PUDUCHERRY TECHNOLOGICAL UNIVERSITY
PUDUCHERRY –605014

(A Technological University of Gover*nment of Puducherry)*

NOTES ON AGENDA

of

the fifth meeting of

BOARD OF STUDIES

In

ELECTRICAL AND ELECTRONICS ENGINEERING

(Both offline and virtual mode)

Held on Friday, 11th August 2023

Venue: Department of Electrical and Electronics Engineering
Puducherry Technological University

Time: 10:30 am

I N D E X

1	For Approval

Item 1.1	Curriculum and Syllabi for B.Tech - Electrical and Electronics Engineering offered in Constituent and Affiliated Colleges under Puducherry Technological University *(Effective from the Academic Year 2022 – 23)*

The curriculum and syllabi of B.Tech. (Electrical and Electronics Engineering) programme offered in Constituent and Affiliated Colleges under Puducherry Technological University have been prepared and placed for approval of BoS. The same is enclosed in Annexure I.

Item 1.2	Course Outcomes (COs) and CO-PO Articulation Matrix revised for all subjects in the B.Tech- EEE Syllabi of both PTU and Constituent / Affiliated Colleges

The course outcomes (COs) and course outcome - program outcome (CO-PO) articulation matrix have been revised for all courses in the B.Tech –EEE syllabi of both PTU and Constituent/affiliated Colleges according to modified Bloom's taxonomy and placed for approval of BoS. The same is enclosed in Annexure I.

2	Annexure

Annexure I	Curriculum and Syllabi of B.Tech - Electrical and Electronics Engineering offered in Constituent / Affiliated Colleges under PTU *(Effective from the Academic Year 2022 – 23)*

Annexure I

Curriculum and Syllabi of B.Tech., - Electrical and Electronics Engineering offered in Constituent / Affiliated Colleges under PTU *(Effective from the Academic Year 2022 – 23)*

PUDUCHERRY TECHNOLOGICAL UNIVERSITY

Applicable to the Constituent and Affiliated Colleges of
Puducherry Technological University

REGULATIONS 2022-2023

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM

The Curriculum of B.Tech. (Electrical and Electronics Engineering) is designed to fulfil the Program Educational Objectives (PEO) and the Program Outcomes (PO) listed below.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	To provide students with the necessary knowledge in basic sciences in general and Electrical and Electronics Engineering in particular so as to develop skills to understand Electrical and Electronics Engineering systems.
PEO2	To provide education and practical training to design, debug and improve reliability of Electrical and Electronics Engineering systems.
PEO3	To impart in-depth knowledge to build competency and capability to analyze and provide feasible solutions for real life problems in power, control and electronics industries.
PEO4	To prepare and encourage students to succeed in leadership positions in industry and to undertake research leading to scientific innovations for sustainable development
PEO5	To promote student awareness for life-long learning and to inculcate sensitivity to professional ethics and codes of professional practices with a commitment to improve the quality of life and environment.

PROGRAM OUTCOMES (PO)

PO1	Apply the knowledge of Basic sciences and Engineering Sciences to provide solutions for Complex engineering problems
PO2	Competency to identify, formulate review research literature and analyze complex engineering problems pertaining to Electrical and Electronics Engineering.
PO3	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO4	Develop innovative thinking to create, select, and apply appropriate techniques & resources with the help of modern computational methods and tools for prediction and modeling of complex engineering tasks.
PO5	Identify, formulate, review research literature, analyze complex engineering problems and conduct original research leading to substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO6	Confident and knowledgeable to take up responsible positions in industry with the ability to work in a group as well as lead a team towards achieving technology enhancement and economic growth.
PO7	Awareness of professional responsibility with sensitivity to ethical practices.
PO8	Communicate effectively so as to interact with the engineering community and society at large. Able to comprehend and to write effective reports, design documentation, presentations, and give and receive clear instructions.

