R4 M.P.Groover, M.Weiss,R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

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OPEN ELECTIVE

Programme	Course Code	Name of the course	L	T	P	C
B.E.	19EE6401	FUNDAMENTALS OF SOLAR PHOTOVOLTAIC SYSTEMS	3	0	0	3

Course Objective

1. To study the Energy Scenarios and Its Impacts.
2. To describe the basics of solar energy radiation and its measurements
3. To understand the various types cell technologies and arrangement of PV modules.
4. To impart knowledge on the balance of solar PV systems.
5. Tounderstand thevarious applications of solar photovoltaic systems

Unit	Description	Instructional Hours
I	**ENERGY RESOURCES** World Energy Use - Primary energy sources –Reserves of Energy Resources –Environmental Aspects of Energy Utilization – Renewable Energy Scenario in Tamilnadu, India and around the World –Potentials –Achievements / Applications –Economics of renewable energy systems.	9
II	**SOLAR ENERGY BASICS & MEASUREMENT** Sun's Energy Advantages-Energy conversion challenges- Solar Constant-Solar Radiation at the Earth's Surface-Solar Radiation-Geometry -Local Solar Time (LST). Local Apparent Time (LAT)-Sunrise, Sunset and Day length. Solar Radiation Measurements: Pyrheliometer – Pyronometer.	9
III	**SOLAR CELL TECHNOLOGY** Solar cell Technologies-Types- Solar PV Modules from solar cells-Series and parallel connection of cells-Mismatch in cell / module- Mismatch in series and parallel connection- Hot spot in the module-Bypass diode- No. of solar cells in a module-Wattage of modules-PV module power output	9
IV	**BALANCE OF SOLAR PV SYSTEMS** Introduction to batteries-Factors affecting battery performance-Types of Batteries for PV systems-Comparison of batteries-Importance and Types of charge controller- Necessity & types of inverter - Maximum Power Point Tracking (MPPT) System	9
V	**APPLICATIONS OF PV SYSTEM** A Basic Photovoltaic Systems for power generation- Grid Interactive solar PV Power system-Applications of solar Photovoltaic system-Solar street lighting-home lighting system-Water pumping system. (Block Diagram Approach)	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Ability to identify the energy demand and environmental impacts.
CO2: Ability to explain the different solar measurement techniques.
CO3: Ability to develop the solar modules.
CO4: Ability to understand different supporting components of Solar PVsystems.
CO5: Ability to explain the applications of Solar PV systems

TEXT BOOKS:

T1 Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications" – Third Edition, PHI Learning Private Limited, New Delhi, 2015.
T2 B.H. Khan Non-Conventional Energy Sources", Tata McGraw – Hill Publishing Company, New Delhi, 2009.

REFERENCE BOOKS:

R1 Ashok Kumar I, Albert Alexander S, Madhuvanthani Rajendran, "Power Electronic Converters for Soalr Photovoltaic Systems" Academic Press An Imprint of Elseiver, 2020.
R2 D.P. Kothari, K.K. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", Prentice-Hall of India Pvt., Limited, 2008.
R3 Rai. G.D., "Solar Energy Utilization", Khanna Publishers, New Delhi, 2005.

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SYLLABUS

Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7201	SOLID STATE DRIVES	3	0	0	3

Course Objective

1. To understand steady state operation and transient dynamics of a motor load system.
2. To analyze and design the speed controllers for a closed loop solid state DC motor drives.
3. To study and analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
4. To study and understand the operation and performance of AC motor drives.
5. To design the speed controllers for induction motor control

Unit	Description	Instructional Hours
I	**DRIVE CHARACTERISTICS** Electric drives and advantages – Equations governing motor load dynamics – steady state stability – multi quadrant operation – modes of operation: steady state, acceleration, deceleration, starting & stopping – Components and classification of load torques – choice of electrical drives	9
II	**DC MOTOR DRIVES** Transient analysis: Armature control and field control – Ward Leonard Drives – Single phase half and fully controlled rectifier control of separately excited DC motor – chopper control of separately excited DC motor.	9
III	**INDUCTION MOTOR DRIVES** Stator voltage control–variable frequency control –Cycloconverter control of induction motor - voltage and current fed inverter control– closed loop speed control – static rotor resistance control-V/f and slip power recovery scheme.	9
IV	**SYNCHRONOUS MOTOR DRIVES** Variable frequency control and self control of synchronous motor variable speed constant frequency generation – CSI fed synchronous motor drive with forced commutation – permanent magnet synchronous motor.	9
V	**DESIGN OF CONTROLLERS FOR DRIVES** Design of controllers for linearly and exponential varying inputs – phase margin optimum control – magnitude optimum control – symmetrical optimum control – application of P, I, D, PI, PD, and PID controller to drive.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Analyze the stability of the system depending on load.
CO2: Identify the type of electric motor applicable for various applications.
CO3:Analyze the operation of the converter and chopper fed dc drive.
CO4:Design the speed controllers for a closed loop solid state DC motor drives.
CO5:Design the speed controllers for induction motors to control and maintain the speed.

TEXT BOOKS:

T1 Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
T2 Vedam Subramanyam, "Electric Drives concepts and applications", Tata McGraw Hill, 2007.

REFERENCE BOOKS:

R1 S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 1993.
R2 Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.
R3 R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Prentice Hall of India, 2001.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7202	ELECTRICAL ENERGY UTILIZATION AND CONSERVATION	3	0	0	3

Course Objective

1. To understand the operating principle of different power generation types.
2. To study the different methods of electric heating and electric welding.
3. To recognize the basic principles of illumination and different types of lightning system.
4. To understand the basic principle of electric traction.
5. To enumerate the concepts of Non Renewable energy resource.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Review of conventional methods - Thermal, Hydro and Nuclear based power generation. Nonconventional methods of power generation - Tidal Power - Geothermal - Magneto Hydro Dynamic (MHD).	9
II	**INDUSTRIAL HEATING AND WELDING** Role of electric heating for industrial applications - Resistance heating - Induction heating - Dielectric heating - Electric Arc Furnaces - Electric welding - Electric Arc Welding.	9
III	**ILLUMINATION** Introduction - Terms used in illumination –Laws of illumination - Lumen or flux methods of calculation - Electric Lamp - Tungsten lamps and fluorescent lamps –Basic principles of light control-Street lighting and Flood lighting – Design of Choke and Capacitor.	9
IV	**ELECTRIC TRACTION** Merits of electric traction - Requirements of electric traction system - Supply systems – Mechanics of train movement - Traction motors - DC motor - AC motor – Braking – Recent trends in electric traction	9
V	**NON CONVENTIONAL ENERGY SOURCES** Introduction –basic components of a WECS (Wind Energy Conservation System)- Classification of WECS - Flat plate collectors- Concentrating collector – Parabolic trough Reflector –Mirror Strip Reflector–Advantages and Disadvantages of Concentrating collectors over Flat plate Collector.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Analyze the various power generation methods both conventional and non-conventional.
CO2: Valuate the most appropriate heating or welding techniques for suitable applications.
CO3: Assess the various level of illuminosity produced by different illuminating sources.
CO4: Formulate the different types of traction motors and braking .
CO5: Handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

T1 C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, 2003

T2 Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS:

R1 E. Openshaw Taylor, "Utilization of Electric Energy", OrientLongman.

R2 B.R. Gupta, 'Generation of Electrical Energy', Eurasia Publishing House (P) Ltd, New Delhi, 2003.

R3 J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and Sons, 2002.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7203	POWER SYSTEM OPERATION AND CONTROL	3	0	0	3

Course Objective

1. Overview of power system operation and control.
2. Model power-frequency dynamics and to design power-frequency controller.
3. Model reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
4. Study the economic operation of power system.
5. Teach about SCADA and its application for real time operation and control of power systems.

