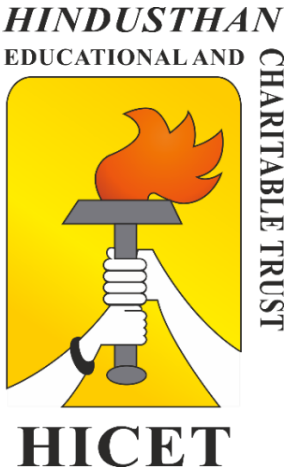
HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

(Approved by AICTE, New Delhi, Accredited by NAAC with 'A' Grade)

Valley Campus, Pollachi Highway, Coimbatore 641 032.

B. E. ELECTRICAL AND ELECTRONICS ENGINEERING



Common to all B.E. / B.Tech. Degree Programmes

(CHOICE BASED CREDIT SYSTEM)

Curriculum & Syllabus

2023-2024

CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING (UG)

REGULATION- 2022 & 2019
For the students admitted during the academic year 2023-2024 and onwards
SEMESTER I

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22MA1101	Matrices and Calculus (common to all branches)	BSC1	3	1	0	4	4	40	60	100
THEORY WITH LAB COMPONENT											
2.	22HE1151	English for Engineers (Common to all branches)	HSC1	2	0	2	3	4	50	50	100
3.	22CY1151	Chemistry for Circuit Engineering	BSC2	2	0	2	3	4	50	50	100
4.	22ME1201	Engineering Drawing	ESC 1	1	0	4	3	5	50	50	100
5.	22CS1151	Problem Solving using C Programming	ESC2	2	0	2	3	4	50	50	100
EEC COURSES (SE/AE)											
6.	22HE1071	UHV (Common to all)	AEC	2	0	0	2	3	40	60	100
7.	22HE1072	Entrepreneurship & Innovation (Common to all)	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
8.	22MC1091/ 22MC1092	தமிழரும்தொழில்நுட்பமும் / Indian Constitution	MC	2	0	0	0	2	0	0	0
			TOTAL	**15**	**1**	**10**	**19**	**27**	**380**	**320**	**700**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22MA2102	Differential Equations and Laplace Transforms	BSC3	3	1	0	4	4	40	60	100
2.	22CY2101	Environmental Studies (Common to all)	ESC3	2	0	0	2	3	40	60	100
3.	22PH2101	Basics of Material Science	BSC4	2	0	0	2	3	40	60	100
4.	22EE2201	Basics of Electrical and Communication Engineering	PCC	3	0	0	3	3	50	50	100

THEORY WITH LAB COMPONENT											
5.	22HE2151	Effective Technical Communication (Common to all)	HSC2	2	0	2	3	4	50	50	100
6.	22PH2151	Physics For Circuit Engineering	BSC5	2	0	2	3	4	50	50	100
PRACTICAL											
7.	22ME2001	Engineering Practices(Common to all)	ESC	0	0	4	2	2	60	40	100
EEC COURSES (SE/AE)											
8.	22HE2071	Design Thinking(Common to all)	AEC	2	0	0	2	2	100	0	100
9.	22HE2072	Soft Skills -1(Common to all)	AEC	1	0	0	1	1	100	0	100
MANDATORY COURSE											
10.	22MC2091/ 22MC2092	தமிழர்மரபு / Heritage of Tamil	MC	2	0	0	0	1	0	0	0
11.	22MC2093	NCC */NSS / YRC / Sports / Clubs / Society Service - Enrollment (Common)	MC	All students shall enroll, on admission, in anyone of the personality and character development programmes and undergo training for about 80 hours							-
			TOTAL	**19**	**1**	**8**	**22**	**27**	**520**	**380**	**900**

For the students admitted during the academic year 2022-2023 and onwards
SEMESTER III

S. No	Course Code	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22MA3102	Complex Analysis and Transforms	BSC	3	1	0	4	4	40	60	100
2.	22EE3201	Electronic Devices and Circuits	PCC	3	0	0	3	3	40	60	100
3.	22EE3202	Electric Circuit Analysis	PCC	3	1	0	4	4	40	60	100
4.	22EE3203	Field Theory	PCC	3	0	0	3	4	40	60	100
THEORY WITH LAB COMPONENT											
5.	22EI3251	Digital Electronics	ESC	2	1	2	4	4	50	50	100
PRACTICAL											
6.	22EE3001	Electric Circuits Laboratory	ESC	0	0	4	2	4	60	40	100
7.	22EE3002	Electronic Devices and Circuits Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
8.	22HE3071	Soft Skills and Aptitude - II	SEC	1	0	0	1	1	100	0	100
9.	22HE3072	Fundamentals of JAVA Programming	AEC	2	0	0	2	2	40	60	100
MANDATORY COURSE											
10	22MC3191	Essentials of Indian Traditional Knowledge	MC	2	0	0	0	2	0	0	0
			TOTAL	**17**	**3**	**10**	**25**	**30**	**470**	**430**	**900**

SEMESTER IV

S. No	CourseCode	Course Title	Category	L	T	P	C	TCP	CIA	ESE	Total
THEORY											
1.	22HE4101	IPR and Start-ups	HSC	2	0	0	2	2	40	60	100
2.	22EE4201	Electrical Machines -I	PCC	3	0	0	3	3	40	60	100
3.	22EE4202	Integrated Circuits and Its Applications	PCC	3	1	0	4	4	40	60	100
4.	22EE4203	Transmission and Distribution	PCC	3	0	0	3	3	40	60	100
5.	22EE4204	Power Plant Engineering	PCC	3	0	0	3	3	40	60	100
THEORY WITH LAB COMPONENT											
6.	22EI4251	Electrical and Electronic Measurements	PCC	2	0	2	3	4	50	50	100
PRACTICAL											
7.	22EE4001	Electrical Machines- I Laboratory	PCC	0	0	4	2	4	60	40	100
8.	22EE4002	Integrated Circuits Laboratory	PCC	0	0	4	2	4	60	40	100
EEC COURSES (SE/AE)											
9.	22HE4071	Soft Skills -III	SEC	1	0	0	1	1	100	0	100
10.	22EE4701	Internship - I*	SEC4	-	-	-	1		100	0	100
			TOTAL	**17**	**1**	**10**	**24**	**28**	**570**	**430**	**1000**

* Two weeks internship carries 1 credit and it will be done during Semester III summer vacation and same willbeevaluated in Semester IV.
If students unable to undergo in semester III, then the Internship I offered in the semester IV can be clubbed withInternship II (Total: 4 weeks-2 credits)

For the students admitted during the academic year 2021-2022 and onwards

SEMESTER V

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21EE5201	Design of Electrical Machines	PC	3	0	0	3	25	75	100
2	21EE5202	Renewable and Non-Renewable Energy Sources	PC	3	1	0	4	25	75	100
3	21EE5203	Microprocessors and Microcontrollers	PC	3	0	0	3	25	75	100
4	21EE5204	Transmission and Distribution	PC	3	0	0	3	25	75	100

5	21EE53XX	**Professional Elective -I**	PE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
6	21EE5251	Control Systems Engineering	PC	2	0	2	3	50	50	100
PRACTICALS										
7	21EE5001	Control and Instrumentation Laboratory	PC	0	0	3	1.5	50	50	100
8	21EE5002	Microprocessors and Microcontrollers Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	21HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	21HE5072	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	21EE6181	Industrial Safety Management	HS	3	0	0	3	25	75	100
2	21EE6201	Power Electronics	PC	3	0	0	3	25	75	100
3	21EE6202	Power System Analysis	PC	3	0	0	3	25	75	100
4	21EE63XX	**Professional Elective -II**	PE	3	0	0	3	25	75	100
5	21XX64XX	**Open Elective– I**	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
6	21EE6251	Embedded Systems	PC	2	0	2	3	50	50	100
PRACTICALS										
7	21EE6001	Power Electronics Laboratory	PC	0	0	3	1.5	50	50	100
8	21EE6002	Control Wiring and Circuit Design Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY COURSES										
9	21EE6701	Internship Training	EEC	0	0	0	1	0	100	100
10	21HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
11	21HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
			Total	**19**	**0**	**8**	**24**	**475**	**625**	**1100**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE II										
1	21EE6301	Industrial Automation	PE	3	0	0	3	25	75	100
2	21EE6302	Electric Vehicle Mechanics and Control	PE	3	0	0	3	25	75	100
3	21EE6303	Flexible AC Transmission Systems	PE	3	0	0	3	25	75	100
4	21EE6304	Electrical Estimation and Costing	PE	3	0	0	3	25	75	100
5	21EE6305	Principles of Robotics	PE	3	0	0	3	25	75	100

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

SEMESTER VII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19EE7201	Solid State Drives	PC	3	0	0	3	25	75	100
2	19EE7202	Protection and Switchgears	PC	3	0	0	3	25	75	100
3	19EE73XX	**Professional Elective-III**	PE	3	0	0	3	25	75	100
4	19XX74XX	**Open Elective – II**	OE	3	0	0	3	25	75	100
THEORY WITH LAB COMPONENT										
5	19EE7251	Power System Operation and Control	PC	2	0	2	3	50	50	100
PRACTICALS										
6	19EE7001	Electric Drives and Control Laboratory	PC	0	0	3	1.5	50	50	100
7	19EE7002	Power System Simulation Laboratory	PC	0	0	3	1.5	50	50	100
PROJECT WORK										
8	19EE7901	Project Work – Phase I	EEC	0	0	4	2	50	50	100
			Total	**14**	**0**	**12**	**20**	**300**	**500**	**800**

SEMESTER VIII

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19EE83XX	**Professional Elective – IV**	PE	3	0	0	3	25	75	100
2	19EE81XX	**Professional Elective- V**	PE	3	0	0	3	25	75	100
PROJECT WORK										
3	19EE8901	Project Work – Phase II	EEC	0	0	16	8	100	100	200
			Total	**6**	**0**	**16**	**14**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	Category	L	T	P	C	CIA	ESE	TOTAL
PROFESSIONAL ELECTIVE III										
1	19EE7301	High Voltage Engineering	PE	3	0	0	3	25	75	100
2	19EE7302	Electrical Energy Utilizatio n and Conservation	PE	3	0	0	3	25	75	100
3	19EE7303	Internet of Things	PE	3	0	0	3	25	75	100
4	19EE7304	Nano Technology	PE	3	0	0	3	25	75	100
5	19EE7305	Wireless Sensor Network	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE IV										
1	19EE8301	Special Electrical Machines	PE	3	0	0	3	25	75	100
2	19EE8302	Microcontroller Based System Design	PE	3	0	0	3	25	75	100
3	19EE8303	Smart Grid	PE	3	0	0	3	25	75	100
4	19EE8304	Advanced Soft Computing	PE	3	0	0	3	25	75	100
5	19EE8305	Power Quality	PE	3	0	0	3	25	75	100
PROFESSIONAL ELECTIVE V										
1	19EE8306	Preventive Maintenance of Electrical Apparatus	PE	3	0	0	3	25	75	100
2	19EE8307	High Voltage Direct Current Transmission	PE	3	0	0	3	25	75	100
3	19EE8308	Energy Auditing and Energy Management	PE	3	0	0	3	25	75	100
4	19EE8309	Application of Power Electronics For Renewable Energy Systems	PE	3	0	0	3	25	75	100
5	19EE8310	Intellectual Property Rights	PE	3	0	0	3	25	75	100

LIST OF OPEN ELECTIVES										
S.No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**	**CIA**	**ESE**	**TOTAL**
1	19EE6401	Fundamentals of Solar Energy & its Applications	OE	3	0	0	3	25	75	100
2	19EE7401	Electric Vehicles	OE	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.

****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

R2022

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

R2019 (Amend)

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

R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	19	22	25	24	21	24	20	10	165

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Dean Academics
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Principal

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH *
Chairman

SEMESTER I

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	**22MA1101**	**MATRICES AND CALCULUS (Common to all Branches)**	3	1	0	4

The learner should be able to

Course Objective

1. Construct the characteristic polynomial of a matrix and use it to identify eigen values and Eigenvectors
2. Impart the knowledge of sequences and series.
3. Analyse and discuss the maxima and minima of the functions of several variables.
4. Evaluate the multiple integrals and apply in solving problems.
5. Apply vector differential operator for vector function and theorems to solve engineering problems.

Unit	Description	Instructional Hours
I	**Matrices** Eigen values and Eigen vectors –Properties of Eigen values and Eigen vectors(without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
II	**Single Variate Calculus** Rolle'sTheorem–Lagrange'sMeanValueTheorem-MaximaandMinima–Taylor'sand Maclaurin's Series.	12
III	**Functions of Several Variables** Partial derivatives-Total derivative, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.	12
IV	**Integral Calculus** Double integrals in Cartesian coordinates–Area enclosed by plane curves (excludingsurfacearea)–TripleintegralsinCartesianco-ordinates–Volume of solids(Sphere, Ellipsoid , Tetrahedron) using Cartesian co-ordinates.	12
V	**Vector Calculus** Gradient, divergence and curl; Green's theorem, Stoke's and Gauss divergence theorem (statement only) for cubes only.	12
	Total Instructional Hours	**60**

Course Outcome

At the end of the course, the learner will be able to

CO1:Compute Eigen values and Eigen vectors of the given matrix and transform given quadratic form into canonical form.

CO2:Apply the concept of differentiation to identify the maximum and minimum values of curve.

CO3:Compute partial derivatives of function of several variables and write Taylor's series for functions with two variables.

CO4: Evaluate multiple integral and its applications in finding area, volume.

CO5:Apply the concept of vector calculus in two and three dimensional spaces.

TEXTBOOKS:

T1:G.B.ThomasandR.L.Finney,"CalculusandAnalyticalGeometry",9thEditionAddisonWesleyPublishing Company,2016.

T2:ErwinKreyszig,"AdvancedEngineeringMathematics",JohnWiley&Sons,2019.

T3:K.P.UmaandS.Padma,"EngineeringMathematicsI(MatricesandCalculus)",PearsonLtd,2022.