PO9	Have broad knowledge of aiding technologies necessary to recommend competitive engineering solutions in a global and societal context.
PO10	Realize the need for lifelong learning and attain good attitude to adopt to modern managements practices in a changing global scenario.
PO11	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12	Create industry ready engineers by building strong collaboration and partnerships with the industry through joint research projects, and also include arrangements for faculty to take up joint research collaboration, curriculum development and continuous education programmes.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Able to apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design, investigate and solve complex engineering problems of electric circuits, power electronics, control systems, electrical machines and power systems
PSO2	Able to provide socially acceptable technical solutions to complex electrical engineering problems with the application of modern and appropriate techniques for sustainable development

Distribution of credits among the subjects grouped under various categories:

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Humanities, Social Sciences and Management Courses	6 + 2 / 3 *	HSM
2	Basic Science Courses (Mathematics, Physics, Chemistry and Biology)	25	BSC
3	Engineering Science Courses (Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc.,)	19	ESC
4	Professional Core Courses	71	PCC
5	Professional Elective Courses (from chosen discipline)	15	PEC
6	Open Elective Courses (from other technical/ emerging disciplines)	10	OEC
7	Professional Activity Courses (Project Work, Entrepreneurship, Seminar, Internship, Comprehensive Test)	14	PAC
8	Mandatory non-Credit Courses (Environmental Sciences, Induction, Indian Constitution, Essence of Indian Traditional Knowledge, Professional Ethics)	Non-credit	MCC
	Total	**160**	

***Included in the 10 credits under open elective category**

Semester-wise Courses and Credits

SEMESTER-I

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
FYA101	Induction Programme	MCC	-	-	-	-	0
MAA101	Mathematics-I	BSC	TY	3	1	0	4
EEA101	Basic Electrical Engineering	ESC	TY	3	1	0	4
CSA101	Programming for Problem Solving	ESC	TY	3	0	0	3
MEA102	Engineering Graphics and Computer Aided Drawing	ESC	TY	2	0	4	3
CEA101	Environmental Science	MCC	-	3	0	0	0
EEA102	Basic Electrical Engineering Laboratory	ESC	LB	0	0	3	1.5
CSA102	Programming Laboratory	ESC	LB	0	0	3	1.5
Total				**14**	**2**	**10**	**-**
				26			**17**

SEMESTER-II

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MAA102	Mathematics-II	BSC	TY	3	1	0	4
PHA101	Physics	BSC	TY	3	1	0	4
CYA101	Chemistry	BSC	TY	3	1	0	4
HSA101	English for Communication	HSM	TY	2	0	2	3
MEA101	Workshop and Manufacturing Practice	ESC	LB	0	0	3	1.5
PHA102	Physics Laboratory	BSC	LB	0	0	3	1.5
CYA102	Chemistry Laboratory	BSC	LB	0	0	3	1.5
Total				**11**	**3**	**11**	**-**
				25			**19.5**

SEMESTER-III

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MAA104	Transforms, Partial Differential Equations and Statistics	BSC	TY	3	1	0	4
EEA103	Electrical Circuit Analysis	PCC	TY	3	1	0	4
EEA104	Electromagnetic Fields	PCC	TY	3	0	0	3
EEA105	Electronic Devices and Circuits	PCC	TY	3	0	0	3
EEA106	Electrical Machines - I	PCC	TY	3	0	0	3
EEA107	Signals and Systems	PCC	TY	3	0	0	3
EEA108	Electronics Laboratory-I	PCC	LB	0	0	3	1.5
EEA109	Electrical Machines Laboratory - I	PCC	LB	0	0	3	1.5
SHA102	Indian Constitution	MCC	-	3	0	0	0
Total				**21**	**2**	**6**	**-**
				29			**23**