Unit	Description	Instructional Hours
	INTRODUCTION	
I	An overview of power system operation and control - system load variation - load characteristics - load curves and load-duration curve –Straight line and curve fitting technique – demand factor - diversity factor – Load forecasting	9
	REAL POWER - FREQUENCY CONTROL	
II	Basics of speed governing mechanism and modeling - speed-load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single-area system – Modelling- response - two-area system – modeling - tie line Response	9
	REACTIVE POWER–VOLTAGE CONTROL	
III	Generation and absorption of reactive power-excitation systems-modeling - static and dynamic analysis - stability compensation - methods of voltage control: tap-changing transformer, SVC (TCR + TSC) and STATCOM.	9
	ECONOMIC LOAD DISPATCH AND UNIT COMMITMENT	
IV	Formulation of economic dispatch problem – I/O cost characterization – incremental cost curve - co-ordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem – priority-list method - forward dynamic programming.	9
	COMPUTER CONTROL OF POWER SYSTEMS	
V	Need for computer control of power systems - concept of energy control centre - functions - system monitoring - data acquisition and control - system hardware configuration – SCADA and EMS functions - state transition diagram showing various state transitions and control strategies.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret the overview of power system operations.
CO2: Analysis the single area and multi-area system using frequency control
CO3: Summarize the various voltage control methods of power system
CO4: Solve the economic load dispatch, optimum unit commitment for a power system
CO5: Illustrate the functional content of SCADA, EMS and related systems

TEXT BOOKS:

T1 Olle.I.Elgerd, 'Electric Energy Systems Theory An Introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010

T2 Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc.,2003.

REFERENCE BOOKS:

R1 V. K. Mehta and R. Mehta, Principles of Power Systems, S. Chand Publishing, New Delhi 4th edition,2009.

R2 Nagrath I.J. and Kothari D.P., Modern Power System Analysis', Tata McGraw-Hill, Fourth Edition, 2011.

R3 Kundur P.,Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7001	DRIVES AND CONTROL LABORATORY	0	0	4	2

Course Objective

1. Acquire software development skills and experience in the usage of standard packages.
2. Apply the knowledge in designing of FPGA controller for Induction Motor.
3. Construct a speed controller using DSP for electrical motor.

S.No	Description of the Experiments
1	Single phase and Three phase fully controlled converter using R and RL load using MATLAB / SIMULINK
2	Simulation of closed loop control of converter fed DC motor using MATLAB / SIMULINK
3	Simulation of closed loop control of chopper fed DC motor using MATLAB / SIMULINK
4	Simulation of VSI fed 3 Phase induction motor using MATLAB / SIMULINK
5	DSP based closed loop drive for induction motor
6	Speed control using FPGA for Induction motor.
7	DSP based chopper fed DC motor drive
8	Speed control of Brush Less DC motor
9	PLC based drives.
10	Study of power converters for Switched Reluctance Motor Drive.

Total Instructional Hours **45**

Course Outcome

CO1: Develop a power electronic circuit using simulation softwares.
CO2: Simulates a closed loop control of conveter fed electrical drives.
CO3: Identify a suitable power electronic converter for ax and dc motor.
CO4: Evaluate the speed controlling techniques for BLDC motor using DSP.
CO5: Examine the configuration of PLC drives for ac motor.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7701	PRESENTATION SKILLS AND TECHNICAL SEMINAR	0	0	4	2

Course Objective

1. Prepare electrical and electronics engineering developments and prepare and present on technical topics.
2. Usage of various teaching aids such as over head projectors, power point presentation and demonstrative models.

Description

During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.

A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL INSTRUCTIONAL HOURS 30

Course Outcome	At the end of this course students will be able to
CO1	Prepare and present a topic on engineering subjects.
CO2	Prepare and present general topics effectively with good communication skills.
CO3	Categorize the available teaching aids and use them in their presentations.
CO4	Discuss their ideas with confidence.
CO5	Transfer their technical or general knowledge to others with confidence.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EE7702	INDUSTRIAL TRAINING / INTERNSHIP	0	0	0	1

Course Objectives

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

The student shall undergo Internship / Industrial Training and the credits earned will be indicated in the grade sheet. The student is allowed to undergo 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 Industrial Training / Internship, 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.	16EE8901	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 andinternal examiners constituted by the Controller of Examination based on oral presentation and the project report.

Course Outcome

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

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PROFESSIONAL ELECTIVE-III

Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7301	MICROCONTROLLER BASED SYSTEM DESIGN	3	0	0	3

Course Objective

1. Explain the hardware architecture of the PIC microcontroller.
2. Extensive hands-on the PIC interrupts and timers.
3. Design and interfacing of microcontroller-based embedded systems.
4. Embedded system for ARM programming model will be introduced.
5. High-level languages are used to interface the Embedded ARM to various applications

UNIT	DESCRIPTION	TOTAL INSTRUCTIONAL HOURS
I	**INTRODUCTION TO PIC MICROCONTROLLER** Introduction to PIC Microcontroller – PIC 16C6x and PIC16C7x Architecture – PIC16cxx — Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.	9
II	**INTERRUPTS AND TIMER** PIC micro controller Interrupts - External Interrupts-Interrupt Programming – Loop time subroutine –Timers - Timer Programming – Front panel I/O-Soft Keys– State machines and key switches – Display of Constant and Variable strings.	9
III	**PERIPHERALS AND INTERFACING** I2C Bus for Peripherals Chip Access – Bus operation-Bus subroutines – Serial EEPROM — Analog to Digital Converter – UART - Baud rate selection – Data handling circuit – Initialization - LCD and keyboard Interfacing – ADC – DAC - and Sensor Interfacing.	9
IV	**INTRODUCTION TO ARM PROCESSOR** ARM Architecture – ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples – Architectural Support for Operating systems.	9
V	**ARM ORGANIZATION** 3-Stage Pipeline ARM Organization – 5 Stage Pipeline ARM Organization – ARM Instruction Execution - ARM Implementation– ARM Instruction Set – ARM coprocessor interface – Architectural support for High Level Languages – Embedded ARM Applications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Experience of working at the architecture of the PIC microcontrollers
CO2: Identify factors moving the data transfer and interrupts and timer in PIC microcontroller.CO3: Programme the controller for typical industrial Electronics application
CO4: write ARM Assembly Language program.
CO5: Embed the code in ARM processor for stand-alone system for embedded system designs.

TEXT BOOKS:

T1 Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
T2 Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

REFERENCE BOOKS:

R1 Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.
R2 Ajay V.Deshmukh' Microcontroller"[Theory and application].
R3 Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7302	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3

Course Objective

1.Apply knowledge of semiconductors and solid mechanics to fabricate MEMS devices
2.Analyze on the rudiments of Micro fabrication techniques
3.Differentiate various sensors and actuators
4.Categorize different materials used for MEMS
5. Interpret the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Intrinsic Characteristics of MEMS – Energy Domains and Transducers—Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis.	9
II	**MICRO SENSORS AND ACTUATORS** Micro sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor –Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micro magnetic components	9
III	**PIEZO ELECTRIC SENSORS AND ACTUATORS** Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements –Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators –piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.	9
IV	**MICROMACHINING AND MANUFACTURING** Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Case studies -Basic surface micro machining processes – LIGA Process - SLIGA-Micro system packaging-materials-Die level-device level-system level-packaging Techniques-die preparation-surface bonding-wire bonding-sealing.	9
V	**MICRO SYSTEM DESIGN** Design considerations-Process Design-Mask layout Design- Mechanical Design-Applications Of Micro Systems In Automotive Industry, Bio-Medical, Aerospace and Telecommunications.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Study and identify the types of semiconductors used in MEMS.
CO2: Analyze the Micro fabrication techniques.
CO3: Generalize the different Types Of Sensors And Actuators.
CO4: Design the different Materials used for MEMS.
CO5: Develop different components related to MEMS and apply in various Engineering disciplines.

TEXT BOOKS:

T1 Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
T2 Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill.