REFERENCEBOOKS:

R1-JerroldE.Marsden,AnthonyTromba,"VectorCalculus",W.H.Freeman,2003

R2-StraussM.J,G.L.BradleyandK.J.Smith,"Multivariablecalculus",PrenticeHall,2002.

R3-VeerarajanT,"EngineeringMathematics",McGrawHillEducation(India)PvtLtd,NewDelhi,2016.

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Programme /Sem	Course Code	Name of the Course	L	T	P	C
B.E/B.Tech/ I	**22CY1151**	**Chemistry for Circuit Engineering)**	2	0	2	3

Course Objective

The learner should be able to

1. Acquire knowledge on the concepts of chemistry involved in day to day life.
2. Identify the water related problems and water treatment techniques.
3. Enhance the fundamental knowledge on electrochemistry and the mechanism of corrosion and its control.
4. Gain knowledge on the nuclear energy source and batteries.
5. Extend the knowledge on the concepts of spectroscopy and its applications.

Unit	Description	Instructional Hours
I	**CHEMISTRY IN EVERYDAY LIFE** Chemicals in food – Food colors – Artificial sweeteners – Food preservatives. Soaps and Detergents – Soaps – Types of Soap – Detergents – Types of detergents. Drugs – Classification of drugs - Therapeutic Action of Different Classes of Drugs. Chemicals in Cosmetics– Creams–Talcum powders-Deodorants– Perfumes. Plastics – Thermoplastics- Preparation, properties and uses of PVC, Teflon and Thermosetting plastics-Preparation,propertiesandusesofPolyesterandPolyurethane.	6
II	**WATER TECHNOLOGY** Impurities in Water, Hardness of Water, Boiler feed Water – Boiler troubles -Sludge and scale formation, Caustic embrittlement, priming and foaming, boiler corrosion- -Softening Methods (Zeolite & Ion-Exchange Methods)- Desalination of Brackish Water - Reverse Osmosis, Potable water and treatment. **Estimation of total, permanent and temporary hardness of water by EDTA. Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample byIndicator method.**	6+9
III	**ELECTRO CHEMISTRY 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. **Conductometric titration of strong acid vs strong base(HCl vs NaOH).Estimation of Ferrous iron by Potentiometry.**	6+6
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 ion battery-fuel cell H_2-O_2fuelcell applications.	6
V	**SPECTROSCOPY** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) - applications – 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.	6
	Total Instructional Hours	**45**

Course Outcome

At the end of the course, the learner will be able to

CO1:Listoutthechemicalsusedinfood,soapsanddetergents,drugs,cosmeticsandplastics

CO2: Differentiate hard and soft water and solve the related problems on water purification in domestic

CO3: Develop knowledge on the basic principles of electro chemistry 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:List out the applications of spectroscopic techniques in various engineering fields.

TEXTBOOKS

T1 -P.C.Jain & Monica Jain,"Engineering Chemistry" Dhanpat Rai Pub,Co., 2018.

T2-O.G.Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	**22HE1151**	**ENGLISH FOR ENGINEERS (Common to all Branches)**	2	0	2	3

The student should be able

Course Objective

1. To improve the communicative proficiency of learners.
2. To help learners use language effectively in professional writing.
3. To advance the skills of maintaining the suitable one of communication.
4. To introduce the professional life skills.
5. To impart official communication etiquette.

Unit	Description	Instructional Hours
I	**Language Proficiency:** Types of Sentences, Functional Units, Framing question. **Writing:** process description, Writing Checklist. **Vocabulary–**words on environment. **Practical Component: Listening**- Watching short videos and answer the questions, **Speaking**-Self introduction, formal& semi-formal	7+2
II	**Language Proficiency**: Tenses, Adjectives and adverbs. **Writing:** Formal letters (letters conveying positive and negative news), Formal and informal email writing (using emoticons, abbreviations& acronyms), reading comprehension**. Vocabulary–** words on entertainment. **Practical Component: Listening**-Comprehensions based on TED talks **Speaking-**Narrating a Short story or an event happened in their life	7+2
III	**Language Proficiency:** Prepositions, phrasal verbs. **Writing:** Formal thanks giving, Congratulating, warning and apologizing letters, cloze test. **Vocabulary –** words on tools.**PracticalComponent:Listening**-Listentosongsandanswerthequestions**Speaking**- Just a minute	5+4
IV	**Language Proficiency:** Subject verb concord, Prefixes& suffixes. **Writing:** Preparing agenda &minutes, writing an event report. **Vocabulary–** words on engineering process. **Practical Component: Listening**- Comprehensions based on Talk of orators or interview shows **Speaking**-Presentation on a general topic with ppt.	5+4
V	**Language Proficiency:** Modal Auxiliaries, Active& passive voice, **Writing:** Project report (proposal & progress) ,sequencing of sentences **Vocabulary –** words on engineering material **Practical Component: Listening**- Listening- Comprehensions based on Nat Geo/Discovery channel videos **Speaking-** Preparing posters and presenting as a team.	6+3
	Total Instructional Hours	**45**

Course Outcome

After completion of the course the learner will be able

CO1:Tocommunicateinaprofessional forum

CO2:Tospeakorwriteacontentintheproficientlanguage

CO3:To maintain and use appropriate one of the communication.

CO4:To read ,write and present in a professional way.

CO5:To follow the etiquettes in formal communication.

TEXTBOOKS:

T1-NormanWhitby, "BusinessBenchmark-Pre-intermediatetoIntermediate",CambridgeUniversityPress,2016.T2-Raymond Murphy, "Essential English Grammar", Cambridge UniversityPress,2019.

REFERENCEBOOKS:

R1-MeenakshiRamanandSangeetha Sharma. "Technical Communication-Principles and Practice", Oxford University Press, 2009.

R2-RaymondMurphy,"EnglishGrammarinUse"-4thedition CambridgeUniversityPress,2004.

R3-KamaleshSadanan"AFoundationCoursefortheSpeakersofTamil-Part-I&II",Orient Blackswan,2010.

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Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22ME1201	ENGINEERING DRAWING (AGRI, BME, (CHEM,,AERO, AUTO, CIVIL,MECH, MECT,FT,EEE)	1	4	0	3

The learner should be able

Course Objective

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

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

Course Outcome

At the end of the course, the learner will be able to

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", 5thedition New Age International Publishers, New Delhi 2016.

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

REFERENCES:

R1. BasantAgrawal 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.

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	22CS1151	PROBLEM SOLVING USING C PROGRAMMING (EEE, EIE, CSE, IT)	2	0	2	3

Course Objective

The learner should be able

1. To develop simple algorithms for arithmetic and logical problems.
2. To understand and implement the fundamental concepts in a program.
3. To enable how to implement conditional branching, iteration and recursion.
4. To understand how to decompose a problem into functions and synthesize a complete program and to enable them to use arrays, pointers, strings and structures in solving problems.
5. To understand the use files to performer ad and write operations

Unit	Description	Instructional Hours
I	**INTRODUCTION TO COMPUTERS** ComputerSystems–ComputingEnvironments–ComputerLanguage–CreatingandRunningprograms– Computer Numbering System – Storing Integers and Real Numbers – Algorithms - Flowchart. **INTRODUCTION TO C LANGUAGE** Character set - C Tokens, Identifiers and Keywords - Constants, Variables - Data types – Text Input / Output – Operators - Expressions – Precedence and Associativity – Evaluating Expressions – Type Conversions. Illustrative program: 1) Josh went to the market to buy N apples. He found two shops, shop A and B, where apples were being sold in lots. He can buy any number of the complete lot(s) but not loose apples. He is confused with the price and wants you to figure out the minimum cost to buy exactly N apples. Write an algorithm for Josh to calculate the minimum cost to buy exactly N apples. (Wipro 2022) **Input Format:** • The first line of the input consists of an integer – N, representing the total number of apples that Josh wants to buy. • The second line consists of two space-separated positive integers – M1 and P1, representing the number of apples in a lot and the lot's price at shop A, respectively. • Thethirdlineconsistsoftwospace-separatedpositiveintegers-M2andP2,representing the number of apples in a lot and lot's price at shop B, respectively. **Output Format:** Print a positive integer representing the minimum price at which Josh can buy the apples. 2) Chaman planned to choose a four digit lucky number for his car. His lucky numbers are 3,5 and 7. Help him find the number, whose sum is divisible by3 or 5 or 7. Provide a valid car number, Fails to provide a valid input then display that number is not a valid car number.(Cognizant) Note: The input other than 4digit positive number[includesnegativeand0] is considered as invalid.	7 10
II	**DECISIONMAKING,ARRAYS,STRINGSANDPOINTERS** Two-way collection – Multi-way Collection – Concept of a Loop – Pre-test and Post-test Loops – Initialization and Updating – Controlled Loops – Other Statements Related to Looping – Looping Application - Arrays - Strings - Pointers – Pointer Applications – Processor Commands. Illustrative program: 1) You are playing an online game. In the game, a list of N numbers is given. The player has to arrange the numbers o that all the odd numbers of the list come after the even numbers. Write an algorithm to arrange the given list such that all the odd numbers of the list come after the even numbers. (Wipro 2022) **Input** • The first line of the input consists of an integer numbers, representing the size of the list(N). • The second line of the input consists of N space-separated integers representing the values of the list **Output** PrintNspace-separatedintegerssuchthatalltheoddnumbersofthelistcomeaftertheevennumbers 2) Given an integer matrix of size NxN. Traverse it in a spiral form. (Wipro2022) Input: The first line contains N,which represents the number of rows and columns of a matrix. The next N lines contain N values, each representing the values of the matrix. Output: Asinglelinecontainingintegerswithspace,representingthedesiredtraversal.Constraints:0<N<500 3) A digital machine generates binary data which consists of a string of0s and1s. A maximum signal M, in the data, consists of the maximum number of either 1s or 0s appearing consecutively in the data but M can't be at the beginning or end of the string. Design a way to find the length of the maximum signal. (Wipro 2022) **Input** The first line of the input consists of an integer N, representing the length of the binary string. These line consists of a string of length N consisting of 0s and 1s only.	10
III		

Output

Print an integer representing the length of the maximum signal.

4) Given a string S(input consisting) of '*' and '#'. The length of the string is variable. The task is to find the minimum number of '*' or '#' to make it a valid string. The string is considered valid if the number of '*' and '#' are equal. The '*' and '#' can be at any position in the string. (TCS NQT 2022)

Note: The output will be a positive or negative integer based on number of'*'and '#'in the input string.

(*>#): positive integer

(#>*):negative integer

(#=*): 0

FUNCTIONS, STRUCTURES AND UNION

IV	Designing Structured Programs – Functions in C – User defined functions – Inter-Function Communication – Standard Function – Passing Arrays to Functions – Passing Pointers to Function – Recursion – Passing an array to a function – typed of – Enumerated types - Structure – Union – Programming Application. Illustrative program: 1) The Caesar cipher is a type of substitution cipher in which each alphabet in the plaintext or messages is shifted by a number of places down the alphabet. For example, with a shift of 1, P would be replaced by Q, Q would become R, and so on. To pass an encrypted message from one person to another, it is first necessary that both parties have the 'Key' for the cipher, so that the sender may encrypt and the receiver may decrypt it. Key is the number of OFFSET to shift the cipher alphabet. Key can have basic shifts from 1 to 25 positions as thereare26 total alphabets. As we are designing custom Caesar Cipher, in addition to alphabets, we are considering numeric digits from 0 to9. Digits can also be shifted by key places. For Example, if a given plain text contains any digit with values 5 and key y =2, then 5 will be replaced by 7, "-"(minus sign) will remain as it is. Key value less than 0 should result into "INVALID INPUT". Write a function Custom Caesar Cipher(int key, String message) which will accept plaintext and key as input parameters and returns its cipher text as output. (TCS NQT 2022) Enter y our Plain Text: All the best Enter the Key: 1 The encrypted Text is:Bmmu if Cftu	9

BINARYINPUT/OUTPUT

V	Defining and Opening a file, closing a file - input/output operations on files - error handling during I/O operations - random access to files - Text versus Binary Streams – Standard Library Functions for Files – Converting File type. Illustrative program: 1) Write a C Program to merge contents of two files intoa third file. 2)Write a program in C to delete a specific line from a file.	9
	TotalInstructionalHours	**45**

Course Outcome

At the end of the course, the learner will be able to

CO1: Develop simple algorithms for arithmetic and logical problems.

CO2:Test and execute the programs and correct syntax and logical errors.

CO3: Implement conditional branching, iteration and recursion.

CO4:Decompose a problemintofunctionsandsynthesizeacompleteprogramandusearrays,pointers, strings and structures to formulate algorithms and programs.

CO5:Use files to perform read and write operations.

TEXTBOOKS:

T1:Byron Gottfried,"ProgrammingwithC",Schaum'sOutlinesSeries,McGrawHillEducation,3rdedition,2017.

REFERENCEBOOKS:

R1:Schildt Herbert,"C:The Complete Reference", TataMcGrawHillEducation,4th edition,2014.

R2: R. S. Bichkar, "Programming with C", Universities Press, 2nd edition 2012.

R3:Yashvant Kanetkar,"ExploringC",BPBPublishers,2ndedition,2003.