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

SEMESTER-IV

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
SHA101	Biology for Engineers	BSC	TY	3	0	0	2
EEA110	Analog Electronics	PCC	TY	3	0	0	3
EEA111	Pulse and Digital Circuits	PCC	TY	3	0	0	3
EEA112	Electrical Machines - II	PCC	TY	3	0	0	3
CSA134	Data Structures and Object Oriented Programming	ESC	TY	3	0	0	3
EEA113	Electronics Laboratory - II	PCC	LB	0	0	3	1.5
EEA114	Electrical Machines Laboratory - II	PCC	LB	0	0	3	1.5
CSA135	Data Structures and Object Oriented Programming Laboratory	ESC	LB	0	0	3	1.5
Total				**15**	**0**	**9**	**-**
				24			**18.5**

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

SEMESTER-V

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
EEA115	Analog and Digital Integrated circuits	PCC	TY	3	0	0	3
EEA116	Power Electronics	PCC	TY	3	0	0	3
EEA117	Measurement and Instrumentation	PCC	TY	3	0	0	3
EEA118	Transmission and Distribution	PCC	TY	3	0	0	3
EEA119	Control Systems	PCC	TY	3	1	0	4
HSA102	Industrial Economics and Management	HSM	TY	3	0	0	3
EEA120	Electronics laboratory - III	PCC	LB	0	0	3	1.5
EEA121	Measurement and Control Laboratory	PCC	LB	0	0	3	1.5
Total				**18**	**1**	**6**	**-**
				25			**22**

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

SEMESTER-VI

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
EEA122	Power System Analysis	PCC	TY	3	1	0	4
EEA123	Microprocessors and Microcontrollers	PCC	TY	3	0	0	3
EEA2XX	Program Elective -I	PEC	TY	3	0	0	3
EEA2XX	Program Elective – II	PEC	TY	3	0	0	3
EPA101	Entrepreneurship	PAC	TY	3	0	0	2
EEA124	Microprocessors and Microcontrollers Laboratory	PCC	LB	0	0	3	1.5
EEA125	Power Electronics Laboratory	PCC	LB	0	0	3	1.5
SHA103	Essence of Indian Traditional Knowledge	MCC	-	3	0	0	0
Total				**18**	**1**	**6**	**-**
				25			**18**

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

SEMESTER-VII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
EEA126	Power System Operation and Control	PCC	TY	3	0	0	3
EEA127	Protection and Switchgear	PCC	TY	3	0	0	3
EEA128	Solid State Drives	PCC	TY	3	0	0	3
EEA2XX	Program Elective – III	PEC	TY	3	0	0	3
EEA2XX	Program Elective – IV	PEC	TY	3	0	0	3
EEA2XX	Program Elective – V	PEC	TY	3	0	0	3
EEA129	Power Systems Laboratory	PCC	LB	0	0	4	2
EEA130	Seminar	PAC	-	0	0	2	1
EEA131	Professional Ethics	MCC	-	2	0	0	0
Total				**20**	**0**	**6**	**-**
				26			**21**

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ZZA3XX	Open Elective	OEC	TY	3	0	0	3

SEMESTER-VIII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
SWA3XX	Open Elective through SWAYAM	OEC	-	0	0	0	2
SWA3XX	Open Elective through SWAYAM	OEC	-	0	0	0	2
EEA132	Comprehensive Test	PAC	-	0	0	0	1
EEA133	Internship	PAC	-	0	0	0	2
EEA134	Project Work	PAC	PR	0	0	16	8
Total				**0**	**0**	**16**	**-**
				16			**15**

List of Professional Elective Courses (PEC)