REFERENCE BOOKS:

R1 Nitaigour premchand Mahalik,"MEMS",Tata MCgrawhill publication 2008.
R2 P.Rai choudhury,"MEMS and MOEMS technology and applications",PHI learning pvt ltd,2012.
R3 Tephen D Senturia, 'Microsystem Design', Springer Publication, 2000.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7303	SOLAR PHOTOVOLTAIC FUNDAMENTALS & APPLICATIONS	3	0	0	3

Course Objective

1. Study the basic principles of solar energy - radiation and its measurements.
2. Describe the different methods of solar tracking system.
3. Compute the solar PV modules with solar cell technologies.
4. Customize the balance of solar PV system
5. Expose various applications of solar Photovoltaic system.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Sun's Energy Advantages-Energy conversion challenges- Solar Constant-Solar Radiation at the Earth's Surface-Solar Radiation-Geometry- Altitude angle-Zenith angle-Solar Azimuth angle-Surface Azimuth angle-Day Length-Local Solar Time(LST).Local Apparent Time (LAT)-Sunrise, Sunset and Day length.	9
II	**SOLAR RADIATION MEASUREMENT and SUN TRACKING** Solar Radiation Measurements : Angstrom Compensation Pyrheliometer- Pyranometer-Estimation of Average Solar Radiation-Solar Radiation on Tilted Surfaces-.Path of sun's motion- Tracking Types-Advantages and disadvantages-One axis tracking-Two axis tracking-Azimuth tracking.	9
III	**SOLAR PV MODULES** Solar cell Technologies-Types-Wafer based Si Technologies-Thin Film: Amorphous-Crystalline Si -Solar PV Modules from solar cells-Series and parallel connection of cells-Mismatch in cell / module- Mismatch in series and parallel connection- Hot spot in the module-Bypass diode-No. of solar cells in a module-Wattage of modules-PV module power output-I-V equation-Rating of PV modules & Arrays –Efficiency of solar cells.	9
IV	**BALANCE OF SOLAR PV SYSTEMS** Introduction to batteries-Factors affecting battery performance-Batteries for PV systems-Lead-acid, Nickel-Cadmium batteries-Comparison of batteries-Importance andTypes of charge controller- Necessity & types of inverter - Maximum Power Point Tracking (MPPT) System- Types (Qualitative approach only)	9
V	**APPLICATIONS OF PV SYSTEM** A Basic Photovoltaic Systems for power generation- Grid Interactive solar PV Power system-Applications of solar Photovoltaic system-Solar street lighting-home lighting system-Water pumping system-Communication equipment-Sea water desalination system-peltier cooling system.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Illustrate basics of solar photovoltaic systems, solar radiation and its measurements.
CO2: Characterize various solar tracking systems.
CO3: Practice the types and arrangement of PV modules.
CO4: Evaluate various level of balance of solar PV systems.
CO5: Generalize various solar photovoltaic applications.

TEXT BOOKS:

T1 Chetan Singh Solanki, 'Solar Photovoltaics Fundamentals,Technologies and Applications" -Third Edition, PHI Learning Private Limited, New Delhi, 2015

T2 B.H.Khan Non-Conventional Energy Sources", Tata McGraw-hill publishing Company, New Delhi, 2009.

REFERENCE BOOKS:

R1 Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2013.

R2 Rai. G.D., "Solar Energy Utilization", Khanna Publishers, New Delhi, 2005.

R3 D.P.Kothari,K.K.Singal,Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", Prentice-Hall of India Pvt. Limited, 2008

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7304	PROFESSIONAL ETHICS	3	0	0	3

Course Objective

1. Impart Knowledge To Students On Human Values /Morals /Ethics
2. Create Awareness On Engineering Ethics /Moral Issues Autonomy.
3. Make The Student Under Stand That Engineering Is Social Experimentation.
4. Develop Capability to analysis safely /responsibility rights of engineers.
5. Expose the students to the various global issues faced by engineers working in multinational corporations

Unit	Description	Instructional Hours
I	**HUMAN VALUES** Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment –Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management	9
II	**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 – Models of professional roles - Theories about right action – Self-interest – Customs and Religion	9
III	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics– A Balanced Outlook on Law.	9
IV	**SAFETY, RESPONSIBILITIES AND RIGHTS** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination	9
V	**GLOBAL ISSUES** Multinational Corporations – Environmental Ethics – Computer Ethics –Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Analyze various concepts and theories of engineering ethics.
CO2: Apply the concepts of ethics and analyze its impact on society.
CO3: Apply and analyze the concept of safety and risk in the light of engineering ethics.
CO4: Analyze and evaluate the rights and responsibility of engineers'.
CO5: Analyze the ethical issues engineers have to consider while operating globally.

TEXT BOOKS:

T1 Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
T2 Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS:

R1 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
R2 Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
R3 John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003

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PROFESSIONAL ELECTIVE-IV

Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7305	ADVANCED CONTROL THEORY	3	0	0	3

Course Objective

1. Design of Linear system
2. Analysis State space.
3. Describing function analysis.
4. Analyze the stability of the systems using different techniques.
5. Analyze the sampling process in control system

Unit	Description	Instructional Hours
I	**LINEAR SYSTEM DESIGN** Introduction to design using compensators-lag compensator-lead compensator-lag and lead compensator-PI,PD and PID controllers-feedback compensation.	9
II	**NON LINEAR SYSTEMS** Introduction to non linear system-describing function-describing function of dead zone and saturation non linearity- - describing function of relay with dead zone and hysteresis-describing function of backlash non linearity- describing function analysis of non linear system..	9
III	**SAMPLED DATA CONTROL SYSTEM** Introduction- sampling process –analysis of sampling process in frequency domain-reconstruction of sampled signals using hold circuits -discrete sequence (discrete time signal)-z transform-linear discrete time system-transfer function LDS system(pulse transform function)-analysis sampler and zero –order hold-analysis of system with impulse sampling-	9
IV	**STATE SPACE ANALYSIS** Introduction-state space formulation-state model of linear system-state diagram-state space representation using physical variables- state space representation using phase variables- state space representation using canonical variables-solution state equations-state space representation of discrete time systems.	9
V	**ANALYSIS AND DESIGN OF CONTROL SYSTEM IN STATE SPACE** Definitions involving matrices –Eigen values and Eigen vectors-similarity transformation –Cayley –Hamiltons theorem-transformations of state model-concepts of controllability and Observability.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Design compensators
CO2: Analyze non-linear systems using describing function
CO3: Represent state space by different variables
CO4: Analyze stability of sampled data control system
CO5: Design and control system in state space.

TEXT BOOKS:

T1 A. Nagoorkani ' Advanced control theory ' RBA publishers ,2nd edition 1999.
T2 I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers,2003

REFERENCE BOOKS:

R1 George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.
R2 M.Gopal, 'Modern control system theory', New Age International Publishers, 2002.
R3 Ogata, Modern Control Engineering, 4th edition , Prentice Hall ,2003.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7306	INTELLIGENT CONTROL TECHNIQUES	3	0	0	3

Course Objective

1. Introduce various soft computing frames works.
2. Impart knowledge about neural networks.
3. Explain various membership function s of fuzzy logic.
4. Outline genetic algorithm and its applications.
5. Figure out hybrid soft computing techniques

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SOFT COMPUTING TECHNIQUES** Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.	9
II	**NEURAL NETWORKS** Artificial neural net terminology, model of a neuron, Topology, Types of learning, Supervised, adaptive linear neuron, multiple adaptive linear neurons, BPN, Unsupervised Learning: Competitive learning, K-means clustering algorithm, Kohonen's feature maps. Introduction to Counter propagation Networks- CMAC Network, ART networks.	9
III	**FUZZY LOGIC** Membership functions, introduction to features of Membership functions, Methods of Membership values assignmrnts, Defuzzification methods. Fuzzy interference algorithm, fuzzy rules and approximate reasoning- mandani and TS method.	9
IV	**GENETIC ALGORITHM** Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle – stopping condition – constraints – classification genetic algorithm – multilevel optimization – real life problem- advantes and limitations of GA.	9
V	**HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS** Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers	9
	Total Instructional Hours	**45**

Course Outcome

CO1:Recognize the appropriate soft computing frame works
CO2: Identify and apply neural networks concepts in decision making applications.
CO3: Explore the various membership functions of fuzzy logic.
CO4: Observe genetic algorithm and its applications
CO5: Apply hybrid soft computing techniques in suitable tasks.

TEXT BOOKS:

T1 S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.
T2 S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education 2004.