R4:W.Kernighan Brian, Dennis M. Ritchie," The C ProgrammingLanguage",PHILearning,2ndedition,1988

Chairman - BoS
EEE - HiCET

Chairman

Dean (Academics)
HiCET

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	**22HE1071**	**UNIVERSAL HUMAN VALUES (Common to All Branches)**	2	0	0	2

Course Objectives

The student should be made

1. To help the students appreciate the essential complementarily between 'VALUES' and' SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. TofacilitatethedevelopmentofaHolisticperspectiveamongstudentstowardslifeandprofession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implicationsofsuchaHolisticunderstandingIntermsofethicalhumanconduct, Trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Unit	Description	Instructional Hours
	Introduction to Value Education	
I	Right Understanding, Relationship and Physical Facility(Holistic Development and the Role of Education)-Understanding Value Education - Self-exploration as the Process for Value Education - Continuous Happiness and Prosperity – the Basic Human Aspirations - Happiness and Prosperity – Current Scenario -Method to Fulfill the Basic Human Aspirations	6
	Harmony in the Human Being and Harmony in the Family	
II	Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - The Body as an Instrument of the Self - Understanding Harmony in the Self- Harmony of the Self with the Body- Programme to ensure self-regulation and Health	6
	Harmony in the Family and Society	
III	Harmony in the Family – the Basic Unit of Human Interaction. Values in Human to Human Relationship' Trust' – the Foundational Value in Relationship Values in Human to Human Relationship' Respect' – as the Right Evaluation Understanding Harmony in the Society	6
	Harmony in the Nature/Existence	
IV	Understanding Harmony in the Nature. Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature- Understanding Existence as Co-existence of mutuallyinteractingunitsinallpervasivespaceRealizingExistenceasCo-existenceatAll LevelsTheHolisticPerceptionofHarmonyinExistence.VisionfortheUniversalHuman Order	6
	Implications of the Holistic Understanding–a Look at Professional Ethics	
V	Natural Acceptance of Human Values Definitiveness of (Ethical) Human Conduct A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order-Competence in ProfessionalEthicsHolisticTechnologies,ProductionSystemsandManagementModels- Typical Case Studies Strategies for Transition towards Value-based Life and Profession	6
	TotalInstructionalHours	**30**

Course Outcome

At the end of the course, the learner will be able

CO1:To become more aware of holistic vision of life-themselves and their surroundings.

CO2:To become more responsible in life, in the Society and in handling problems with sustainable Solutions.

CO3:To sensitive towards their commitment towards what they understood towards environment and Socially responsible behavior.

CO4:To able to apply what have learnt to their own self in different day-to-day settings in real life and In handling problems with sustainable solutions.

CO5:To develop competence and capabilities for maintaining Health and Hygiene.

Reference Books:

R1.AFoundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, GP Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

R2.Teachers'ManualforAFoundationCourseinHumanValuesandProfessionalEthics,RRGaur, RAsthana,GP Bagaria,2ndRevised Edition,Excel Books, NewDelhi,2019.ISBN978-93-87034-53-2

R3.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak,1999.

Chairman - BoS
EEE - HiCET

Chairman

Dean (Academics)
HiCET

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	**22HE1072**	**ENTREPRENEURSHIP& INNOVATION (Common for all Branches)**	1	0	0	1

Course Objectives

The student should be made

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 the opportunities.
4. To acquire the resources necessary to implement these plans.
5. Tomakestudentsunderstandorganizationalperformanceanditsimportance.

Module	Description
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

At the end of the course, the learner will be able to

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 customerneed, competitors, and industry attractiveness..

CO5:Developabusinessmodelforanewventure,includingrevenue.Margins,operations, Working capital, and investment

TEXTBOOKS

T1**:**Arya Kumar“ Entrepreneurship–Creating and leading an Entrepreneurial Organization”, Pearson, Second Edition(2012).
T2:EmrahYayici“DesignThinkingMethodology”, Artbiztech, First Edition(2016).

REFERENCE BOOKS

R1:Christopher Golis“ Enterprise& Venture Capital”, Allen& Unwin Publication, Fourth Edition (2007).
R2: ThomasLockWood&EdgerPapke“InnovationbyDesign”,CareerPress, SecondEdition(2017).
R3:Jonathan Wilson“EssentialsofBusinessResearch”,SagePublication,FirstEdition(2010).

WEBRESOURCES

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

Chairman - BoS
EEE - HiCET

Chairman

Dean (Academics)
HiCET

Programme/ Sem	Course Code	Name of the Course	L	T	P	C
B.E./B.Tech/ I	**22MC1091**	**INDIAN CONSTITUTION**	2	0	0	0
		(Common for all Branches)				

Course Objectives

The student should be made to

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

Unit	Description	Instructional Hours
	BASIC FEATURES AND FUNDAMENTAL PRINCIPLES	
I	Meaning of the constitution law and constitutionalism–Historical perspective of the constitution of India– salient features and characteristic of the constitution of India.	**6**
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights–fundamental duties and its legislative status– The directive principles of state policy–its importance and implementation- Federal structure and distribution of legislative and financial powers between the union and states.	**6**
	PARLIAMENTARYFORMOFGOVERNMENT	
III	The constitution powers and the status of the president in India.–Amendment of the constitutional Powers and procedures–The historical perspective o f the constitutional amendment of India– Emergency provisions: National emergency, President rule, Financial emergency.	**6**
	LOCALGOVERNANCE	
IV	Local self-government-Rural Local Government-Panchayath Raj, Elections of Panchayat-State Election Commission-Urban Local Government-Amendment Act, Urban Local Government Structures in India.	**6**
	INDIANSOCIETY	
V	Constitutional Remedies for citizens– Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	**6**
	Total Instructional Hours	**30**

Course Outcome

At the end of the course, the learner will be able to

CO1:Understand the functions of the Indian government.

CO2:Understand and abide the rules of the Indian Constitution

TEXTBOOKS:

T1: DurgaDasBasu,"IntroductiontotheConstitutionofIndia",PrenticeHallofIndia,NewDelhi,1997.
T2: AgarwalRC.,"Indian Political System", S.Chand and Company, NewDelhi,1997.
T3: MaciverandPage,"Society:AnIntroductionAnalysis",MacMilanIndiaLtd.,NewDelhi.
T4:SharmaKL.,"SocialStratificationinIndia:IssuesandThemes",JawaharlalNehruUniversity,NewDelhi,1997.

REFERENCEBOOKS:

R1-Sharma,BrijKishore,"IntroductiontotheConstitutionofIndia:,PrenticeHallofIndia,NewDelhi.
R2-GahaiUR.,"IndianPoliticalSystem",NewAcademicPublishingHouse, Jalaendhar.
R3-SharmaRN.,"IndianSocialProblems",MediaPromotersandPublishersPvt.Ltd.

Chairman - BoS
EEE - HiCET

Chairman

Dean (Academics)
HiCET

திட்டம்/செம்	பாடநெறி குறியீடு	பாடத்தின் பெயர்	L	T	P	C
பி.இ/ க	22MC1091	**தமிழரும்தொழில்நுட்பமும்** **(முதலாம் ஆண்டு பி.இ பொது பாடப்பிரிவு)**	2	0	0	0

கற்றவர்இயலவேண்டும்

பாடத்தின் நோக்கம்

1. சங்க காலத்தில் தொழில்துறை பற்றிய அறிவைப் பெறுதல்.
2. சங்க காலத்தில் வீட்டின் பொருள் ,சிற்பங்கள் மற்றும் கோவில்கள் வடிவமைப்பு பற்றி கூட்டு கற்றல்
3. வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் அறிவை வளர்த்துக் கொள்ளுங்கள்.
4. வேளாண்மை மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பண்டைய நுட்பங்களைப் பற்றிய அறிவைப் பெறுதல்.
5. தமிழ் மொழியின் மென்பொருள் பற்றி அறிதல்

அலகு	விளக்கம்	பயிற்சி நேரம்
I	**நெசவுமற்றும்பானைத்தொழில்நுட்பம்** சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம்-கருப்பு சிவப்பு பாண்டங்கள் -பாண்டங்களில் கீறல் குறியீடுகள்.	3
II	**வடிவமைப்புமற்றும்கட்டிடத்தொழில்நுட்பம்** சங்க இலக்கியத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் மற்றும்சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு -சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிப்பாடுத் தளங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டி நாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோச்செனிக் கட்டிடக் கலை.	3
III	**உற்பத்தி தொழில்நுட்பம்** கப்பல் கட்டும் கலை- உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருகுதல் எஃகு - வரலாற்றுசாலை சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடிமணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின்வகைகள்.	3
IV	**வேளாண்மைமற்றும்நீர்பாசனத்தொழில்நுட்பம்** அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்க பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.	3
V	**அறிவியல்தமிழ்மற்றும்கணித்தமிழ்** அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணைய கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.	3
	மொத்தபயிற்றுவிக்கும்நேரம்	15

பாடத்தின் முடிவு

பாடநெறியின்முடிவில்கற்றவர்கற்றபின்

பா மு1: பண்டைய தொழில்நுப்பதை அடையாளம் கொள்ள தெரியும்

பா மு2: சங்க கால கட்டுமானப் பொருட்கள்- சிற்ப வகைகளை வேறுபடுத்த முடியும்

பா மு3: வரலாறு மற்றும் தொல்லியல் சான்றுகளின் ஆதாரமாக உலோகவியல் ஆய்வுகளில் பட்டியலிட்டு அடையாளம் காண முடியும்

பா மு4: விவசாயம் மற்றும் வேளாண் செயலாக்கத்தில் பயன்படுத்தப்படும் பழங்கால நுட்பங்களைப் பற்றி விளக்கத்துடன் நிரூபிக்க முடியும்

பா மு5: தமிழ் மொழியின் புதிய மென்பொருள் பற்றி உருவாக்கக் கூடிய திறன் மேம்படுத்துதல்.

உரைபுத்தகங்கள்

உ1- தமிழக வரலாறு - மக்களும் பண்பாடும் - கே .கே பிள்ளை (வெளியீடு தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

உ2- எஸ்.கே. சிங், இடைக்கால இந்தியாவின் வரலாறு. புது தில்லி: ஆக்சிஸ் புக்ஸ் பிரைவேட் லிமிடெட், 2013.

குறிப்புகள்

கு1- கணிதத்தமிழ் -முனைவர் இல. சுந்தரம் .(விகடன் பிரசுரம்)

கு2- கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E	22MA3102	COMPLEX ANALYSIS ANDTRANSFORMS (EEE, EIE, ECE)	3	1	0	4

Course Objective

The learner should be able to

1. Introduction to analytic functions and its properties.
2. Understand Cauchy's theorem and its applications in evaluation of integral.
3. Analyze Fourier series which is central to many applications in engineering
4. Apply Fourier transform techniques in various situations.
5. Analyze Z transform techniques for discrete time systems

Unit	Description	Instructional Hours
I	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann 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
II	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem - Contour Integration with unit circle only.	12
III	**FOURIER SERIES** Dirichlet's conditions- General Fourier Series – Odd and Even Functions – Change of Interval - Parseval's Identity - Half Range Sine and Cosine Series.- Harmonic analysis	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

At the end of the course, the learner will be able to

CO1: Understand the concept of analytic functions and discuss its properties.

CO2: Evaluate various integrals by using Cauchy's residue theorem and classify singularities and derive Laurent series expansion

CO3: Understand the principles of Fourier series which helps them to solve physical problems of Engineering

CO4: Apply Fourier transform techniques which extend its applications.

CO5: Illustrate the Z- transforms for analyzing discrete-time signals and systems

TEXT BOOKS:

T1 – Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2019.

T2 - Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS:

R1 - James Ward Brown, Ruel Vance Churchill, Complex Variables and Applications, McGraw-Hill Higher Education, 2004

R2 - Dennis Zill, Warren S. Wright, Michael R. Cullen, Advanced Engineering Mathematics, Jones & Bartlett Learning, 2011

R3 - Ian N. Sneddon, Elements of Partial Differential Equations, Courier Corporation, 2013

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Programme	CourseCode	Name of the course	L	T	P
BE	22EE3201	Electronic Devices and Circuits	3	0	0

Course Objectives

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

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

Course 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.

R3 Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EE3202	Electrical Circuit Analysis	3	1	0	4

Common to EEE and EIE

Course Objective

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

Unit	Description	Instructional Hours
I	**BASIC CIRCUITS ANALYSIS** Ohm's Law – Kirchoff's laws – DC and AC Circuits — Mesh current and Node voltage method - Energy stored in Capacitor and Inductor – Impedance and Admittance – Phasor Relationship for R, L and C - Phasor Diagram.	12
II	**NETWORK THEOREMS FOR DC AND AC CIRCUITS** Thevenin's and Norton Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem-Millman's Theorem.	12
III	**RESONANCE AND COUPLED CIRCUITS** Series and Parallel resonance –Variation of Capacitor Voltage and Inductor Voltage with Frequency - Self and mutual inductance – Coefficient of coupling – Dot rule for coupled circuits - Tuned circuits -Single tuned circuits.	12
IV	**TRANSIENT RESPONSE** Transient response of RL, RC and RLC Circuits using Laplace transform for DC input - Time constants - Transient response of A.C. circuits for single loop circuit.	12
V	**THREE PHASE CIRCUITS** Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected, balanced & unbalanced loads – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits using two wattmeter method.	12
	Total Instructional Hours	**60**

Course Outcome

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

TEXT BOOKS:

T1 William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", Tata McGraw Hill publishers, 6th edition, New Delhi, 2003.

T2 Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGraw Hill, 2007.

REFERENCE BOOKS:

R1 Paranjothi SR, "Electric Circuits Analysis", New Age International Ltd., New Delhi, 1996.

R2 Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series,Tata McGraw-Hill, NewDelhi, 2001.

R3 Chakrabati A, "Circuits Theory (Analysis and synthesis)", Dhanpath Rai & Sons, New Delhi, 1999.

R4 arles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003).