Professional Electives	Course Code	Course	Semester
Professional Elective – I/II	EEA201	Electrical Safety and Quality Management	VI
	EEA202	Digital System Design using VHDL	
	EEA203	Special Electrical Machines	
	EEA204	Digital Signal Processing	
	EEA205	Fuzzy Logic and Neural Networks	
	EEA206	Modern Control Theory	
	EEA207	Electric and Hybrid Vehicles	
	EEA208	Optimization Techniques	
Professional Elective – III/IV/V	EEA209	Smart Grid	VII
	EEA210	Renewable Energy	
	EEA211	Embedded Systems	
	EEA212	Power Quality	
	EEA213	High Voltage Direct Current Transmission	
	EEA214	Digital Control Systems	
	EEA215	Power System Restructuring and Deregulation	
	EEA216	High Voltage Engineering	
	EEA217	Power System Economics	
	EEA218	Utilization of Electrical Energy	

List of Open Elective Courses (OEC)

Course Code	Course
EEA301	Power Generation Systems
EEA302	System Dynamics
EEA303	Fuzzy and Neural Systems
EEA304	PLC and Industrial Automation
EEA305	Process Control Engineering
EEA306	Electric and Hybrid Vehicles
EEA307	Wiring, Estimation and Costing

Courses offered under various categories

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MAA101	Mathematics – I	I	4	25
	PHA101	Physics	II	4	
	CYA101	Chemistry	II	4	
	PHA102	Physics Laboratory	II	1.5	
	CYA102	Chemistry Laboratory	II	1.5	
	MAA102	Mathematics –II	II	4	
	MAA104	Transforms, Partial Differential Equations and Statistics	III	4	
	SHA101	Biology for Engineers	IV	2	
ESC	MEA101	Workshop and Manufacturing Practice	II	1.5	19
	EEA101	Basic Electrical Engineering	I	4	
	CSA101	Programming for Problem Solving	I	3	
	MEA102	Engineering Graphics & Computer Aided Drawing	I	3	
	EEA102	Basic Electrical Engineering Laboratory	I	1.5	
	CSA102	Programming Laboratory	I	1.5	
	CSA134	Data structures and Object Oriented Programming	IV	3	
	CSA135	Data structures and Object Oriented Programming Laboratory	IV	1.5	
PCC	EEA103	Electrical Circuit Analysis	III	4	71
	EEA104	Electromagnetic Fields	III	3	
	EEA105	Electronic Devices and circuits	III	3	
	EEA106	Electrical Machines - I	III	3	
	EEA107	Signals and Systems	III	3	
	EEA108	Electronics Laboratory -I	III	1.5	
	EEA109	Electrical Machines Laboratory - I	III	1.5	
	EEA110	Analog Electronics	IV	3	
	EEA111	Pulse and Digital Circuits	IV	3	
	EEA112	Electrical Machines - II	IV	3	
	EEA113	Electronics Laboratory - II	IV	1.5	
	EEA114	Electrical Machines Laboratory - II	IV	1.5	
	EEA115	Analog and Digital Integrated Circuits	V	3	
	EEA116	Power Electronics	V	3	
	EEA117	Measurement and Instrumentation	V	3	
	EEA118	Transmission and Distribution	V	3	
	EEA119	Control Systems	V	4	
	EEA120	Electronics Laboratory - III	V	1.5	
	EEA121	Measurement and Control laboratory	V	1.5	
	EEA122	Power System Analysis	VI	4	
	EEA123	Microprocessors and Microcontrollers	VI	3	
	EEA124	Microprocessors and Microcontrollers Laboratory	VI	1.5	
	EEA125	Power Electronics Laboratory	VI	1.5	
	EEA126	Power System Operation and Control	VII	3	
	EEA127	Protection and Switchgear	VII	3	
	EEA128	Solid State Drives	VII	3	
	EEA129	Power Systems Laboratory	VII	2	