REFERENCE BOOKS:

R1 S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis &Applications", Prentice-Hall of India Pvt. Ltd., 2006
R2 Timothy j ross fuzzy logic with engineering appilication second edition wiley studentedition 2005
R3 George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7307	COMMUNICATION ENGINEERING	3	0	0	3

Course Objective

1. Introduce the different methods of analog communication and their significance
2. Impart knowledge on Digital Communication methods for high bit rate transmission
3. Explain the concepts of data communication and coding techniques for enhancing rating of transmission of minimizing the errors in transmission.
4. Outline the MAC used in communication systems for enhancing the number of users.
5. Figure out various optical fiber modes, configurations and various signal degradation factors associated with optical fiber

Unit	Description	Instructional Hours
I	**ANALOG COMMUNICATION** Amplitude modulation and demodulation circuits – Frequency modulation and demodulation circuits - Super heterodyne radio receiver.	9
II	**DIGITAL COMMUNICATION** Pulse code modulation – concepts of sampling and sampling theormes, time division multiplexing - digital T-carrier system.-Digital radio system. - Digital modulation,- Frequency and phase shift keying – Modulator and demodulator - bit error rate calculation - applications of Data communication.	9
III	**DATA COMMUNICATION AND NETWORK PROTOCOL & ERROR CONTROL** Primary communication - Data Communication codes - error control - Serial and parallel interface - telephone network- data modem – ISDN- LAN- ISO - OSI seven layer architecture for WAN- Error control codes and applications - convolutions & block codes.	9
IV	**MULTIPLE ACCESS TECHNIQUES** SS&MA techniques : FDMA –TDMA – CDMA - SDMA application in wire and wireless communication : Advantages (merits)	9
V	**SATELLITE, OPTICAL FIB.E.R COMMUNICATION** Orbital satellites - geostationary satellites - look angles - satellite system link models- satellite system link equations - advantages of optical fibre communication - Light propagation through fibre -fibre loss, -light sources and detectors.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Experience on analog communication. and demodulation
CO2: Analyze the performance of a sampling and pass band digital communication system in terms of error rate and calculation .
CO3: Perform the network protocol and error control codes of the signals in a data communication system.
CO4: Know about the multiple access techniques, transmission medium and error control.
CO5: Gather expose on satellite and optical fibre communication.

TEXT BOOKS:

T1 Wayne Tomasi, Electronic Communication Systems, Pearson Education Asia Ltd, 3rd Edition, New Delhi, 2001

T2 Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill 2007.

REFERENCE BOOKS:

R1 J.Das "Principles of Digital Communication" New Age International, 1986.

R2 Kennedy and Davis "Electronic Communication Systems" Tata McGraw hill, 4th Edition, 1993.

R3 B.P.Lathi "Modern Digital and Analog Communication Systems" Oxford University Press, 1998.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE7308	SPECIAL ELECTRICAL MACHINES	3	0	0	3

Course Objective

1. Identify the special electrical motors for specific applications.
2. Select a suitable controller for controlling stepping motors.
3. Identify a suitable power converter for improving the performance of switched reluctance motors.
4. Describe the controllers for controlling the speed of permanent magnet brushless D.C. motors.
5. Discuss the sensorless control of permanent magnet synchronous motors.

Unit	Description	Instructional Hours
I	**SPECIAL ELECTRICAL MOTORS** Introduction to Special Electrical Machines - Constructional features and Working Principles: AC series motor - Repulsion motor - Hysteresis motor - Single phase Reluctance Motor - Universal Motor - AC & DC Servo motors - Applications	9
II	**STEPPER MOTORS** Introduction - Types of stepper motors - Constructional features - Principle of operation - Variable Reluctance motor - Single and multi stack configurations - Permanent Magnet Stepper Motor - Hybrid Stepper motor - Open loop control of 3 phase VR stepper motor - Torque equations - Characteristics - Microprocessor control of stepper motors - Applications	9
III	**SWITCHED RELUCTANCE MOTORS (SRM)** Introduction - SRM configurations - Rotary SRM - Constructional features - Principle of operation - Torque Equation and characteristics – Characteristics - Power Converters - Two switching devices per phase - (n+1) switching devices and (n+1) diodes – Split-link - C-dump - Rotor position sensor - Microprocessor based control of SRM drive - Sensor less operation - Applications	9
IV	**PERMANENT MAGNET BRUSHLESS D.C. MOTORS (PM BLDC)** Permanent Magnet materials - Construction - Electronic Commutation - Principle of Operation – BLDC Square wave Motor - Control of BLDC Motor - Microprocessor based control of BLDC Motor - DSP based control of BLDC Motor - Sensorless control of BLDC Motor - Applications	9
V	**PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)** Principle of operation - EMF and Torque equations - Phasor Diagram - Control of PMSM - Microprocessor based control of PMSM Motor - DSP based control of PMSM Motor - Sensorless control of PMSM Motor - Applications	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify various special electrical motors for specific applications.
CO2: Control the speed of the Stepper motor using an appropriate controller.
CO3: Select an appropriate power converter of Switched Reluctance Motor drive for different applications.
CO4: Develop a speed controller for Brushless DC Motors using microprocessor.
CO5: Illustrate the working of Permanent Magnet Synchronous Motor by using sensorless control.

TEXT BOOKS:

T1 E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.
T2 K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.

REFERENCE BOOKS:

R1 R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001
R2 P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
R3 T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

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PROFESSIONAL ELECTIVE-V

Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8301	APPLICATION OF POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	3	0	0	3

Course Objective

1. Impart the knowledge various operation and analysis of renewable energy systems.
2. Study the power converters used for PV systems.
3. Learn the power inverters used for Wind energy systems.
4. Analyze the Grid connection and its issues in renewable energy systems.
5. Enumerate the algorithm used for hybrid renewable energy systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell and hybrid renewable energy systems (Qualitative Study)	9
II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION** Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG. (Qualitative Study)	9
III	**POWER CONVERTERS** Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) – DC to DC Converter – types & comparison - Boost and buck-boost converters- selection of inverter, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters	9
IV	**ANALYSIS OF WIND AND PV SYSTEMS** Solar: Stand alone operation of solar system - Grid Integrated solar system - Grid connection Issues Wind: Stand alone operation of fixed and variable speed wind energy conversion systems and - Grid integrated PMSG, SCIG Based WECS- Grid connection Issues	9
V	**HYBRID RENEWABLE ENERGY SYSTEMS** Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV hybrid systems – Types of Maximum Power Point Tracking (MPPT) algorithm - Perturb and observe - Incremental conductance.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Familiarized the basic of renewable energy systems..
CO2: Design the different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
CO3: Analysis the operation of solar and wind systems at stand alone and Grid integrated system
CO4: Develop the hybrid renewable energy systems
CO5: Intend the algorithm of MPPT technique used in wind energy systems.

TEXT BOOKS:

T1 B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi, 2009.
T2 Rai. G.D, —Non conventional energy sources, Khanna publishes, 1993.

REFERENCE BOOKS

R1 Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
R2 Solanki Chetan Singh, "Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2011
R3 Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8302	BIOMEDICAL INSTRUMENTATION	3	0	0	3

Course Objective

1. Recall human physiological system and fundamentals of biomedical engineering.
2. Identify the non-electrical parameters of measurement systems.
3. Understand the electrical parameters of measurement systems and electrical safety.
4. Describe the various imaging techniques.
5. To learn about life assisting and therapeutic equipments.

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF BIOMEDICAL ENGINEERING** Cell and its structure – Resting and Action potential – Nervous system and its fundamentals - Physiological systems of thee body-Cardiovascular systems, Respiratory systems – Bioelectric signals- Basic components of a biomedical system.	9
II	**NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES** Measurement of blood pressure - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter.	9
III	**ELECTRICAL PARAMETERS ACQUISITION AND ELECTRICAL SAFETY** Electrodes – Limb electrodes – floating electrodes - Micro, needle electrodes–ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safetyin medical environment, shock hazards – leakage current	9
IV	**IMAGING TECHNIQUES AND ANALYSIS** Radio graphic and Fluoroscopic techniques – Computer Tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.	9
V	**LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES** Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Explain the human physiological system and fundamentals of biomedical engineering.
CO2: Examine the non-electrical parameters measurement systems.
CO3: Evaluate the electrical parameters measurement systems and electrical safety.
CO4: Analyze the various imaging techniques.
CO5: Enumerate the life assisting and therapeutic equipments.