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Programme	Course Code	Name of the course	L	T	P	C
BE	22EE3203	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	**INTRODUCTION** Electrostatic fields – Vector Fields & Calculus - Various coordinate Systems(Cartesian Coordinate, Polar Coordinates) –Gradient, Divergence, Curl and Stokes – theorems and applications - Coulomb's Law – Gauss law and its Applications.	9
II	**STATIC ELECTRIC FIELD** Electric Potential - Potential due to point charge – Electric field and equipotential points, Uniform and Non-Uniform field– Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Boundary conditions - Poisson's and Laplace's equations- Capacitance in different medium, coaxial cable and transmission line - Energy density - Applications.	9
III	**STATIC MAGENTIC FIELD** Lorentz force - Magnetic field intensity (H) - Magnetic flux density (B) – Biot–Savart's Law - Ampere's Circuit Law – point form of Ampere's Circuital Law– H & B due to straight conductors, Circular loop and Infinite sheet of current - Magnetic materials – Magnetization,– Boundary conditions - Scalar and Vector Magnetic Potential - Magnetic force, Torque – Inductance - Energy density Applications.	9
IV	**ELECTRODYNAMIC FIELDS** Magnetic Circuit - Faraday's law - Self Inductance and Mutual Inductance - Magnetic Circuits – Transformer(Static) and Motional(Dynamic) EMF – Current Densities (Displacement & Conduction) -Maxwell's equations (Differential and Integral form) Relation between field theory and circuit theory.	9
V	**ELECTROMAGNETIC WAVES** Electromagnetic waves propagation concepts – Plane Electromagnetic wave Equation – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy conductors and Dielectrics – Skin effect & skin depth – Plane wave reflection and refraction - Poynting Theorem- Standing wave ratio.	9
	Total Instructional Hours	**45**

Course Outcomes

CO1	Apply the Vector calculus application in Electromagnetics
CO2	Analyse the concepts of Electrostatics
CO3	Evaluate the concepts of Magnetostatics.
CO4	Analyze the static and dynamic induced emf and determine the Maxwells equations.
CO5	Analyse the propagation of plane Electromagnetic wave, Plane wave reflection and refraction.

TEXT BOOKS:

T1 K.A. Gangadhar, P.M. Ramanthan ' Electromagnetic Field Theory (including Antennaes and wave propagation', 16th Edition, Khanna Publications, 2007.

T2 Mathew N.O.Sadiku, 'Principles of Electromagnetics',4 th Edition ,Oxford University Press Inc.First India edition, 2009

REFERENCE BOOKS:

R1 Ashutosh Pramanik,"Electromagnetism – Theory and Applications", PHI Learning PVT LTD., 2nd Esition, 2009.

R2 Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

R3 William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill 8th Revised edition, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22EI3251	Digital Electronics	2	1	2	4

Common to EEE and EIE

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 - **Design 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 – **Design 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. **Design 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 - **Design 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 - **Design 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	P	T	C
B.E	22EE3001	Electric Circuit Laboratory Common to EEE and EIE	0	0	4	2

Course Objective

1. To provide practical experience on verification of kirchoff's voltage law, kirchoff's current law and network theorems.
2. To design series and parallel resonant circuit and to analyse the simulation results.
3. To compare the time constant values of RL,RC circuits by conducting suitable experiments
4. To measure three phase power using two wattmeter method
5. To provide knowledge on signal measurements using CRO and DSO

S.No	Description of the experiments	Total Practical Hours
1.	Experimental verification of Kirchhoff's voltage and current laws	
2.	Experimental verification of network theorems (Thevenin's and Superposition).	
3.	Experimental verification of network theorems (Reciprocity Theorem and Maximum power transfer Theorem).	
4.	Experimental determination of time constant of RL & RC electric circuits.	
5.	Experimental determination of frequency response of RLC circuits.	
6.	Design and Simulation of series resonance circuit.	
7.	Design and Simulation of parallel resonant circuits.	
8.	Simulation of three phases balanced and unbalanced star, delta networks circuits.	
9.	Experimental determination of power in three phase circuits by two-watt meter method.	
10.	Study of CRO, DSO and measurement of sinusoidal voltage, frequency and power factor	
	Total Instructional Hours	**45**

Course Outcome

CO1: Verify ohm's law and Kirchoff's law
CO2: Understand and verify theorems
CO3: Perform mesh and nodal analysis
CO4:Understand transient response of RL,RC circuits for DC input
CO5: Evaluate frequency response of series, parallel resonant circuits and tuned circuits

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	22EE3002	Electronic Devices and Circuits Laboratory	0	0	4	2

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.	Construct and testing of Single Phase half-wave rectifier
5.	Construct and testing Single Phase full wave rectifier
6.	Characteristics of UJT
7.	Implementation of Relaxation Oscillator
8.	Frequency response characteristics of a Common Emitter amplifier
9.	Construct and analyze the Current series Feedback Amplifier.
10.	Develop and testing of transistor RC phase shift oscillator
11.	Characteristics of photo diode and photo transistor
	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 Engineering‖, Vikas Publishing House Pvt. Ltd., New Delhi, 2007.

R2. Laboratory manual prepared by the Department of Electronics and Instrumentation Engineering, 2016.

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Programme	Course Code	Course Title	L	T	P	C
BE/BTECH	22HE3071	Soft Skills and Aptitude - II	0	0	0	1

Course Objectives:

1. Solve Logical Reasoning questions of easy to intermediate level
2. Solve Quantitative Aptitude questions of easy to intermediate level
3. Solve Verbal Ability questions of easy to intermediate level
4. Display good writing skills while dealing with essays

Unit	Description	Instructional Hours
	Logical Reasoning	
I	Clocks - Calendars - Direction Sense - Cubes - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	9
	Quantitative Aptitude	
II	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, - Profit and loss, Basic terminologies in profit and loss - Averages - Weighted average	12
	Verbal Ability	
III	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.	7
	Writing skills for placements	
IV	Essay writing: Idea generation for topics, Best practices, Practice and feedback	2
	Total Instructional Hours	30

Course Outcome:

CO1: Students will avoid the various fallacies that can arise through the misuse of logic.

CO2: Students would opt for alternate methods to solve the problems rather than conventional methods.

CO3: Students will heighten their awareness of correct usage of English grammar in writing and speaking

CO4: Students will be concise and clear, using professional language for placements.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	22HE3072	Fundamentals of JAVA Programming	2	0	0	2

Course Objective

1. To understand Object Oriented programming concepts like Data Abstraction, Encapsulation
2. To analyze different types of constructor, Inheritance and polymorphism
3. To understand and apply package, Interface and Applet concepts
4. To understand and apply exception and i/o handling
5. To know the fundamental concepts of collection framework and multithreading in lving real world problems

Unit	Description	Instructional Hours
I	**Introduction to Object Oriented Programming** Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File - Structure – Compilation	6
II	**Java Fundamentals** Introduction to java programming – Features of java-Classes and objects - Arrays -Methods-Constructor-Access Specifier - Nested Classes-Inner Classes -Command line arguments.	6
III	**Inheritance, packages and Interface:** Inheritance types -Method overriding - Abstract Classes- Packages- Interfaces	6
IV	**Exceptions and I/O handling:** Exception handling fundamentals-I/O basics – Reading console input – Writing console output-Files	6
V	**Applets, AWT and Event Handling:** Applet classes-AWT-event handling–multithreaded programming- Collection framework	6
	Total Instructional Hours	**30**

Course Outcome

CO1: Identify and reproduce the features of Object Oriented programming paradigm.
CO2: Interpret the fundamental concepts of collection framework algorithms and its uses
CO3: Understand the basis of Package, multithreading, and interface concepts
CO4: Use I/O functionality to code basic file operations and experiment with exceptions handling
CO5: Apply the concepts of Applets, AWT and Event handling mechanism to solve a given problems.

TEXT BOOKS:

T1: Herbert Schildt, "Java : The Complete Reference", 9th edition, TMH, 2014.2017

T2: Paul Deitel, Harvey Deitel, "Java How To Program", 10th Edition, Prentice Hall Publications,2014.

REFERENCE BOOKS:

R1: Daniel Liang ,"Introduction to Java Programming", 9th Edition , Prentice Hall Publications,2015

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SEMESTER V

Programme	Course Code	Name of the course	L	T	P	C
BE	21EE5201	Design of Electrical Machines	3	0	0	3

Course Objective

1. Interpret the fundamentals of specific loading and ratings of electrical machines.
2. Design armature and field systems of D.C. machines.
3. Analyse and design core, yoke, windings and cooling systems of transformers.
4. Design stator and rotor of induction machines.
5. Outline the behaviour 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 – Magnetizing current calculations.	9
V	**SYNCHRONOUS MACHINES** Output equations – Choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – Armature design & Parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Design of field winding.	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, 2018.
T2 A.Nagoor Kani., "Electrical Machine Design", RBA Publications, 2nd Edition, 2014

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" , SK Kataria & Sons, Delhi, 2010.
R3 M.V.Deshpande, "Design And Testing Of Electrical Machines", PHI Learning , 2010.
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
BE	21EE5202	Renewable and Non-Renewable Energy Sources	3	1	0	4

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 Heating Systems: Solar Cooker, Solar Power Tower- solar photo voltaic conversion: solar cell, classification- construction of module, panel and array- Standalone and grid connected Solar PV power generation.	12
II	**WIND ENERGY CONVERSION SYSTEM** Energy available from wind – Wind Energy Data of India- Power, torque and speed characteristics - Basic principle and theories of wind energy conversion system- Horizontal axis and Vertical axis rotors – pitch and Yaw control mechanism-Wind generators-Types- Working of PMSG - Stand alone, grid connected and hybrid applications of WECS.	12
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.	12
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 – Combined Cycle Power Plant.	12
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 different Nuclear Reactors -Safety measures for Nuclear Power plants.	12
	Total Instructional Hours	**60**

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.,2021

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

R3 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
BE	21EE5203	Microprocessors and Microcontrollers *(Common To EEE And EIE)*	3	0	0	3

Course Objectives

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

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

Course Outcomes

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

TEXT BOOKS:

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

T2 Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry", John Wiley & Sons, Inc.2nd Edition, Oct 2021.

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.

R4 Simon Monk, "Programming Arduino Getting Started with Sketches", 1st Edition, McGraw-Hill Education, USA, 2012.

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Programme	Course Code	Name of the course	L	T	P	C
BE	21EE5204	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
I	**STRUCTURE OF POWER SYSTEM** Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors –interconnection – EHVAC and HVDC transmission - Introduction to FACTS.	9
II	**TRANSMISSION LINE PARAMETERS** 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
III	**MODELLING AND PERFORMANCE OF TRANSMISSION LINES** 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
IV	**INSULATORS AND CABLES** 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
V	**MECHANICAL DESIGN OF LINES AND GROUNDING** 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
BE	21EE5251	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, **Simulation of Time response of Second order system using MATLAB**	9
III	**FREQUENCY DOMAIN ANALYSIS** Frequency response– Bode plot – Polar plot – M and N – 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, **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 **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
BE	21EE5001	Control and Instrumentation Engineering	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
BE	21EE5002	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	21HE5071	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..	21HE5072	Design Thinking	1	0	0	1

Course Objective

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

Course Outcome

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

TEXT BOOKS:

T1 - 1. Nigel Cross, “Design Thinking”, Kindle Edition.

REFERENCE BOOKS:

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

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PROFESSIONAL ELECTIVE-I

Programme	Course Code	Name of the course	L	T	P	C
BE	21EE5301	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 FIBERS 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	**INDUSTRIAL APPLICATION OF OPTICAL FIBRES** Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage.	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, semiconductor lasers	9
IV	**INDUSTRIAL APPLICATION OF LASERS** Laser for measurement of distance, velocity, current, and voltage– 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 instruments for surgery, removal of tumors of vocalcards, 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, 2178.

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
BE	21EE5302	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 prosthesesfixation	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 measurement‖, 2nd edition, prentice hall of India, New Delhi, 2015

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

REFERENCE BOOKS:

R1 Khandpur R.S, ―Handbook of Biomedical Instrumentation‖, 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
BE	21IT5331	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 – Superclasses-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, ArrayLists – 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 reference‖, 8th Edition, McGraw Hill Education, 2011

T2 Cay S. Horstmann, Gary cornell, Core Java Volume I Fundamentals‖, 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 book‖, 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

Programme	Course Code	Name of the Course	L	T	P	C
B.E EEE	21EE5304	**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
BE	21EE5305	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 –Interlocking of Drives.	9
II	**CONTROL CIRCUIT COMPONENTS** Introduction –Fuses, Switches–MCCB and MCB .Contactors: Solenoid and Clapper types .Relays: Voltage Relays – D.C. Series Current Relay-Frequency Responsive Relay and Latching Relays. Switches: Push button switches, Limit Switches –Simple Limit Switch	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,2216

T2 Denis O'Kelly-Performance and control of electrical machines, McGraw-Hill, 2211

REFERENCE BOOKS:

R1 Sunil S. Rao **,** Switchgear Protection and Power Systems,Khanna Publishers, 2219.

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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SEMESTER VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21EE6181	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) - Statutory authorities –- safety standards – types- special provisions – penalties and procedures Important Acts: Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948 , Environment act 1986. - Tamilnadu safety officer rules 2005.	9
II	**SAFETY MANAGEMENT** Management Principles, Levels of Management-Lower, Middle and Top, Types of Management –Line and Staff, Authority, Accountability and Responsibility of Management. Span of Management, Delegation and decentralization of authority. "The permit- to- work" system - safety life cycle (SLC): concept, types, examples.	9
III	**ACCIDENT PREVENTION & INVESTIGATION** Theories / Models of accident occurrences, Principles of accident prevention, Accident and Financial implications. 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 2148", 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
BE	21EE6201	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
BE	21EE6202	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
BE	21EE6251	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 EMBEDDED SYSTEM** Basics of Developing and Functional building block of embedded system - Characteristics of embedded system applications - Structural units in Embedded processor -Challenges in embedded system design - **Experimental study**-PCB Designing of simple electronic circuits	9
II	**ARCHITECTURE OF EMBEDDED SYSTEM** PIC Microcontroller – Architecture of PIC 16F8xx -Supervisor mode, Exceptions & Traps, Co-processors, - CPU bus - Memory devices - I/O devices -Assembly and linking – **Experimental study-**Interfacing Of LED and LCD.	9
III	**OS FOR EMBEDDED SYSTEMS** Introduction to RTOS, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling – Semaphores**-** Types of operating systems - 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 **Experimental study-**Design Of Traffic Light Control	9
V	**REAL TIME APPLICATIONS&IMPLEMENTATION** Design examples: ACVM, Washing Machines, Cell phones, Digital Still Cameras, Smart card applications. **Experimental study-** Design of Five flex Robotic arm	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 2021

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
BE	21EE6001	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
BE	21EE6002	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
BE	21EE6701	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	21HE6071	Soft Skills-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	21HE6072	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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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE7201	Solid State Drives	3	0	0	3

Course Objectives

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

Unit	Description	Instructional Hours
I	**DRIVE MOTOR 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 – Typical load torque characteristics – choice of electrical drives	9
II	**DC MOTOR DRIVES** Steady state analysis of the single phase and three phase converter fed separately excited DCmotor drives– Ward Leonard Drives – chopper control of separately excited DC motor.	9
III	**INDUCTION MOTOR DRIVES** Stator voltage control–Cyclo converter control of induction motor - voltage and current fed inverter control– closed loop speed control – static rotor resistancecontrol-V/F Control of Induction Motor and qualitative treatment of slip power recovery drives.	9
IV	**SYNCHRONOUS MOTOR DRIVES** V/f control and self-control of synchronous motor: margin angle control and power factor control – CSI fed synchronous motor drive with forced commutation – permanent magnet synchronous motor-Brushless DC 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 Outcomes

- 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 P.C. Sen Principles of Electric Machines and Power Electronics,3rd Edition Wiley publication,2013

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, 2193.