CCC	Course Code	Course	Semester	Credit	Total Credit
PEC	EEA2XX	Professional Elective – I	VI	3	**15**
	EEA2XX	Professional Elective – II	VI	3	
	EEA2XX	Professional Elective – III	VII	3	
	EEA2XX	Professional Elective – IV	VII	3	
	EEA2XX	Professional Elective – V	VII	3	
OEC	ZZ0XX	Open Electives offered by other Departments	III-VII	6	**10**
	SWOXX	Open Electives offered under SWAYAM	-	4	
PAC	EPA101	Entrepreneurship	VI	2	**14**
	EEA130	Seminar	VII	1	
	EEA132	Comprehensive Test	VIII	1	
	EEA133	Internship	VIII	2	
	EEA134	Project Work	VIII	8	
HSM	HSA101	English For Communication	I	3	**6 + 3*/2***
	HSA102	Industrial Economics and Management	V	3	
	HSA3XX	Humanities Open Elective offered by HSS Department	-	3*	
	SWA3XX	Humanities Open Elective offered under SWAYAM	-	2*	
TOTAL					**160**

*Included in the 10 credits under Open Elective category.

III SEMESTER

Department: **Mathematics**	Programme: **B.Tech., (EE)**	
Semester: **Third**	Subject Category: **BSC**	Semester Exam Type: **TY**

Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MAA104	**Transforms, Partial Differential Equations and Statistics**	3	1	-	4	25	75	100

Prerequisite		
Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explain the concept of Laplace transform & can apply to solve D.E and integral equation.	Understand
CO2	Solve P.D.E and apply for solving non-linear and linear first order equations.	Apply
CO3	Solve PDE by method of separation of variables for one dimensional wave equations.	Apply
CO4	Solve the one and two dimensional heat equation using Fourier series	Apply
CO5	Extend the concept of probability to find Distribution and Expectation	Understand

UNIT-I	**Laplace Transforms**	**Periods: 12**
Definition of Laplace Transform, Inverse Laplace Transform, Linearity property, Laplace transform of unit step function, Unit impulse function and some elementary functions, change of scale and first shifting property, Derivatives and integrals of Laplace transform, transform of derivatives and integrals, Application: Solution of single ordinary linear differential equation with constant Coefficients-Laplace transform of Periodic functions.		**CO1**
UNIT-II	**Partial Differential Equations**	**Periods: 12**
General and Singular solution of PDE, Complete Solution of First order Non-linear PDE, Lagrange's linear equation of first order, Solution of the simultaneous equations by the method of grouping and multipliers.		**CO2**
UNIT-III	**Higher Order PDE and Boundary Value Problems**	**Periods: 12**
Homogeneous linear PDE of higher order with constant coefficients. Solution of partial differential equation by the method of separation of variables. Application of PDE: Variable separable solutions of the one-dimensional wave equation, Transverse vibration of a stretched string.		**CO3**
UNIT-IV	**One Dimensional and Two-Dimensional Heat Flow**	**Periods: 12**
Heat Equation, Variable and separable solution of one-dimensional heat equation, Temperature distribution with zero and non-zero boundary values, Two-dimensional heat flow under steady state conditions (Cartesian).		**CO4**
UNIT-V	**Probability and Statistics**	**Periods: 12**
Probability, Events, Sample space, Axioms of probability, Random variable (Discrete and Continuous), Expectation, Probability Distribution: Binomial, Poisson & Normal distribution and statistical parameters of these distributions, Correlation and Regression, Rank correlation.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:15**	**Practical Hours: 00**	**Total Hours:60**

Reference Book:

1. Veerarajan T, Engineering Mathematics II, McGraw-Hill Education (India) Private Limited, 2014
2. Veerarajan T, Transforms and Partial Differential Equations, Third Edition, McGraw-Hill Education (India)Private Limited, 2016.
3. Venkataraman M.K., Engineering Mathematics, Third Year, Part-B, The National Publishing Company, Chennai, 2008.
4. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand &Sons, New Delhi, 2000.
5. Erwin Kreyszig, Advanced Engineering Mathematics (9 th Ed), John Wiley & Sons, New Delhi, 2011.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
7. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi,9thEdition, 2011.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	1	-
AV	2	2	-	-	-	-	-	-	-	-	-	-	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA103	**ELECTRICAL CIRCUIT ANALYSIS**	3	1	-	4	25	75	100