TEXT BOOKS:

T1 Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
T2 Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCE BOOKS

R1 John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 1998.
R2 M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.
R3 Joseph J.carr and John M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, 2012

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8303	POWER SYSTEM DYNAMICS	3	0	0	3

Course Objective

1. Analyze the fundamentals of power system dynamics.
2. Teach dynamic modeling of a synchronous machine.
3. Describe the modeling of excitation and speed governing system.
4. Analyze the fundamental concepts of stability of dynamic systems.
5. Interpret and enhance the transient stability simulation of multi machine power system.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design – distinction between transient and dynamic stability.	9
II	**SYNCHRONOUS MACHINE MODELLING** Synchronous machine - flux linkage equations - Park's transformation - per unit conversion -normalizing the equations - equivalent circuit - current space model - flux linkage state space model - Sub-transient and transient inductances - time constants.	9
III	**MACHINE CONTROLLERS** Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. - function of speed governing systems.	9
IV	**TRANSIENT STABILITY** State equation for multi machine system with one axis model and simulation – modelling of multi-machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer.	9
V	**DYNAMIC STABILITY** System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact – linearization of the load equation for the one machine problem – simplified linear model – dynamic performance measure - small signal performance measures.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify the basics of power system dynamics.
CO2: Analyze dynamic modeling of a synchronous machine.
CO3: Develop the models for excitation and speed governing system.
CO4: Explain the fundamental concepts of stability of dynamic systems.
CO5: Examine the small signal stability problem in power systems.

TEXT BOOKS:

T1 P. Kundur, 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010

T2 M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8304	ENERGY MANAGEMENT AND ELECTRICAL SAFETY	3	0	0	3

Course Objective

1. Discuss the concepts of power factor, load management etc.
2. Interpret the various measures for energy conservation in electrical static machineries.
3. Infer the various measures for energy conservation in electrical rotating machineries.
4. Describe the illumination and energy efficient devices.
5. Illustrate the practical measures of Electrical Safety

Unit	Description	Instructional Hours
I	**BASICS OF ELECTRICAL ENERGY USAGE** Fuel to Power : Cascade Efficiency – Electricity Billing : Components & Costs – kVA – Need & Control – Determination of kVA demand & Consumption – Time of Day Tariff – Power Factor Basics – Penalty Concept for PF – PF Correction – Demand Side Management	9
II	**TRANSFORMERS & MOTORS** Transformer – Basics & Types – AVR & OLTC Concepts –Selection of Transformers – Performance Prediction - Energy Efficient Transformers – Motors : Specification & Selection – Efficiency / Load Curve – Load Estimation – Assessment of Motor Efficiency under operating conditions – Factors affecting performance – effects of Rewinding & Oversizing - Energy Efficient Motors	9
III	**FANS / PUMPS / COMPRESSORS** Basics – Selection – Performance Evaluation – Cause for inefficient operation – Energy conservation in Centrifugal pumps, Fans & Blowers, Air compressor – Energy consumption & energy saving potentials – Design consideration.	9
IV	**ILLUMINATION & ENERGY EFFICIENCY DEVICES** Specification of Luminaries – Types – Efficacy – Selection & Application – ENCON Avenues & Economic Proposition - New Generation Luminaries (LED / Induction Lighting) - Soft Starters / Auto Star – Delta – Star Starters / APFC / Variable Speed & Frequency Drives – Time Sensors – Occupancy Sensors	9
V	**ELECTRICAL SAFETY** Hazards of Electricity – Safety Procedures and methods – Grounding of Electrical systems and equipment – Accident prevention, Accident investigation, Rescue and first aid – safety training methods and systems	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Calculate different Electricity tariff , penalty concepts
CO2: Design energy efficient transformers
CO3: Identify the Energy saving opportunities in pumps
CO4: Design proper lighting scheme with Energy saving opportunities
CO5: Summarize the Electrical safety rules

TEXT BOOKS:

T1 Andreas Sumper, Angelo Baggini "Electrical Energy Efficiency: Technologies and Applications", John Wiley & Sons, 2012

T2 Frank Kreith, D. Yogi Goswami "Energy Management and Conservation Handbook", Second Edition, CRC Press, 2016

REFERENCE BOOKS:

R1 John Cadick, P.E.., Mary Capelli-Schellpfeffer, et.al., "Electrical Safety Handbook", Fourth Edition Mcgraw-hill, 2012

R2 Handbook on Energy Efficiency, TERI, New Delhi, 2001

R3 Kraushaar and Ristenen, "Energy and Problems of a Technical Society", 1993.

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PROFESSIONAL ELECTIVE-VI

Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8305	COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS	3	0	0	3

Course Objective

1. Familiarize with Finite Element Method as applicable for Electrical Engineering
2. Calculate the losses and electrical parameters in field and energy equations
3. Analyze steady state equations of AC machines
4. Explore the usage of organization of a typical CAD package
5. Develop the applications of design of several Electrical apparatus.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction - The Galerkin's Finite element method - Boundary conditions - Magnetostatic example - Non linear Problems : Representation of B-H curve - The basic Newton-raphson method for a single equation.	9
II	**COMPUTATION OF LOSSES, RESISTANCE AND INDUCTANCE** Conventional design procedures - Limitations - Computation of eddy current losses - Losses in an series winding - Inductance and Reactance - Calculation of Force and Torque : Ampere's force law - Maxwell's stress method - Using machine models to find Torque.	9
III	**AC MACHINES IN THE STEADY STATE** Basic configuration of Synchronous Machine - Steady state operation - Modeling considerations - Excitation calculations - Computation of Steady state reactances - Direct Axis Transient and Sub transient reactances. Frequency response curves	9
IV	**CAD PACKAGES** Elements of a CAD System - Pre-processing - Modeling - Meshing - Material properties- Boundary Conditions - Setting up solution - Post processing.	9
V	**DESIGN APPLICATIONS** Voltage Stress in Insulators - Capacitance calculation - Design of Solenoid Actuator - Inductance and force calculation - Torque calculation in Switched Reluctance Motor.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Identify an appropriate design using finite element analysis for electromagnetic study.
CO2: Derive the power and energy equations and calculate the electrical losses
CO3: Develop the mathematical model of steady state analysis for AC machines
CO4: Explain the concepts of organization of CAD packages.
CO5: Select the appropriate design procedures of different Electrical apparatus.

TEXT BOOKS:

T1 S.J Salon, 'Finite Element Analysis of Electrical Machines', Kluwer Academic Publishers, London, 1995
T2 Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor& Francis, 2005

REFERENCE BOOKS:

R1 P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
R2 D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986
R3 S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8306	INDUSTRIAL ELECTRONICS	3	0	0	3

Course Objective

1. Understand the concept of power supplies and filters
2. Analyze the firing circuits using power semiconductor devices
3. Study about the power converters
4. Analyze the control of electric drives using converters.
5. Study the applications of converters in industries.

Unit	Description	Instructional Hours
I	**POWER SUPPLIES** Introduction to power supply- filters and types – voltage multiplier: half wave and full wave voltage doubler- voltage regulator LM340- flyback converter.	9
II	**FIRING CIRCUITS** Overview of firing devices- firing characteristics of unijunction transistor- relaxation oscillator- thyristor firing using DIAC- different methods of triggering SCR circuits- causes of damage to SCRs.	9
III	**POWER CONVERTERS** Single phase parallel inverter with feedback diodes- single phase series inverter – AC chopper – Chopper control techniques- gas filled diode- loss of power in semiconductor devices.	9
IV	**MOTOR CONTROL** Zero voltage switch - Synchronous Tapchanger - phase control of DC motor- AC power control of a Lamp Dimmer- Chopper control of DC series Motor- Advantages of AC motor control over DC motor control.	9
V	**INDUSTRIAL APPLICATIONS** Battery charger circuit – dielectric heating - Online and offline Uninterrupted power supply – Switched mode power supply – Principle and application of induction heating.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Design the power supplies for electronic circuits
CO2: Design the firing circuits for converters
CO3: Choose the power converter for industrial application
CO4: Employ soft switching technique to control AC and DC motors.
CO5: Troubleshoot the various domestic and industrial appliances.

TEXT BOOKS:

T1 Biswanath paul, "Industrial Electronics and Control", Prentice Hall of India, 2002.
T2 Thomas E Kissell, "Industrial Electronics", Prentice Hall of India, 2006.