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.

R4 John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE7202	Protection and Switchgear	3	0	0	3

Course Objectives

1. Educate the causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
2. Construction ,operation and characteristics of various electromagnetic relays
3. Describe the various protection of apparatus
4. Understanding arc quenching theories of various circuit breakers
5. Impart knowledge on functioning of circuit breakers

Unit	Description	Instructional Hours
I	**PROTECTION SCHEMES** Essential requirements of Protection – nature and causes of faults – types of faults — Zones of protection and essential qualities of protection – Protection schemes-protection against over voltages due to lightning /switching transients.	9
II	**ELECTROMAGNETIC RELAYS** Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Introduction to numerical relays- essential ofnumerical relay-working of numerical relay and its types –earth fault relay- Motor Protection relay-cable differential relays	9
III	**APPARATUS PROTECTION** Current transformers (CT) and Potential transformers (PT) and their applications inprotection schemes - Protection of transformer, generator, motor, bus-bars and transmission line- numerical relay-protection schemes for over current and distance protection of transmission line..	9
IV	**THEORY OF ARC QUENCHING** Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping – Capacitive current breaking	9
V	**CIRCUIT BREAKERS** Classification of circuit breakers – air circuit breakers, SF_6 and vacuum circuit breakers -Gound Fault circuit interrupter(GFCI) and Arc Fault Circuit breaker (AFCB)-MCB, MCCB and characteristics curves of MCB and MCCB-Programmable relay and breakers – comparison of different circuit breakers –testing of Circuit breakers	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Analyze the causes of faults in electrical apparatus and power system
- CO2 Evaluate the characteristics and function of relays.
- CO3 To gain knowledge the various apparatus protection techniques and their applications
- CO4 Solve the problems associated with the circuit interruptions by circuit breakers.
- CO5 Classify the types of circuit breaker and their testing

TEXT BOOKS:

T1 Badri Ram ,B.H. Vishwakarma, Power System Protection and Switchgear‘, New Age International Pvt LtdPublishers, Second Edition 2011.

T2 Y.G.Paithankar and S.R.Bhide, Fundamentals of power system protection‘, Second Edition,Prentice Hall of IndiaPvt. Ltd., New Delhi, 2010.

REFERENCE BOOKS:

R1 C.L.Wadhwa, Electrical Power Systems‘, 6th Edition, New Age International (P) Ltd., 2010

R2 Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,‘Protection and Switchgear‘ Oxford University Press, 2011.

R3 Sunil S.Rao, Switchgear and Protection‘, Khanna Publishers, New Delhi, 2008.

R4 B.Rabindranath and N.Chander, Power System Protection and Switchgear‘, New Age International (P) Ltd., First Edition 2011.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE7251	Power System Operation and Control	2	0	2	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
I	**INTRODUCTION** An overview of power system operation and control - system load variation - load characteristics - load curves and load-duration curves –**Simulation of daily load curve.**	6+3
II	**REAL POWER - FREQUENCY CONTROL** Basics of speed governing mechanism and modeling – control area concept - LFC control of a single-area system – Modelling- response –two area system- **Simulink model of Load Frequency Control of single area power system.**	6+3
III	**REACTIVE POWER–VOLTAGE CONTROL** Generation and absorption of reactive power - Excitation systems-modeling - methods of voltage control: Shunt capacitors, Series capacitors and Shunt Reactors – **Simulink model of Tap-Changing transformer.**	6+3
IV	**ECONOMIC LOAD DISPATCH AND UNIT COMMITMENT** Formulation of economic dispatch problem - co-ordination equations - λ-iteration method - statement of unit commitment problem. **Simulation of Economic Load Dispatch without considering losses.**	6+3
V	**COMPUTER CONTROL OF POWER SYSTEMS** Concept of energy control center - functions - system monitoring - data acquisition and control - system hardware configuration – SCADA - state transition diagram showing various state transitions and control strategies. **Experimental study of Electromagnetic Transients in power systems.**	6+3
	Total Instructional Hours	**45**

Course Outcome

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

TEXT BOOKS:

T1 Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', 3rd edition, John Wiley & Sons, Inc.,2013.

T2 Olle.I.Elgerd, 'Electric Energy Systems Theory An Introduction', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010

REFERENCE BOOKS:

R1 V. K. Mehta and R. Mehta, Principles of Power Systems, S. Chand Publishing, New Delhi 24th edition,2009.

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

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

R4 HadiSaadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi,21st reprint, 2010.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE7001	Electric Drives and Control Laboratory	0	0	3	1.5

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	Simulation of 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 drive.
6	Speed control using FPGA for Induction motor drive.
7	DSP based chopper fed DC motor drive.
8	Speed control of Brush Less DC motor drive.
9	PLC based AC Motor drives.
10	PLC based DC Motor drives

Total Instructional Hours 45

Course Outcome

CO1: Develop a power electronic circuit using simulation software's.
CO2: Simulates a closed loop control of converter 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
BE	19EE7002	Power System Simulation Laboratory	0	0	3	1.5

Course Objective

To assist the students to acquire power system software development skills and experience in the usage of standard packages necessary for

1. Computation of line parameters and modeling of transmission lines.
2. Formation of Bus impedance and admittance matrices.
3. Simulation of Economic Load Dispatch and Load Frequency of Dynamics of power system.
4. Load flow analysis using GS and NR method of power System.
5. Fault analysis for balanced and unbalanced faults in Power system.

S.No	Description of the Experiments
1.	Computation of Transmission line parameters.
2.	Modeling and performance of Transmission lines.
3.	Formation of Bus Admittance Matrices.
4.	Formation of Bus Impedance Matrices.
5.	Economic Load Dispatch considering losses.
6.	Load Frequency Dynamics of Two Area Power Systems.
7.	Load Flow Analysis: Solution of Load Flow and Related Problems Using Gauss-Seidel method.
8.	Load Flow Analysis: Solution of Load Flow and similar Problems Using Newton-Raphson method.
9.	Fault Analysis- Symmetrical Fault.
10.	Fault Analysis- Unsymmetrical Fault.

Total Instructional Hours 45

Course Outcome

CO1: Realize the skills acquired in the previous semesters to solve complex engineering problems.
CO2: Build up an innovative model / prototype of an idea related to the field of specialization.
CO3: Create the work individually 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
BE	19EE7301	High Voltage Engineering	3	0	0	3

Course Objective

1. Describe the various types of over voltages in power system and protection methods.
2. Impart knowledge on nature of breakdown mechanisms in various dielectrics.
3. Classify the various generating techniques of high AC, DC and Impulse voltage.
4. Summarize the different circuits for high voltage and high current measurement.
5. Explain the high voltage testing of power apparatus and insulation coordination

Unit	Description	Instructional Hours
I	**OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS** Causes of over voltages and its effects on power system – Lightning phenomenon, switching surges and system faults –control of over voltages due to switching - protection of transmission line against over voltages	9
II	**ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS** Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Testing of insulating oils – Breakdown mechanisms in solid and composite dielectrics.	9
III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS** Generation of High voltages / currents - DC, AC, impulse voltages and currents. Tripping and control of impulse generators.	9
IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS** Measurement of High DC, AC, impulse voltages and currents – cathode ray oscillographs for Impulse voltages and current measurements.	9
V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION** High voltage testing of electrical power apparatus - Power frequency, impulse voltage and DC testing of Insulators, bushing, circuit breakers, isolators, cables and transformers– Insulation Coordination.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Categorize the various types of over voltages in power system and protection methods.
CO2: Analyze the various breakdown mechanisms in different dielectrics.
CO3: Classify the various generating techniques of high AC, DC and Impulse voltage.
CO4: Construct the circuits for high voltage and high current measurement.
CO5: Describe the high voltage testing of power apparatus and insulation coordination

TEXT BOOKS:

T1 M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, Tata McGraw Hill, 6th Edition, 2020.

T2 E. Kuffel and W. S. Zaengel, “High Voltage Engineering Fundamentals”, Pergamon Press, Oxford, London, 2000.

REFERENCE BOOKS:

R1 C.L.Wadhwa, “High Voltage Engineering”, New Age International Publishers,Third Edition,2012

R2 E. Kuffel and M. Abdullah, “High Voltage Engineering”, Pergamon Press, Oxford, 2186.

R3 Subir Ray, “An Introduction to High Voltage Engineering”, PHI Learning Private Limited, New Delhi, Second Edition, 2013.

R4 L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2011.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE7302	Electrical Energy Utilization and Conservation	3	0	0	3

Course Objective

1. To learn about different type of electric drives and the systems employed in electric traction.
2. To know about various lamps and design of illuminators schemes.
3. To familiarize with the existing methods, used for heating and welding.
4. To introduce the concepts of refrigeration and Air conditioning
5. To analyze the various energy saving methods

Unit	Description	Instructional Hours
I	**ELECTRIC DRIVES AND TRACTION** Fundamentals of Electric drive – choice of an Electric Motor – Application of motors for particular services. Traction Motors – Characteristic features of Traction motor – Systems of railway electrification – Electric Braking – Train movement and energy consumption – Traction Motor control – Track equipment and collection gear.	9
II	**ILLUMINATION** Introduction – Definition and meaning of terms used in illumination Engineering – Classification of light sources. Incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – Design of illumination systems – factory lighting halls – flood lighting – street lighting.	9
III	**HEATING AND WELDING** Introduction – advantages of Electric heating – Modes of heat transfer – Methods of electric heating – Resistance heating –Direct –Indirect , Arc furnaces – Direct –Indirect , Induction heating – Direct – Indirect,Dielectric heating. Electric welding – Types – Resistance welding –Butt-Spot-Projection-Seam, Arc welding – Metal arc-Carbon arc, Requirements of good weld –Power supply for arc welding.	9
IV	**REFRIGERATION AND AIR CONDITIONING** Introduction – Refrigeration cycle – Refrigeration system – Types of refrigerants – Domesticrefrigerator – Water coolers – Air conditioning systems– Classification of air conditioning systems – Central system — Heating of building.	9
V	**ECONOMICS OF ELECTRICAL ENERGY UTILIZATION** Economics of Electric power supply – General rule for charging the energy – power factor improvement – methods of reducing power factor occurrence – Economic choice of equipment – energy management – energy auditing – power quality.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Ability to choose suitable electric drives for different applications
CO2: Ability to design the illumination systems for energy saving
CO3: Ability to understand the utilization of electrical energy for heating and welding purposes
CO4: Illustrate the concepts of refrigeration and air conditioning
CO5: Apply the various method of energy saving and choosing suitable energy efficient systems.

TEXT BOOKS:

T1 Dr.N.V.Suryanarayana, Utilisation of Electric power, Wiley Eastern Limited, New Age International Limited, 2193

T2 J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K. Kataria and Sons, 2002.

REFERENCE BOOKS:

R1 R.K.Rajput, Utilisation of Electrical Power, Laxmi publications (P) Ltd., 2007.

R2 H.Partab, Art and Science of Utilisation of Electrical Energy, Dhanpat Rai and Co., New Delhi – 2004.

R3 E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt. Ltd, 2003.

R4 C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, 2003

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE7303	Internet of Things	3	0	0	3

Course Objective

1. Understanding Elements of an internet of thing system.
2. Various wired network schemes for internet of things.
3. Improve the networking fundamentals.
4. Understanding the basic smart grid technologies.
5. Analysing smart transmission systems.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO IoT** Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology	9
II	**IoT ARCHITECTURE** M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.	
III	**IoT PROTOCOLS** Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security	9
IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO** Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino	9
V	**CASE STUDIES AND REAL-WORLD APPLICATIONS** Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT –Amazon Web Services for IoT.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Differentiate the the various microcontrollers used for internet of things.
CO2: Various wired networking systems.
CO3: Evaluate the various networking system
CO4: Analyze the components of smart grids.
CO5: Analyze and design smart transmission technologies.

TEXT BOOKS:

T1 Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015

T2 Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011

REFERENCE BOOKS:

R1 Charles Bell, Beginning Sensor Networks with Arduino and Raspberry Pi , Apress, 2013.

R2 Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.