Prerequisite	Basic Electrical Engineering, Laplace Transform	
Course Outcome	**Course Outcome Statement**	**Level**
CO1	Apply electrical circuits with DC excitation using network theorems.	Apply
CO2	Apply electrical circuits with AC excitation using network theorems.	Apply
CO3	Analysis of coupled circuits and understanding of resonant RL,RC and RLC circuits	Analyse
CO4	Explain the behavior of magnetically coupled circuits	Understand
CO5	Analyse the behaviour of three phase circuits for different loads under balanced and unbalanced conditions,	Analyse

UNIT-I	**Sources And Theorems for DC Circuits**	**Periods: 12**
Series parallel circuits. Theorems for DC circuits- Maximum power transfer theorem, Millman's theorem, Substitution theorem. Dependent current and voltage sources. Super Mesh Analysis – Super Node Analysis.		**CO1**
UNIT-II	**AC Circuit Analysis**	**Periods: 12**
Basic elements and phasor diagram. AC source conversion. Review of Mesh and node methods of analysis for AC circuits. Theorems for AC circuits- Superposition theorem, Thevenin's Theorem, Norton's theorem, Maximum power transfer theorem, Millman's theorem, Substitution theorem.		**CO2**
UNIT-III	**Transient Analysis**	**Periods: 12**
Natural and Forced response – Steady state and Transient state response, Step and sinusoidal response for RL, RC & RLC circuits. Solution using Laplace Transforms.		**CO3**
UNIT-IV	**Coupled And Resonance Circuits**	**Periods: 12**
Coupled circuits: Self and Mutual inductance – coefficient of coupling–dot convention– Equivalent Inductance in series and parallel coupled circuits -- single tuned and double tuned circuits. Resonant circuits- Series and parallel resonance circuits, resonant frequency – Bandwidth - Quality Factor Q - effect of Q on resonance. Relations between Q, resonant frequency and bandwidth		**CO4**
UNIT-V	**Three Phase Circuits and Network Topology**	**Periods: 12**
Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, and hybrid parameters, interconnections of two port networks. Graph Theory- Types of graphs- subgraph, Tree, Co-tree, Incidence matrix, cut set matrix, Tie-set matrix.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:15**	**Practical Hours: 00**	**Total Hours:60**

Reference Book:

1. W. H. Hayt J. K. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 7th Edition, Tata McGraw Hill, 2007.
2. Joseph A Edminister, "Electric circuits Theory", 6th Edition, Schaum's outline series, Tata McGraw Hill, 2014.
3. Sudhakar A and Shymohan SP, "Electric Circuit Analysis", Tata McGraw Hill, 2008
4. Allan H. Robbins and Miller," Circuit Analysis Theory and Practice", Delmer Publishers, 5th edition, 2012
5. Charles K. Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits" 2nd edition, Tata McGraw Hill 2013.
6. Mark Summerfield, "Programming in Python 3", 2nd edition. Pearson Publishers 2010

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	1	0.8	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA104	**ELECTROMAGNETIC FIELDS**	3	-	-	3	25	75	100
Prerequisite	Vector Calculus and Material Science							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Apply the basic mathematical concepts related to electromagnetic vector fields in field calculations.	Apply
CO2	Apply the basic concepts about electrostatic fields for the calculation of electric field intensity, electrical potential and energy density.	Apply
CO3	Describe the nature of electric field in free space, conductors, dielectric and multiple dielectrics and apply the basic concepts in capacitance calculations.	Understand
CO4	Describe the basic concepts of magnetic fields for the calculation of magnetic field intensity, force, torque and inductance.	Analyse
CO5	Explain different methods of emf generation, Maxwell's equations and concept of electromagnetic waves and characterizing parameters.	Understand