REFERENCE BOOKS:

R1 Akhilesh R Uadhayay, L P Singh, A K Gupta, "Industrial Electronics", Dhanpat Rai Publishing Company, 2005.
R2 Vanvalkenburgh, Nooger & Neville, "Solid State Electronics", Cengage Learning, 2009.
R3 Paul B Zbar, "Industrial Electronics", Tata McGraw Hill, 1983.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8307	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	3	0	0	3

Course Objective

1. Identify the concept and planning of HVDC power transmission
2. Discuss the HVDC converters
3. Study about the HVDC system control and reactive power
4. Correlate the harmonics and design of filters.
5. Review power flow and simulation of HVDC system.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction of DC power transmission technology-Comparison of AC and DC transmission-Types of DC link- description of converter station –Planning for HVDC transmission-Modern trends in HVDC technology-Applications of HVDC system-Types and applications of MTDC systems.	9
II	**ANALYSIS OF HVDC CONVERTER** Pulse number-Analysis of Line Commutated Converter (LCC)-Two and Three valve conduction mode- Three and Four valve conduction mode LCC Bridge characteristics-Rectifier-Inverter –Characteristics of 12 pulse converter.	9
III	**CONVERTER AND HVDC SYSTEM CONTROL** Principles of DC link control-starting and stopping of DC link-Control Characteristics – system control hierarchy-Firing angle control-Current and extinction angle control-Power control-Higher level controllers-Frequency and Power / Frequency control.	9
IV	**REACTIVE POWER AND HARMONIC CONTROL** Sources of reactive power-SVC-STATCOM-Generation of harmonics-Types of AC and DC Filters-Design of single tuned AC Filters-DC Filters-Active Filters-Power line Communication and RI Noise.	9
V	**POWER FLOW ANALYSIS AND SIMULATION OF HVDC SYSTEMS** Per unit system for DC quantities-DC system model-Power flow analysis-case study-HVDC system simulation: Philosophy, Tools and applications-HVDC system simulation-Digital dynamic Simulation.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Explain Planning and Modern trends in HVDC technology.
CO2: Design HVDC converter system.
CO3: Summarize the converter control configurations used in HVDC transmission
CO4: Generalize filters for eliminating harmonics and design of AC filters.
CO5: Criticize the power flow analysis and HVDC system simulation

TEXT BOOKS:

T1 Padiyar, K.R., "HVDC Power Transmission system",New Age International (P) Ltd., New Delhi, Second Edition, 2010

T2 Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971

REFERENCE BOOKS:

R1 Colin Adamson and Hingorani N G, "High Voltage Direct Current Transmission",Garraway Limitted, London,1960

R2 S.Kamakshaiah, V.Kamaraju, "HVDC Transmission",Tata Mc Graw Hill Education Private Limited, 2011.

R3 Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.

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Programme	Course Code	Name of the course	L	T	P	C
B.E.	16EE8308	TOTAL QUALITY MANAGEMENT	3	0	0	3

Course Objective

1. Analyse the quality concepts and determine the voice of the customer
2. Understand the TQM concepts like Employee Focus and their involvement, continuos process improvement and Supplier Management
3. Provide exposure to students on the basic and new seven management tools,Quality concepts like Six sigma, Failure mode effect analysis.
4. Explore industrial applications of Quality function deployment, taguchi quality concepts and TPM.
5. Impart detailed exposure to students on various quality systems like ISO and its standards.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction - Need for quality - Evolution of quality -Definitions of quality –Dimensions of product and service quality - Basic concepts of TQM -TQM Framework - Contributions of Deming, Juran - Barriers to TQM -Quality statements - Customer focus - Customer orientation, Customer Satisfaction, Customer complaints, Customer retention - Costs of quality.	9
II	**TQM PRINCIPLES** Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership –Supplier selection , Supplier Rating.	9
III	**TQM TOOLS AND TECHNIQUES I** The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types	9
IV	**TQM TOOLS AND TECHNIQUES II** Control Charts - Process Capability – Quality Function Development (QFD) – Taduchi Quality Loss Function - TPM - Concepts, improvement needs - Performance measures.	9
V	**QUALITY SYSTEMS** Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in Manufacturing and service sectors.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Gain basic knowledge in total quality management relevant to both manufacturing and service industry including IT sector.
CO2: Implement the basic principles of TQM in manufacturing and service based organization.
CO3: Apply the tools and techniques of quality management to manufacturing and services processes.
CO4: Apply the tools and techniques of quality management to manufacturing and services processes.
CO5: Gain the knowledge on various ISO standards and quality systems

TEXT BOOKS:

T1 Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006
T2 James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

REFERENCE BOOKS:

R1 Feigenbaum.A.V. "Total Quality Management", McGraw Hill.
R2 Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
R3 Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EE6401	INDUSTRIAL AUTOMATION – PLC AND SCADA	3	0	0	3

Course Objectives

1. Discuss the basic concepts involved in Programmable Logic Controllers
2. Interpret the Programmable Logic Controllers programming concepts
3. Cite the applications of Programmable Logic Controllers
4. Outline the basics of SCADA
5. Articulate the various SCADA communications and its applications.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO PLC** An Overview – Parts of PLC – Principles of Operation – Hardware Components – I/O Section – Discrete I/O Modules – Analog I/O Modules – Specifications – CPU – Memory Types – Human Machine Interface (HMI) – Processor Memory Organization – Program Scan.	9
II	**PLC PROGRAMMING** Basics of Ladder Diagram – Mnemonic Programming Code - Fundamental PLC Programming – Advanced Programming Techniques - Wiring Techniques – Programming Using Timers And Counters.	9
III	**PLC INSTRUCTIONS AND APPLICATIONS** Program Control Instructions – Data Manipulation Instructions – Math Instructions – Sequencer And Shift Register – Motor Controls – Closed Loop And PID Control – Case Studies in PLC.	9
IV	**INTRODUCTION TO SCADA** Evolution – Definition – Architecture - Remote Terminal Units (RTU) -Master Terminal Units (MTU) – Sensors, Actuators And Wiring - Intelligent Electronic Devices (IED) - Operator Interface.	9
V	**SCADA COMMUNICATIONS AND APPLICATIONS** Fundamentals of SCADA Communications – Basics of SCADA Protocols: DNP3, IEC 60870-5 – Ethernet And TCP/IP Networks – Profibus – Foundation Fieldbus. Applications: Substation Automation - Petroleum Wellhead Pump Control – Water Purification System – Crane Control.	9
	Total Instructional Hours	45

Course Outcomes

CO1: Demonstrate the knowledge of Programmable Logic Controllers
CO2: Develop Programs using ladder diagram.
CO3: Correlate the applications of PLC in various domains.
CO4: Summarise the basic concepts involved in SCADA System.
CO5: Analyze about communication standards in SCADA.

TEXT BOOKS:

T1 - F.D. Petruzella, 'Programmable Logic Controllers', Tata Mc-Graw Hill, Third Edition, 2010.
T2 - Stuart A. Boyer, 'SCADA- Supervisory Control and Data Acquisition', The Instrumentation, Systems and Automation (ISA) Society, USA, Third Edition, 2004.

REFERENCE BOOKS:

R1 - Ronald L.Krutz, 'Securing SCADA Systems', Wiley Publishing Inc. 2006.
R2 - David Bailey, Edwin Wright, 'Practical SCADA for Industry' Newnes - Elsevier Publications, 2003.
R3 - Gordon Clarke, Deon Reynders, 'Practical Modern SCADA protocols', Newnes - Elsevier Publications, 2004. R4 - John R.Hackworth, Frederick D.Hackworth, Jr, 'Programmable Logic Controllers: Programming Methods and Applications', Prentice Hall Publications, First Edition, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16EE7402	LABVIEW FOR ENGINEERING APPLICATIONS	3	0	0	3

Course Objective

6. Infer the knowledge about virtual instrumentation.
7. Transform the conventional programming to data flow programming.
8. Discuss the various instrument interface and protocol.
9. Integrate the hardware with LabVIEW Programming via DAQ system.
10. Build the application via graphical programming knowledge.