R3 Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

R4 Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley,2012

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE7304	Nano Technology	3	0	0	3

Course Objective

1. To introduce the concept and knowledge of Nano science and Nanotechnology.
2. To create awareness of clean room environment & societal implications of Nanotechnology
3. To know about preparation methods and nanofabrication techniques.
4. To know about the different characterization techniques used for Nano systems.
5. To understand the significant applications of nanotechnology

Unit	Description	Instructional Hours
I	**INTRODUCTION** Overview of Nano scale Science and Technology- Implications on Science, Engineering and society nano structured materials- Properties- Nanotoxicology-Clean room standards.	9
II	**PREPARARTION ROUTES** Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, self assembly; vapour phase deposition, CVDs, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy.	9
III	**LITHOGRAPHY FOR NANOSCALEDEVICES** Lithography process, optical/UV, electron beam, Ion Beam and x-ray lithography, Nanoimprint technique- Scanning probe lithography.	9
IV	**CHARECTERIZATION TECHNIQUES** X-ray and Neutron diffraction technique, Scanning Electron Microscopy plus environmental techniques, Transmission Electron Microscopy including high-resolution imaging, analytical electron microscopy, EDX and EELS, Surface Analysis techniques, XPS, SIMS, Auger.	9
V	**EVOLVING INTERFACES OF NANO** Applications of nanotechnology: NEMS – Nanosensor – nanomedicines –Nano applications in electrical engineering –Nanoelectronics: quantum transport devices, molecular electronics devices, quantum computing ,memory, CNT and its applications, Nano motor, Nano robot, energy efficient battery technology, Nano dielectrics, lighting system, solar cell.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Students will be able to understand the significance and implication of nanotechnology
CO2: To be able to apply the concept of nanotechnology for Electrical and Electronics EngineeringApplications.
CO3: Familiar with Rules and guidelines of clean room standards
CO4: Understanding the Fabrication methods and characterization techniquesCO5:
Students will be able to know the recent trends of nanotechnology

TEXT BOOKS:

T1 Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, PHI, 2009.

T2 T. Pradeep, Nano the essentials, Tata-McGraw Hill Education, 2007

REFERENCE BOOKS:

R1 B S Murthy,P Shankar, Baldev Raj, BB Rath& James Murday.'Text book of Nanoscience and Nano Technology',,Universities Press, 2011.

R2 Charles P.Poole & Frank ,J.Owens,Introduction to nanotechnology ,Wiley India,2007.

R3 Jan Korwink and Andreas Greiner, Semiconductors for Micro and Nanotechnology: An Introduction for Engineers, Weinheim Cambridge: wiley-VCH,2001.

R4 N.John Dinardo, Nanoscale Characterization of Surfaces and Interfaces, Second edition, Weinheim Cambridge: wiley-VCH,2000

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE7305	Wireless Sensor Network	3	0	0	3

Course Objective

1. Introduce about Wireless sensor network
2. Various protocols for Wireless sensor network
3. Gain knowledge about routing and network layer
4. To learn about Time synchronization
5. Impart knowledge on network security

Unit	Description	Instructional Hours
I	**INTRODUCTION** Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture, Applications : Structural Health Monitoring, Traffic Control, Health Care. Architecture: The Sensing Subsystem, the Processor Subsystem, Communication Interfaces, Prototypes.	9
II	**BASIC ARCHITECTURAL FRAMEWORK** Physical Layer, Basic Components, Source Encoding, Channel Encoding, Modulation Medium Access Control: Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC Protocols, Contention-Based MAC Protocols, and Hybrid MAC Protocols	9
III	**NETWORK LAYER** Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols Node and Network Management: Power Management, Local Power Management aspects, Dynamic Power Management, Conceptual Architecture	9
IV	**TIME SYNCHRONIZATION** Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks, Basics of Time Synchronization, Time Synchronization Protocols Localization: Ranging Techniques, Range-Based Localization, Range-Free Localization, Event Driven Localization.	9
V	**SECURITY** Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks , Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and Zig Bee Security	9
	Total Instructional Hours	**45**

Course Outcomes

CO1	Understand the basics of wireless sensor network
CO2	Summarize the different protocol networks.
CO3	Describe the routing matrices and management aspects for network layer
CO4	Observe the time synchronizations in wireless sensor network.
CO5	Study on fundamentals of security network.

TEXT BOOKS:

T1 Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley 2010.

T2 Mohammad S. Obaidat, Sudip Misra, "Principles of Wireless Sensor Networks", Cambridge, 2014.

REFERENCE BOOKS:

R1 Ian F. Akyildiz, Mehmet Can Vuran , "Wireless Sensor Networks", Wiley 2010

R2 FEI HU., XIAOJUN CAO, "Wireless Sensor Networks", CRC Press, 2013

R3 C S Raghavendra, K M Sivalingam, Taieb Znati, "Wireless Sensor Networks", Springer, 2010

R4 C. Sivarm murthy & B.S. Manoj, "Adhoc Wireless Networks", PHI-2004

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE7401	Electric Vehicles	3	0	0	3

Course Objective

1. Understand the different types of Electric Vehicle
2. Confer the basic principles of suitable power drive.
3. Discuss the basic principles and determine the performance of suitable drive scheme for EV
4. Recognize the different energy storage systems for vehicle applications
5. Recognize the various characteristics of Braking Energy.

Unit	Description	Instructional Hours
I	**OVERVIEW OF ELECRIC VEHICLES** Introduction Air Pollution – Global Warming - History of EVs - History of HEVs - Configurations of EVs - Performance of EVs - Tractive Effort in Normal Driving - Concept of Hybrid Electric Drive Trains .	9
II	**HYBRID ELECTRIC DRIVE TRAIN** , Architectures of Hybrid Electric Drive Trains-Series Hybrid Electric Drive Trains – Parallel Hybrid Electric Drive Trains – Torque Coupling - Speed Coupling -Torque &Speed Coupling of Parallel Hybrid Electric Drive Trains.	9
III	**DC & AC ELECTRICAL MACHINES** DC Motor Drives - Principle of Operation - Multi-Quadrant Control - Chopper Fed DC Motor Drives - Induction Motor Drives - Constant Volt/Hertz Control - Permanent Magnetic BLDC Motor Drives - Performance Analysis and Control of BLDC Machines- SRM Drives and PMSM Drives	9
IV	**ENERGY STORAGE SOURCES : BATTERIES AND FUEL CELLS** Battery Basics – Types – Lead-Acid, Li-Ion, Li-Polymer, Ni-Cd, NiMH , Fuel cells – Types : AFC,PAFC,DMFC– Battery -SOC-SOH –Ultra capacitor	9
V	**FUNDAMENTALS OF REGENERATIVE BRAKING** Energy Consumption in Braking, - Braking Energy on Front and Rear Axles - Brake System of EV, HEV-Series Brake optimal feel-Optimal Energy recovery-Parallel brake, Antilock Brake System.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Identify the Importance of EVs and HEVs
CO2	State a suitable drive scheme for developing an electric hybrid vehicle depending on resources
CO3	Design and develop basic drive schemes of electric vehicles and hybrid electric vehicles
CO4	Choose proper energy storage systems for vehicle applications
CO5	Identify various characteristics of Braking Energy.

TEXT BOOKS:

T1 Mehrdad Ehsani, Yimini Gao & Ali emadi "Modern Electric, Hybrid Electric and Fuel cell Vehicles" Third Edition, CRC Press, 2018.

T2 Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", CRC Press - Boca Raton London New York Washington, D.C. 2012.

REFERENCE BOOKS:

R1 Gianfranco Pistoia, "Electric and Hybrid Vehicles – Power sources, Models, Sustainability, Infrastructure and the market" Elsevier, The Netherlands – 2010.

R2 Ali emadi , "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis, 2012

R3 Ron Hodkinson and John Fenton, "Lightweight Electric/ Hybrid Vehicle Design", Butterworth-Heinemann, 2011.

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SEMESTER-VIII

Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE8901	Project Phase II	0	0	24	12

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.

The Project work (Phase II) shall be pursued for a minimum prescribed period as per regulation.

The project work shall be supervised by a supervisor of the department, (and an expert in industry if it is a industrial project), and the student shall be instructed to meet the supervisor periodically and to attend the review committee meeting for evaluation of the progress.

The Project report shall be prepared and submitted according to the approved guidelines as given by the Controller of Examination and bonafied duly signed by Supervisor and the Head of the Department.

Course Outcome

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

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PROFESSIONAL ELECTIVE-IV

Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8301	Special Electrical Machines	3	0	0	3

Course Objective

1. Identify the special electrical motors for specific applications.
2. Review the basics concept of stepper motor and its applications.
3. Understand the concept of the operating principle and characteristics of switched reluctance motors.
4. Impact the knowledge on controllers for controlling the speed of permanent magnet brushless D.C. motors.
5. Gain knowledge on 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 –– 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 - 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, 2182.
R3 T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 2189.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8302	Microcontroller Based System Design	3	0	0	3

Course Objectives

1. Infer the fundamental components of the PIC microcontroller.
2. Educate the PIC micro controller Interrupts and Timers.
3. Integrate the concept of peripherals and interfacing of microcontroller-based embedded systems.
4. Propose the architecture of arm processor
5. Introduce the concept of arm organization

Unit	Description	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 – Timers – Timer modules – Front panel I/O-Soft Keys – State machines and key switches – Display of Constant and Variable strings.	9
III	**PERIPHERALS AND INTERFACING**: I^2C Bus for Peripherals Chip Access – Bus operation-- Bus subroutines – Serial EEPROM – Baud rate selection – 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 – Embedded ARM Applications	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Understand the working of the architecture for PIC microcontrollers
- CO2 Identify the factors for data transfer in interrupts and understand the timer function of PIC microcontroller
- CO3 Observe the peripherals and interfacing of microcontroller-based embedded systems.
- CO4 Interpret the ARM Architecture and Assembly Language Programming
- CO5 Employ the role of arm organization

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 R2 Ajay V.Deshmukh' Microcontroller"[Theory and application].

R3 Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013

R4 C.Ravichandran. M. Arulaalan, "Microcontroller Based System Design," Suchitra Publications,2016.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8303	Smart Grid	3	0	0	3

Course Objectives

1. To study about smart grid technologies
2. Analyse features of smart grid and also automation
3. Distinguish various communication protocols for smart grid
4. Study and Understand about various computational techniques and tools for smart grid
5. Understand about smart grid applications and its challenges

Unit	Description	Instructional Hours
I	**INTRODUCTION TO SMART GRID** Evolution of Electric Grid – Need for smart grid – Difference between conventional & smart grid – Overview of enabling technologies – International experience in smart grid deployment efforts – Smart grid road map for INDIA – smart grid architecture	9
II	**SENSOR SYSTEM TO MEASURE THE SYSTEM STATE** Sensor Networks– Smart Meter – Advanced Meter Reading – Advanced Meter Management – Smart Vehicle Chargers – Vehicle to Grid Systems – SCADA – RTU – IED – Phasor Measurement Unit – Fault Detection and Self- Healing Systems – Applications and Challenges.	9
III	**INFORMATION AND COMMUNICATION TECHNOLOGY** Overview of smart grid communication system – Modulation and Demodulation techniques – Radio communication – Mobile communication – Power line communication – Optical fibre communication – Communication protocol for smart grid.	9
IV	**TOOLS AND TECHNIQUES FOR SMART GRID** Computational Techniques – Static and Dynamic Optimization techniques – Computational Intelligence Techniques – Evolutionary Algorithms – Artificial Intelligence techniques.	9
V	**SMART GRID APPLICATIONS** Overview and concept of renewable integration – role of protective relaying in smart grid – House Area Network – Advanced energy Storage Technology – Flow battery – Fuel cell – SMES – Super capacitors – Plug-in Hybrid electric vehicles – Cyber Security requirements – Smart grid information model.	9
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Understand the features of smart grid
- CO2 Assess the role of automation in Transmission and Distribution
- CO3 Describe the concepts and principles of communications technologies for smart grid
- CO4 Apply evolutionary algorithms for the smart Grid
- CO5 Understand several applications of smart grid

TEXT BOOKS:

T1 Janaka Ekanayake, Smart Grid Technology and Applications, John Wiley & Sons Publication, 2012

T2 Stuart Borlase, Smart Grids, Infrastructure, technology and Solutions, CRC Press, 1e, 2013.

REFERENCE BOOKS:

R1 James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 2012

R2 Clark W. Gellings, The Smart Grid: Enabling Energy Efficiency and Demand Response, 1st Edition, CRC Press, 2009

R3 A. Keyhani, Smart Power Grid Renewable Energy Systems, Wiley 2011

R4 India Smart Grid Knowledge Portal

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE8304	Advanced Soft Computing	3	0	0	3

Course Objective

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

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

Course Outcome

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

TEXT BOOKS:

T1 Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood Cliffs, N.J., 2192

T2 Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 2000.

REFERENCE BOOKS:

R1 Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc. 2189

R2 Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 2192

R3 Ethem Alpaydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)', MIT Press, Second Edition, 2010.

R4 Zhang Huaguang and Liu Derong, "Fuzzy Modeling and Fuzzy Control Series:Control Engineering", 2006

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8305	Power Quality	3	0	0	3

Course Objectives

1. To understand the various power quality issues.
2. To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads.
3. To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
4. To understand the active compensation techniques used for power factor correction
5. To understand the active compensation techniques used for load voltage regulation

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards	**9**
II	**ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM** Single phase linear and non linear loads –single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf – three phase three wire – three phase four wire system.	**9**
III	**CONVENTIONAL LOAD COMPENSATION METHODS** Principle of load compensation and voltage regulation – classical load balancing problem : open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured	**9**
IV	**LOAD COMPENSATION USING DSTATCOM** Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory –Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.	**9**
V	**SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM** Rectifier supported DVR – Dc Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.	**9**
	Total Instructional Hours	**45**

Course Outcomes

- CO1 Able to classify power quality disturbances, their causes, detrimental effects and knowledge about national and international Power quality standards.
- CO2 Ability to assess the impact of harmonics in single phase and three phase distribution systems.
- CO3 Capability to adopt passive harmonic mitigation techniques for load compensation and voltage regulation.
- CO4 Able to employ dynamic harmonic current compensation methods in distribution systems.
- CO5 Able to employ dynamic voltage regulation methods in distribution systems.

TEXT BOOKS:

T1 Roger C. Dugan , Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, Electrical Power Systems Quality, Tata McGraw Hill Education Private Ltd, 3rd Edition 2012.

T2 "Math H J Bollen", "Understanding Power Quality Problems" , IEEE Press, 2000.