Unit	Description	Instructional Hours
I	**INTRODUCTION** Architecture of Virtual Instrumentation – Virtual Instruments Vs Traditional Instruments – Graphical System Design using LabVIEW-Conventional and Graphical Programming.	9
II	**GRAPHICAL PROGRAMMING AND LabVIEW** Concepts of graphical programming – LABVIEW software – Concept of VIs and sub VI - Loops - Structures - Arrays – Clusters-Local and global variables – String and file I/O.	9
III	**INSTRUMENT INTERFACES AND PROTOCOLS** RS232, RS422, RS485 and USB standards - IEEE 488 standard – Introduction to bus protocols of MOD bus and CAN bus.	9
IV	**DATA ACQUISITION (DAQ) AND INSTRUMENT CONTROL** Components of DAQ- Hardware components of DAQ -Analog I/O and Digital I/O- Configuration of DAQ -Instrument control: VISA, GPIB.	9
V	**ADVANCED LABVIEW APPLICATIONS** Applications of LabVIEW: Process control, Biomedical, Image acquisition and Processing, Power quality monitoring.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Interpret knowledge on virtual instrumentation using LabVIEW.
CO2: Perform the basic programming with LabVIEW palettes.
CO3: Outline concept of various instrument interfaces with LabVIEW.
CO4: Employ the role of DAQ concepts for interfacing hardware components.
CO5: Implementing the LabVIEW in various engineering application.

TEXT BOOKS:

T1 - Sanjay Gupta and Joseph John, "Virtual Instrumentation using LabVIEW", Tata McGraw-Hill, Second Edition, 2010.
T2 - Jovitha Jerome, "Virtual Instrumentation using LabVIEW" Prentice Hall, 2010.

REFERENCE BOOKS:

R1 - Gary W. Johnson, Richard , "LabVIEW Graphical Programming", Tata McGraw Hill Professional Publishing, 2006.
R2 - Lisa K Wells & Jeffrey Travels, "LabVIEW for Everyone", Prentice Hall, 2003.
R3 - Robert H. Bishop, "Learning with LabVIEW", Prentice Hall, 2009.
R4 - Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes - Elsevier Publications, 2000.

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

SEMESTER I (R2019-Ammenment)

Course Code & Name 21HE1101- Technical English

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21MA1103- Calculus and Differential Equations

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21PH1151- Applied Physics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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	1.333333	-	-	-	-	-	1	2.4	2.4

Course Code & Name 21CY1151- Chemistry for Engineers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21CS1151- Python Programming and Practices

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21ME1152- Engineering Drawing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21HE2101- Business English for Engineers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21MA2102- Complex Variables and Transform Calculus

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21PH2151- Material Science

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21CY2151- Environmental Studies

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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	-	-

Course Code & Name 21CS2152- Essentials of C & C++ Programming

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 21EE2151- Circuit Theory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2												3	3
CO2		2											3	3
CO3		1	1										3	
CO4													3	3
CO5			1		1								3	3
Avg	2	1.5	1		1								3	3

Course Code & Name 21ME2001- Engineering Practices

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	3	-	1	-	1	-	-	-	1	2
CO2														
CO3														
CO4														
CO5														
Avg	3	-	3	-	3	-	1	-	1	-	-	-	1	2

Semester – III R2019

Course Code & Name 19MA3102- Fourier Analysis and Transforms

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 19EE3201- Electronic Devices and Circuits

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2				1				1	3	3
CO2	2	2	3	2				1				1	3	3
CO3	3	2	3	2				1				1		3
CO4	2	2	3	2				1				1		3
CO5	2	2	3	2				1				1		3
Avg	2.2	2	3	2	0	0	0	1	0	0	0	1	3	3

Course Code & Name 19EE3202- Electrical Machines I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	1	0	0	1	0	0	0	1	3	0
CO2	3	3	1	1	1	0	0	1	0	0	0	1	3	0
CO3	3	3	1	1	1	0	0	1	0	0	0	1	3	0
CO4	3	3	1	2	1	0	0	1	0	0	0	1	3	0
CO5	3	3	1	2	1	0	0	1	0	0	0	1	3	0
Avg	3	3	1	1.4	1			1				1	3	

Course Code & Name 19EE3203- Field Theory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	1	-	-	-	-	-	3	-
CO2	3	3	1	2	-	-	1	-	-	-	-	-	3	-
CO3	3	3	2	2	-	-	1	1	-	-	-	-	3	-
CO4	3	2	1	1	-	2	1	1	-	-	-	-	3	-
CO5	3	2	2	2	-	2	2	2	-	-	-	-	3	-
Avg	3	2.6	1.6	1.8	-	2	1.2	1.3	-	-	-	-	3	-

Course Code & Name 19EE3251- Electrical and Electronic Measurements

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	1	2	2	0	3	0	3	3	3	0
CO2	3	2	1	3	1	2	2	0	3	0	0	1	3	3
CO3	3	2	1	3	1	2	2	0	3	0	0	1	3	0
CO4	2	2	1	3	1	2	2	0	3	0	0	1	3	3
CO5	3	2	1	3	1	2	2	0	3	0	0	1	3	0
Avg	2.6	2	1.2	3	1	2	2	0	3	0	3	1.4	3	3

Course Code & Name 19EE3001- Electronic Devices and Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1				3	3			2			3	1	3	3
CO2			3	3	3			2			3	1	3	3
CO3		3	3	3				2			3	1	3	3
CO4		3	3	3				2			3	1	3	3
CO5								2			3	1	3	3
Avg	0	3	3	3	3	0	0	2	0	0	3	1	3	3

Course Code & Name 19EE3002- Electrical Machines Laboratory I

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	1	0	0	0	0	1	0	0	0	3	0
CO2	3	3	0	1	0	0	0	0	1	0	0	0	3	3
CO3	3	3	0	1	0	0	0	0	1	0	0	0	3	3
CO4	3	3	0	1	0	0	0	0	1	0	0	0	3	0
CO5	3	3	0	1	0	0	0	0	1	0	0	0	3	0
Avg	3	3		1					1				3	3

SEMESTER IV

Course Code & Name 19MA4101- Numerical Methods

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
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

Course Code & Name 19EE4201- Electrical Machines II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	0	0	0	1	0	0	0	0	3	0
CO2	2	2	1	1	0	0	0	1	0	0	0	0	3	0
CO3	3	3	1	2	0	0	0	1	0	0	0	0	3	0
CO4	3	3	1	1	0	0	0	1	0	0	0	0	3	0
CO5	3	3	1	1	0	0	0	1	0	0	0	0	3	0
Avg	3	3	1	1.4				1					3	

Course Code & Name 19EE4202- Integrated Circuits and its Applications

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	3	2	1	2	0	2	2	3	3	3
CO2	3	3	3	3	3	2	1	2	0	3	0	3	3	3
CO3	3	3	3	3	3	2	1	2	0	3	0	3	3	3
CO4	3	3	3	3	3	2	0	2	0	2	0	3	3	3
CO5	2	3	3	3	3	2	0	2	0	2	0	3	3	3
Avg	2.6	3	3	2.8	3	2	1	2	0	2.667	2	3	3	3

Course Code & Name 19EE4203 Digital Signal Processing

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3			2	1				3	3	3
CO2	2	2	3	2				1					3	3
CO3	3	3	3	2			2	1					3	3
CO4	3	3	3				1	1				3	3	3
CO5	3	3	3				1	1				3	3	3
Avg	2.6	2.6	3	2.3	0	0	1.5	1	0	0	0	3	3	3

Course Code & Name 19EE4251 Digital Logic Circuits

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	1	2	1	2	3	2	0	3	3	0
CO2	2	3	2	3	3	2	1	2	3	2	0	3	3	0
CO3	3	3	2	3	3	2	2	2	3	2	0	3	3	0
CO4	2	3	2	3	3	2	1	2	3	2	0	3	3	3
CO5	3	3	2	3	3	2	2	2	3	2	0	3	3	3
Avg	2.4	2.8	2.2	2.8	2.6	2	1.4	2	3	2	0	3	3	3

Course Code & Name 19EE4001 Electrical Machines Laboratory II

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	0	0	0	1	1	0	0	0	3	0
CO2	3	3	1	1	0	0	0	1	1	0	0	0	3	3
CO3	3	3	1	1	0	0	0	1	1	0	0	0	3	0
CO4	3	3	1	1	0	0	0	1	1	0	0	0	3	3
CO5	3	3	1	1	0	0	0	1	1	0	0	0	3	0
Avg	3	3	1	1				1	1				3	3

Course Code & Name 19EE4002- Integrated Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	2	1	3	3	3	0	3	3	3
CO2	3	3	2	3	3	2	1	3	3	3	0	3	3	3
CO3	3	3	3	3	3	2	1	3	3	3	0	3	3	3
CO4	3	3	3	3	3	2	1	3	3	3	0	3	3	3
CO5	2	3	3	3	3	2	1	3	3	3	0	3	3	3
Avg	2.8	3	2.6	3	3	2	1	3	3	3	0	3	3	3