REFERENCE BOOKS:

R1 G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 2194(2nd edition)

R2 "R. Sastry Vedam and Mulukutla S. Sarma", "Power Quality VAR Compensation in Power Systems", CRC Press, 2008.

R3 ArindamGhosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002

R4 C. Sankaran, Power Quality, CRC Press 2001.

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PROFESSIONAL ELECTIVE-V

Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE8306	Preventive Maintenance of Electrical Apparatus	3	0	0	3

Course Objective

1. Provide knowledge on fundamentals of maintenance of electrical equipments.
2. Familiar with the importance of preventive maintenance & safety measures.
3. Recognize the various components and maintenance for AC and DC motors.
4. Acquire knowledge on maintenance of transformer and domestic appliances.
5. Acquire knowledge on maintenance of storage batteries.

Unit	Description	Instructional Hours
I	**MAINTENANCE OF ELECTRICAL APPARATUS** Need and importance of maintenance of equipments-Fundamentals of electrical maintenance and repairs-Classification scope and frequency of electrical maintenance work- Repair records and maintenance schedule of electric motors. Accessories required for maintenance and repair work- Maintenance types-Industry-Corrective-Preventive-Condition based and risk based maintenance. General responsibility of safety engineers.	9
II	**PREVENTIVE MAINTENANCE & SAFETY MEASURES** Definition-necessity and utility of preventive maintenance- Types of preventive maintenance-Calendar based and Run time based-Elements of preventive maintenance-check list – Electrical inspection check lists- Advantages and economics benefits of preventive maintenance. Causes of electrical accident-electrical shock-prevention and remedial action-safety regulations and safety measures. Fire extinguishers	9
III	**MAINTENANCE OF THREE PHASES INDUCTION MOTORS** Causes of fault in electrical equipments-internal and external faults–Common troubles in electrical equipments-Causes for failure of the motors-Insulation classifications - permissible operating temperatures- effect of altitude, inactive motors. Ageing of insulation- insulation resistance tests- cleaning and drying of insulation-Role of single phase preventer- Types of enclosures-Maintenance schedule and troubleshooting of AC and DC motors.	9
IV	**MAINTENANCE OF TRANSFORMER & DOMESTIC APPLIANCES** Transformer protective devices and their maintenance-Buchholz relay-Insulating oil and its characteristics, inhibited oils, causes of deterioration of oil. Effect of moisture and temperature-Ageing of insulating oil-Resistivity of the oil, Di-electric strength tests -purification of insulating oil. Need of trouble shooting chart-advantages –trouble shooting chart for domestic appliances-Electric iron, Ceiling fan, water heater, air-cooler-fluorescent tube light.	9
V	**MAINTENANCE OF STORAGE BATTERY** Introduction, battery selection, stationary storage batteries-Alkaline, Lead acid batteries-comparison-Causes of faults in batteries-Maintenance check list for lead acid battery- Charging and discharging of lead acid battery-Life of the lead acid battery-safety precautions, General care- maintenance schedule (daily / Weekly / yearly) and trouble shooting. Maintenance free battery-Batteries for Electric vehicles.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand the concepts of maintenance of electrical equipments
CO2: Articulate the importance of preventive maintenance &understand the concepts of safety measures.
CO3: Demonstrate the concepts of maintenance and troubleshooting for AC and DC motors.
CO4: Exhibit the maintenance schedule and troubleshooting for transformer and domestic appliances.
CO5: Understand the concept of maintenance of storage batteries.

TEXT BOOKS:

T1 Sharotri SK, "Preventive Maintenance of Electrical Apparatus", Katson Pub. House

T2 Rao S, "Testing Commissioning operation and maintenance of Electrical Equipments" Khanna Publication (6th edition) 2012.

REFERENCE BOOKS:

R1 K.B.Bhatia, Maintenance and control of Electrical Equipments, standard publishers Distributors, New Delhi, 2010

R2 Rao S, Testing, Commissioning, Operation and Maintenance of Electrical Equipment, Khanna Technical Publication, New Delhi.

R3 Asfaq Hussain "Basic Electrical Engineering", Dhanpat Rai.

R4 Operation and Maintenance of Electrical Equipment – Volume I & lI B.V.S.Rao Media Promoters & Publishers Private Limited, Mumbai 1st Edition, 1st Reprint 2011

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8307	High Voltage Direct Current Transmission	3	0	0	3

Course Objectives

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

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction of DC power transmission technology-Constitution of EHV 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-Limitations and advantages of AC and DC transmission.	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-stability of control.	9
IV	**REACTIVE POWER AND HARMONICCONTROL** DC reactor- voltage oscillations and valve dampers-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 Outcomes

- CO1 Educate Planning and Modern trends in HVDC technology.
- CO2 Understand the different types of HVDC converter system.
- CO3 Summarize the converter control used in HVDC transmission
- CO4 Generalize filters for eliminating harmonics and study 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, Third Edition, 2017

T2 Sunil S.Rao,sanjaykumar Sharma,”EHV AC,HVDC Transmission And Distribution Engineering .Kanna Publications,2018.

REFERENCE BOOKS:

R1 Dragan Jovcic,”High Voltage Direct Current Transmission: Converters, Systems and DC Grids”, Second Edition,2021.

R2 S.Kamakshaiah, V.Kamaraju, “HVDC Transmission”,TataMcGraw Hill Education Private Limited, 2011.

R3 M.Karthick , “HVDC Transmission System: Concept Of Transmission” , First edition,Notion Press,2020.

R4 Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE8308	Energy Auditing and Energy Management	3	0	0	3

Course Objective

1. Impart knowledge on basics of energy auditing.
2. Understand the concepts of energy management.
3. Familiarize the various energy efficient equipments.
4. Interpret the importance of power factor improvement and energy instruments.
5. Manipulate the economic analysis of energy management and audit.

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF ENERGY AUDIT** Energy audit – definition, concept, type of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes – Energy audit of industries – energy saving opportunities, sample energy audit of industry, power station.	9
II	**ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS** Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy Manager – Eligibility, Qualification and functions - Questionnaire and check list for top management.	9
III	**ENERGY EFFICIENT MOTORS AND LIGHTING** Factors affecting efficiency - Energy efficient motors - constructional details, characteristics – variable speed, variable frequency drives - voltage variation –voltage unbalance – over motoring – motor energy audit – Energy efficient lighting system design and practice- lighting control	9
IV	**POWER FACTOR IMPROVEMENT AND ENERGY INSTRUMENTS** Power factor - methods of improvement, location of capacitors, p.f with nonlinear loads, effect of harmonics on p.f,- p.f motor controllers –Different type of Energy Measuring Instruments - Power Quality Manger, Digital Multimeter, thermocouples, lux meters, Digital Pressure Meter.	9
V	**ECONOMIC ANALYSIS METHODS** Economics analysis – Depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis - Calculation of simple payback method, net present worth method.	9
	Total Instructional Hours	**45**

Course Outcome

At the end of the course Students will be able to

CO1 Apply the knowledge to calculate the efficiency, energy conservation of various utilities.
CO2 Design suitable energy monitoring system to analyze and optimize the energy consumption.
CO3 Improve the efficiency by designing suitable energy efficient systems.
CO4 Use the energy auditing tools learnt to save energy expenditure.
CO5 Carry out the cost- benefit analysis of various investment alternatives for meeting the energy needs.

TEXT BOOKS:

T1 Paul o' Callagham, "Energy Management",Mc-Graw Hill Book Company – 1st edition; 2198.
T2 Murphy W.R. and G.Mckay Butter worth , "Energy Management", Heinemann Publications 2007.

REFERENCE BOOKS:

R1 John.C.Andreas, "Energy Efficient Electric Motors", Marcel Dekker Inc Ltd – 3rd edition; 2005
R2 W.C.Turner Steve Doty, "Energy Management Handbook", John Wiley and Sons, 7th Edition 2009.
R3 Amlan Chakrabarti, Energy Engineering and Management, Prentice hall India 2011
R4 Stephan A. Roosa, Steve Doty, Wayne C. Turner, "Energy Management Handbook", 9th Edition 2018.

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Programme	Course Code	Name of the course	L	T	P	C
BE	19EE8309	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. model the electrical machines used for renewable energy conversion systems
3. Study the power converters used for PV 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) - Boost and buck-boost converters- selection of inverter, array sizing Wind: Three phase AC voltage controllers, 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-Renewable energy in Industrial Applications	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Familiarized the basic of renewable energy systems.
CO2: Features of electrical machines used in renewable energy conversion are studied.
CO3: Various topologies of power converters used for interfacing renewable energy system are studied
CO4: Analysis the operation of solar and wind systems at stand alone and Grid integrated system
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, 2193.

REFERENCE BOOKS:

R1 Gray, L. Johnson, “Wind energy system”, prentice hall linc, 2195.
R2 Solanki Chetan Singh, “Solar Photovoltaics : Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd., 2011
R3 Rai. G.D, “Solar energy utilization”, Khanna publishes, 2193.
R4 S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press 2005

Chairman - BoS
EEE - HiCET

Chairman

Dean (Academics)
HiCET

Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE8310	Intellectual Property Rights	3	0	0	3

Course Objective

1. 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. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. Understand the knowledge on agreement and its related rights and registration aspects.
4. disseminate knowledge on digital products and law
5. Aware about current trends in IPR and Govt. steps in fostering IPR

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.	9
II	**REGISTRATION OF IPRs** Meaning and practical aspects of registration of copy rights, trademarks, patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad	9
III	**AGREEMENTS AND LEGISLATIONS** International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.	9
IV	**DIGITAL PRODUCTS AND LAW** Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies	9
V	**ENFORCEMENT OF IPRs** Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.	9
	Total Instructional Hours	**45**

Course Outcome

CO1: Understand Intellectual Property portfolio to enhance the value of the firm.
CO2: Understand the basics Registration of IPRs.
CO3: Acquire knowledge on Agreements and Legislations.
CO4: Interpret the digital products and law
CO5: Acquire knowledge on Enforcement IPRs

TEXT BOOKS:

T1 V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
T2 S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2002

REFERENCE BOOKS:

R1 Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
R2 PrabuddhaGanguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011
R3 Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
R4 Managing Intellectual Property in the Book Publishing Industry, Monica Seeber, Richard Balkwill | WIPE Publication year: 2007

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OPEN ELECTIVE

Programme	Course Code	Name of the course	L	T	P	C
BE	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**

TEXT

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

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 l,Albert Alexander S,Madhuvanthani Rajendran, "Power Electronic Converters for Solar Photovoltaic Systems"Academic Press An imprint of Elseiver,2020

R2 D.P.Kothari, K.K.Singal, RakeshRanjan, "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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Programme	Course Code	Name of the Course	L	T	P	C
BE	19EE7401	Electric Vehicles	3	0	0	3

Course Objective

6. Understand the different types of Electric Vehicle
7. Confer the basic principles of suitable power drive.
8. Discuss the basic principles and determine the performance of suitable drive scheme for EV
9. Recognize the different energy storage systems for vehicle applications
10. Recognize the various characteristics of Braking Energy.

Unit	Description	Instructional Hours
I	**OVERVIEW OF ELECRIC VEHICLES** Introduction Air Pollution – Global Warming - History of EVs - History of HEVs - Configurations of EVs - Performance of EVs - Tractive Effort in Normal Driving - History of HEVs - Concept of Hybrid Electric Drive Trains - Architectures of Hybrid Electric Drive Trains-Standards BEV,PHEV,HEV	9
II	**DESIGN PRINCIPLES OF SERIES , PARALLEL HYBRID ELECTRIC DRIVE TRAIN** Operation Patterns - Control Strategies - Design Principles of a Series (Electrical Coupling) Hybrid Drive Train – Parallel Drive Train Configuration and Design Objectives - Control Strategies – Series – Parallel Drive Train Configuration.	9
III	**DC & AC ELECTRICAL MACHINES** DC Motor Drives - Principle of Operation - Multi-Quadrant Control - Chopper Fed DC Motor Drives - Induction Motor Drives - Constant Volt/Hertz Control - Permanent Magnetic BLDC Motor Drives - Performance Analysis and Control of BLDC Machines- SRM Drives and PMSM Drives	9
IV	**ENERGY STORAGE SOURCES : BATTERIES AND FUEL CELLS** Battery Basics – Types – Lead-Acid, Ni-Cd, NiMH , Li-Ion, Li-Polimer, Zins-Air and Sodium-sulfur Battery – Battery Performance – Technical Characteristics – Fuel cells – Types : AFC , PEM , DMFC– Fuel cell EV-Charging Methodologies –SOC-SOH –Ultracapacitor-supercapictor	9
V	**FUNDAMENTALS OF REGENERATIVE BRAKING** Braking Energy Consumed in Urban Driving - Braking Energy versus Vehicle Speed - Braking Energy versus Braking Power - Braking Power versus Vehicle Speed - Braking Energy versus Vehicle Deceleration Rate - Braking Energy on Front and Rear Axles - Brake System of EV, HEV, and FCV.	9
	Total Instructional Hours	**45**

Course Outcome

CO1	Identify the Importance of EVs and HEVs
CO2	State a suitable drive scheme for developing an electric hybrid vehicle depending on resources
CO3	Design and develop basic drive schemes of electric vehicles and hybrid electric vehicles
CO4	Choose proper energy storage systems for vehicle applications
CO5	Identify various characteristics of Braking Energy.

TEXT BOOKS:

T1 Mehrdad Ehsani, Yimini Gao & Ali emadi “Modern Electric, Hybrid Electric and Fuel cell Vehicles” Third Edition, CRC Press, 2018.

T2 Iqbal Husain, “Electric and Hybrid Vehicles Design Fundamentals”, CRC Press - Boca Raton London New York Washington, D.C. 2012.

REFERENCE BOOKS:

R1 Gianfranco Pistoia, “Electric and Hybrid Vehicles – Power sources, Models, Sustainability, Infrastructure and the market” Elsevier, The Netherlands – 2010.

R2 Ali emadi , “Handbook of Automotive Power Electronics and Motor Drives”, Taylor & Francis, 2012

R3 Ron Hodkinson and John Fenton, “Lightweight Electric/ Hybrid Vehicle Design”, Butterworth-Heinemann, 2011.

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HiCET

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

SEMESTER I – R 2022

Course Code &Name : 22MA1101/ MATRICES AND CALCULUS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	0	0	0	0	0	0	2	2	1
CO2	3	3	3	2	2	0	0	0	0	0	0	2	2	2
CO3	3	3	3	2	3	0	0	0	0	0	0	2	2	2
CO4	3	3	3	3	3	0	0	0	0	0	0	2	2	3
CO5	3	3	3	3	3	0	0	0	0	0	0	2	1	2
AVG	3	3	3	2.6	2.8	0	0	0	0	0	0	2	1.8	2

Course Code & Name : 22PH1151/PHYSICS FOR NON CIRCUIT ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	0	1	0	2	3	3	2
CO2	3	3	2	2	1	1	1	0	1	0	2	2	3	1
CO3	3	3	2	2	2	1	1	0	1	0	1	2	2	2
CO4	3	2	3	1	3	1	1	0	1	0	1	2	2	1
CO5	3	2	3	1	2	1	1	0	1	0	2	2	2	1
Avg	3	2.6	2.6	1.6	2.2	1	1	0	1	0	1.6	2.2	2.4	1.4

Course Code & Name : 22CY1151/ CHEMISTRY FOR CIRCUIT ENGINEERING

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	1	1	1	0	1	0	1	2	0	0
CO2	2	3	2	1	1	1	1	0	1	0	1	2	0	0
CO3	2	2	2	2	1	1	1	0	1	0	1	2	0	0
CO4	2	2	3	1	2	1	1	0	1	0	2	2	0	1
CO5	2	3	3	2	2	1	1	0	1	0	1	2	0	0
Avg	2	2.6	2.6	1.4	1.4	1	1	0	1	0	1.2	2	0	1

Course Code & Name : 22HE1151 / ENGLISH FOR ENGINEERS

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	0	0	0	1	2	2	2	3	1	1	1	2
CO2	2	1	0	0	1	1	1	2	2	3	0	2	0	2
CO3	2	1	0	0	1	1	2	3	3	3	0	1	1	2
CO4	2	1	0	0	0	1	2	2	2	3	1	1	0	0
CO5	2	0	0	0	0	1	1	2	3	3	0	1	1	2
Avg	2	1	0	0	1	1	1.6	2.2	2.4	3	1	1.2	1	2

Course Code & Name : 22HE1071 / UNIVERSAL HUMAN VALUES

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	0	0	1	3	1	1	0	1	0	0	2
CO2	0	0	0	0	0	2	3	2	1	0	2	0	0	2
CO3	0	0	0	0	0	0	0	0	0	0	0	0	0	2
CO4	0	0	0	0	0	2	1	1	1	0	2	0	0	3
CO5	0	0	0	0	0	1	2	1	1	0	1	0	0	2
Avg	0	0	0	0	0	1	2	1	1	0	2	0	0	2.2

Semester – III R2022

Course Code & Name : 22MA3102/Complex Analysis and Transforms

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	2	2	2
CO3	3	3	3	3	3	0	0	0	0	0	0	2	2	2
CO4	3	3	3	3	3	0	0	0	0	0	0	2	1	2
CO5	3	3	3	3	3	0	0	0	0	0	0	2	2	1
Avg	3	3	3	2.6	2.8	0	0	0	0	0	0	2	1.8	1.8

Course Code & Name : 22EE3201/ Electronic Devices and Circuits

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	2	2	3	1	2	3	2	1	3	3	3
CO 2	2	3	2	3	3	2	1	2	3	2	0	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	2	0	3	3	0
CO 4	2	3	2	3	3	2	1	2	3	2	0	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	0	3	3	3
AVG	2.6	2.8	2.2	2.8	2.8	2.2	1.4	2	3	2	0.2	3	3	3

Course Code & Name : 22EE3202/ Electric Circuit Analysis

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	3	1	2	3	3	1	3	3	3
CO 2	3	3	2	3	3	2	1	2	3	2	1	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	3	1	3	3	0
CO 4	3	3	2	3	3	2	1	2	3	2	1	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	0	3	3	3
AVG	3	3	2.2	2.8	3	2.2	1.4	2	3	2.4	0.8	3	3	3

Course Code & Name: 22EE3203/ Field Theory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	3	1	2	3	3	1	3	3	3
CO 2	3	3	2	3	3	2	1	2	3	2	1	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	3	2	3	3	0
CO 4	3	3	2	3	3	2	1	2	3	2	1	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	1	3	3	3
AVG	3	3	2.2	2.8	3	2.2	1.4	2	3	2.4	1.2	3	3	3

Course Code & Name: 22EI3251/ Digital Electronics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	1	2	1	2	3	2	0	3	3	0
CO 2	2	3	2	3	3	2	1	2	3	2	0	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	2	0	3	3	0
CO 4	2	3	2	3	3	2	1	2	3	2	0	3	3	3
CO 5	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

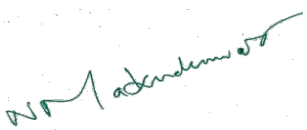
Course Code & Name: 22EE3001/ Electric Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	3	1	2	2	2	2	3	3	3
CO 2	3	3	3	3	3	3	1	2	2	3	2	3	3	3
CO 3	3	3	3	3	3	3	1	2	2	3	2	3	3	3
CO 4	3	3	3	3	3	3	1	2	2	2	2	3	3	3
CO 5	3	3	3	3	3	3	1	2	2	2	2	3	3	3
AVG	3	3	3	3	3	3	1	2	2	2.6	2	3	3	3

Course Code & Name: 22EE3002/ Electronic Devices and Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	2	2	3	3	3	3	3	3
AVG	3	3	3	3	3	3	2	2	3	3	2	3	3	3

Chairman Board of Studies



Dean - Academics

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

Semester – III R2022

Course Code & Name : 22MA3102/Complex Analysis and Transforms

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	0	0	0	0	0	0	2	2	2
CO2	3	3	3	2	3	0	0	0	0	0	0	2	2	2
CO3	3	3	3	3	3	0	0	0	0	0	0	2	2	2
CO4	3	3	3	3	3	0	0	0	0	0	0	2	1	2
CO5	3	3	3	3	3	0	0	0	0	0	0	2	2	1
Avg	3	3	3	2.6	2.8	0	0	0	0	0	0	2	1.8	1.8

Course Code & Name : 22EE3201/ Electronic Devices and Circuits

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	2	3	2	2	3	1	2	3	2	1	3	3	3
CO 2	2	3	2	3	3	2	1	2	3	2	0	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	2	0	3	3	0
CO 4	2	3	2	3	3	2	1	2	3	2	0	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	0	3	3	3
AVG	2.6	2.8	2.2	2.8	2.8	2.2	1.4	2	3	2	0.2	3	3	3

Course Code & Name : 22EE3202/ Electric Circuit Analysis

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	3	1	2	3	3	1	3	3	3
CO 2	3	3	2	3	3	2	1	2	3	2	1	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	3	1	3	3	0
CO 4	3	3	2	3	3	2	1	2	3	2	1	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	0	3	3	3
AVG	3	3	2.2	2.8	3	2.2	1.4	2	3	2.4	0.8	3	3	3

Course Code & Name: 22EE3203/ Field Theory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	2	3	3	1	2	3	3	1	3	3	3
CO 2	3	3	2	3	3	2	1	2	3	2	1	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	3	2	3	3	0
CO 4	3	3	2	3	3	2	1	2	3	2	1	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	1	3	3	3
AVG	3	3	2.2	2.8	3	2.2	1.4	2	3	2.4	1.2	3	3	3

Course Code & Name: 22EI3251/ Digital Electronics

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2	3	2	1	2	1	2	3	2	0	3	3	0
CO 2	2	3	2	3	3	2	1	2	3	2	0	3	3	0
CO 3	3	3	2	3	3	2	2	2	3	2	0	3	3	0
CO 4	2	3	2	3	3	2	1	2	3	2	0	3	3	3
CO 5	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: 22EE3001/ Electric Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	3	1	2	2	2	2	3	3	3
CO 2	3	3	3	3	3	3	1	2	2	3	2	3	3	3
CO 3	3	3	3	3	3	3	1	2	2	3	2	3	3	3
CO 4	3	3	3	3	3	3	1	2	2	2	2	3	3	3
CO 5	3	3	3	3	3	3	1	2	2	2	2	3	3	3
AVG	3	3	3	3	3	3	1	2	2	2.6	2	3	3	3

Course Code & Name: 22EE3002/ Electronic Devices and Circuits Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 4	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	2	2	3	3	3	3	3	3
AVG	3	3	3	3	3	3	2	2	3	3	2	3	3	3

SEMESTER V

Course Code & Name 21EE5201 Design of Electrical Machines

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	2	1	0	0	1	0	0	0	1	3	0
CO 2	3	3	1	2	1	0	0	1	0	0	0	1	3	3
CO 3	3	3	1	2	1	0	0	1	0	0	0	1	3	3
CO 4	3	3	1	2	1	0	0	1	0	0	0	1	3	0
CO 5	3	3	1	2	1	0	0	1	0	0	0	1	3	0
AVG	3	3	1	2	1	0	0	1	0	0	0	1	3	3

Course Code & Name 21EE5202/ Renewable and Non-Renewable Energy Sources

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	0	3	0	3	0	0	3	3	3
CO 2	3	3	3	3	3	0	3	0	3	0	0	3	3	3
CO 3	3	3	3	3	3	0	3	0	3	0	0	3	3	3
CO 4	3	3	0	0	0	0	3	0	0	0	0	3	3	3
CO 5	3	3	0	0	0	0	3	0	0	0	0	3	3	3
AVG	3	3	3	3	3	0	3	0	3	0	0	3	3	3

Course Code & Name 21EE5203- Microprocessors and Microcontrollers

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	2	3	0	0	0	2	0	0	0	0	3	2
CO 2	2	2	2	3	0	0	0	1	0	0	0	0	3	2
CO 3	2	2	2	3	2	0	0	1	0	0	0	0	3	2
CO 4	2	1	2	3	2	0	0	1	0	0	0	0	3	2
CO 5	2	1	2	3	0	0	0	1	0	0	0	0	3	2
AVG	2	1.4	2	3	2	0	0	1.2	0	0	0	0	3	2

Course Code & Name 21EE5204- Transmission and Distribution

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	2	0	2	2	0	0	0	0	2	3	0
CO 2	3	3	2	2	2	0	0	0	0	0	0	2	3	3
CO 3	3	3	2	2	2	0	0	0	0	0	0	2	3	3
CO 4	3	3	0	2	2	0	2	0	0	0	0	2	3	3
CO 5	3	2	2	0	2	0	0	0	0	0	0	2	3	3
AVG	3	3	2	2	2	2	2	0	0	0	0	2	3	3

Course Code & Name 21EE5301- Fibre Optics and Laser Instruments

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	0	0	0	0	0	0	0	0	0	0	0	3	3
CO 2	0	2	0	0	0	0	0	0	0	0	0	0	3	0
CO 3	0	1	1	0	0	2	0	0	0	0	0	0	3	0
CO 4	0	0	0	0	0	0	0	0	1	0	1	0	3	0
CO 5	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 21EE5251- Control Systems Engineering

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	2	3	0	0	0	0	0	0	0	1	3	0
CO 2	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO 3	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO 4	3	3	2	3	3	0	0	0	3	0	0	1	3	3
CO 5	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 21EE5001- Control and Instrumentation Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO 2	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO 3	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO 4	3	3	3	3	3	0	0	2	3	3	0	3	3	3
CO 5	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 21EE5002- Microprocessors and Microcontrollers Laboratory

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	3	2	3	0	0	0	2	0	1	0	3	3	2
CO 2	2	2	3	3	0	0	0	1	0	1	0	3	3	2
CO 3	3	2	2	3	3	0	0	2	0	2	0	3	3	2
CO 4	3	2	3	3	3	0	0	2	0	2	0	3	3	2
CO 5	2	2	2	3	0	0	0	1	0	1	0	3	3	2
AVG	2.4	2.2	2.4	3	3	0	0	1.6	0	1.4	0	3	3	2

SEMESTER VII

Course Code & Name 19EE7201- Solid State Drives

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	0	3	0	0	0	0	0	0	0	0	0	0	0	0
CO2	0	3	0	0	0	0	0	0	0	0	0	0	0	0
CO3	0	3	0	0	1	0	0	0	0	0	0	0	0	0
CO4	0	0	3	0	2	0	0	0	0	0	0	0	2	0
CO5	0	0	3	0	2	0	0	0	0	0	0	0	2	0
Avg	0	3	3	0	1.6	0	0	0	0	0	0	0	2	0

Course Code & Name 19EE7302- Electrical Energy Utilization and Conservation

PO& PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	1	0	0	0	0	1	0	0	0	0	1	0	0	1
CO2	1	0	0	0	0	0	0	0	0	0	1	0	0	2
CO3	1	0	0	0	0	0	0	0	0	0	1	1	0	2
CO4	1	0	0	0	0	0	0	0	0	0	1	0	0	2
CO5	1	0	0	0	2	1	0	0	0	0	1	0	0	2
Avg	1	0	0	0	2	1	0	0	0	0	1	1	0	1.8

Course Code & Name 19EE7251- 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	0	2	0	0	0	0	0	0	0	0	0	0
CO2	0	3	2	2	2	0	0	0	0	0	0	0	2	0
CO3	0	3	2	2	0	0	0	0	0	0	0	0	2	0
CO4	0	3	0	2	0	0	0	0	0	0	0	0	2	0
CO5	0	3	0	2	0	0	0	0	0	0	0	0	3	0
Avg	3	2.8	2	2	2	0	0	0	0	0	0	0	2.25	0

Course Code & Name 19EE7001- Electric Drives and Control Laboratory

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

Chairman Board of Studies

Dean - Academics