SEMESTER V

Course Code & Name 19EE5201 Design of Electrical Machines

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1	0	0	1	0	0	0	1	3	0
CO2	3	3	1	2	1	0	0	1	0	0	0	1	3	3
CO3	3	3	1	2	1	0	0	1	0	0	0	1	3	3
CO4	3	3	1	2	1	0	0	1	0	0	0	1	3	0
CO5	3	3	1	2	1	0	0	1	0	0	0	1	3	0
Avg	3	3	1	2	1			1				1	3	3

Course Code & Name 19EE5202- Renewable and Non-Renewable Energy Sources

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3		3		3			3	3	3
CO2	3	3	3	3	3		3		3			3	3	3
CO3	3	3	3	3	3		3		3			3	3	3
CO4	3	3					3					3	3	3
CO5	3	3					3					3	3	3
Avg	3	3	3	3	3		3		3			3	3	3

Course Code & Name 19EE5203- Microprocessors and Microcontrollers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	3	-	-	-	2	-	-	-	-	3	2
CO2	2	2	2	3	-	-	-	1	-	-	-	-	3	2
CO3	2	2	2	3	2	-	-	1	-	-	-	-	3	2
CO4	2	1	2	3	2	-	-	1	-	-	-	-	3	2
CO5	2	1	2	3	-	-	-	1	-	-	-	-	3	2
Avg	2	1.4	2	3	2	-	-	1.2	-	-	-	-	3	2

Course Code & Name 19EE5204- Transmission and Distribution

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2		2	2					2	3	
CO2	3	3	2	2	2							2	3	3
CO3	3	3	2	2	2							2	3	3
CO4	3	3		2	2		2					2	3	3
CO5	3	2	2		2							2	3	3
Avg	3	3	2	2	2	2	2					2	3	3

Course Code & Name 19EE5301- Fibre Optics and Laser Instruments

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	0	0	0	0	3	3
CO2	0	2	0	0	0	0	0	0	0	0	0	0	3	0
CO3	0	1	1	0	0	2	0	0	0	0	0	0	3	
CO4	0	0	0	0	0	0	0	0	1	0	1	0	3	0
CO5	0	0	1	1	1	0	0	0	0	0	0	0	3	3
Avg	3	1.5	1	1	1	2	0	0	1	0	1	0	5	3

Course Code & Name 19EE5251- Control Systems Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	0	0	0	0	0	0	0	1	3	0
CO2	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO3	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO4	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO5	3	3	2	3	3	0	0	0	3	0	0	1	3	3
Avg	3	3	2	3	3	0	0	0	3	0	0	1	3	3

Course Code & Name 19EE5001- Control and Instrumentation Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO2	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO3	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO4	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO5	3	3	3	3	3	0	0	2	3	3	0	3	3	3
Avg	3	3	3	3	3	0	0	2	3	3	0	3	3	3

Course Code & Name 19EE5002- Microprocessors and Microcontrollers Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	-	-	-	2	-	1	-	3	3	2
CO2	2	2	3	3	-	-	-	1	-	1	-	3	3	2
CO3	3	2	2	3	3	-	-	2	-	2	-	3	3	2
CO4	3	2	3	3	3	-	-	2	-	2	-	3	3	2
CO5	2	2	2	3	-	-	-	1	-	1	-	3	3	2
Avg	2.4	2.2	2.4	3	3	-	-	1.6	-	1.4	-	3	3	2

SEMESTER VI

Course Code & Name 19EE6181- Industrial Safety Management

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3		3										2	
CO2	1	3	2		2								2	
CO3	2	1	3		2								3	
CO4	2	3	1		1								2	
CO5	2	2	2		2									
Avg	2	2.25	2.2		1.75								2.25	

Course Code & Name 19EE6201- Power Electronics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3			2	1				3	3	3
CO2	3	3	3	3				1					3	3
CO3	3	3	3	3			2	1					3	3
CO4	3	3	3	3			1	1				3	3	3
CO5	3	3	3	3			1	1				3	3	3
Avg	3	3	3	3	0	0	1.5	1	0	0	0	3	3	3

Course Code & Name 19EE6202- Power System Analysis

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	0	0	0	1	0	0	0	3	0
CO2	3	3	1	2	1	0	0	0	1	0	0	0	3	3
CO3	3	3	1	2	1	0	0	0	1	0	0	1	3	3
CO4	3	3	1	2	1	0	0	0	1	0	0	1	3	0
CO5	3	2	1	2	1	0	0	0	1	0	0	1	3	0
Avg	3	3	1	2	1				1			1	3	3

Course Code & Name 19EE6303- Flexible AC Transmission Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2									3	
CO2	3	3	3	2	2				3			3	3	3
CO3	3	3	3	2	2				3			3	3	3
CO4	3	3	3	2	3				3			3	3	3
CO5	3	3	3	2	3				3			3	3	3
Avg	3	3	3	2	2.5				3			3	3	3

Course Code & Name 19EE6251- Embedded Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	3	0	2	3	1	3	0	3	3	0
CO2	2	2	3	3	3	0	1	3	1	3	0	3	3	0
CO3	3	3	2	3	3	2	1	3	1	3	0	3	3	3
CO4	3	2	3	3	3	2	2	3	1	3	0	3	3	3
CO5	2	2	3	3	3	2	1	3	1	3	0	3	3	3
Avg	2.4	2.2	2.6	3	3	1.2	1.4	3	1	3	0	3	3	3

Course Code & Name 19EE6001- Power Electronics Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3				1				3	3	3
CO2	3	3	3	3				1				3	3	3
CO3	3	3	3	3				1				3	3	3
CO4	3	3	3	3				1				3	3	3
CO5	3	3	3	3				1				3	3	3
Avg	3	3	3	3	0	0	0	1	0	0	0	3	3	3

Course Code & Name 19EE6002 - Control Wiring and Circuit Design Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3					3			3	3	3
CO2	3	3	3	3					3			3	3	3
CO3	3	3	3	3					3			3	3	3
CO4	3	3	3	3	3				3			3	3	3
CO5	3	3	3	3	3				3			3	3	3
Avg	3	3	2	2	3				3			3	3	3

SEMESTER VII

Course Code & Name 16EE7201- Solid State Drives

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1		3												
CO2		3												
CO3		3			1									
CO4			3		2								2	
CO5			3		2								2	
Avg		3	3		1.6								2	

Course Code & Name 16EE7202- Electrical Energy Utilization and Conservation

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	1					1					1			1
CO2	1										1			2
CO3	1										1	1		2
CO4	1										1			2
CO5	1				2	1					1			2
Avg	1				2	1					1	1		1.8

Course Code & Name 16EE7203- Power System Operation and Control

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2		2										
CO2		3	2	2	2								2	
CO3		3	2	2									2	
CO4		3		2									2	
CO5		3		2									3	
Avg	3	2.8	2	2	2								2.25	

Course Code & Name 16EE7303- Solar Photo Voltaic Fundamentals & Applications

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	3		3			2						3	
CO2	3			3			2	2					3	3
CO3	3	2			3								3	3
CO4	2				3		3	3						3
CO5	2				3									3
Avg	2.6	2.5		3	3		2.3	2.5					3	3

Course Code & Name 16EE7308- Special Electrical Machines

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3		3										2	
CO2	1	3	2										2	
CO3	2	1	3										3	
CO4	2	3	1										2	
CO5	2	2	2											
Avg	2	2.25	2.2										2.25	

Course Code & Name 16EE7001- Drives and Control Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1					2								2	
CO2					2								2	
CO3	3													
CO4	3													
CO5	3													
Avg	3				2								2	

SEMESTER VIII

Course Code & Name 16EE8301- Application of Power Electronics for Renewable Energy Systems

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	2					2	2							2
CO2	1	1	3				1						2	1
CO3	1	2	2				1						1	1
CO4	2	2					1						2	2
CO5	2	1					1						1	1
Avg	1.6	1.5	2.5			2	1.2						1.5	1.4

Course Code & Name 16EE8307- High Voltage Direct Current Transmission

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	2	2	2	2									2	
CO3	2	2	2	2									2	
CO4	3	3	2	2									2	
CO5	2	2	2											
Avg	2.4	2.2	2	2									2	

Chairman Board of Studies

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