UNIT-I	**Vector Analysis**	**Periods: 09**
Scalar - Vector- Vector addition- Subtraction and Multiplication - Coordinate Systems, Differential elements- Del operator- Gradient- Divergence and Curl of a vector- Divergence Theorem and Stoke's Theorem.		**CO1**
UNIT-II	**Electrostatic Field**	**Periods: 09**
Coulomb's law - charge density- Electric flux density and Electric field intensity– electric fields due to point, line, surface and volume charge distributions – Electric Potential - Gauss law –Applications of Gauss 'Law– Potential Field-Potential gradient –Relation between E and V -Field due to dipoles– dipole moment–Energy density.		**CO2**
UNIT-III	**Electric Fields in Material Space**	**Periods: 09**
Current - Current Density - Continuity of current - Conductivity and resistivity of materials. Permittivity - Dielectric constant and Dielectric Strength – Boundary conditions – Capacitance of system of conductors– Polarization in dielectrics – Energy stored in a capacitor–-Poisson's and Laplace equations		**CO3**
UNIT-IV	**Magnetic Field**	**Periods: 09**
Biot-Savart Law–Ampere's Circuital Law– Magnetic flux and -Magnetic field density – The Scalar and Vector magnetic potentials– Force on a moving charge and current elements– Force and Torque on closed circuit – Magnetization and Permeability–Magnetic boundary conditions – Magnetic circuit – Potential energy and forces on Magnetic materials – Inductance and mutual inductance – Inductance of solenoids, toroids, and transmission lines.		**CO4**
UNIT-V	**Electromagnetic Field**	**Periods: 09**
Faraday's Law, -Time varying magnetic field – Conduction current – Displacement current - Maxwell's equation in point and integral forms - Electromagnetic Wave in free space and in Dielectrics – Poynting vector and Poynting Theorem.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:
1. William Hayt Jr. and John A. Buck, “Engineering Electromagnetics”, TMH publishing co. Ltd., 7th Edition, 2006. 2. John D. Kraus, Electromagnetics, McGraw Hill, 5th Edition, 1999 3. Mathew N.O. Sadiku, “Principles of Electromagnetic Fields”, 4th Edition, Oxford University Press, 2010. 4. Joseph A. Edminister, “Theory and problems of Electromagnetics”, Schaum’s series McGraw Hill International Edition, 2nd Edition, 1993, Singapore. 5. S.P. Seth,” Fundamentals of Electromagnetics”, Wiley Eastern Ltd., 1st Edition, 2002. 6. Narayana Rao, Elements of Engineering Electromagnetics, Prentice Hall of India, 6th Edition,2008.

MAPPING OF CO’S WITH PO’S AND PSO’S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	2	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	2	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	1	0.8	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA105	**ELECTRONIC DEVICES AND CIRCUITS**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Explain the construction, biasing, equivalent circuit and characteristics of PN Junction diode.	Understand
CO2	Explain the construction, characteristics and operation of BJT. Design of different biasing circuits for BJT.	Understand
CO3	Explain the construction and operation JFET and MOSFET. Design of different biasing circuits for JFET.	Understand
CO4	Explain the construction, characteristics and operation of different power devices. Design of clipper, clamper, half wave and full wave rectifier circuits with and without filters.	Apply
CO5	Outline the properties and characteristics of few specialized diodes and opto-electronic devices	Understand

UNIT-I	**Semiconductor Diodes**		**Periods: 09**
PN junction diode - Construction – forward and reverse bias operation – mathematical model of a PN junction diode–Silicon versus Germanium diodes – Effects of temperature on diode operation– Static and dynamic resistances–Diode equivalent models– Specification sheets–Transition and diffusion capacitances–Diode switching characteristics -reverse recovery time–Diode applications – Clipping and Clamping circuits			**CO1**
UNIT-II	**Bipolar Junction Transistors**		**Periods: 09**
Construction and operation– NPN and PNP transistors– CB, CE and CC configurations– transistor characteristics and regions of operation–Specification sheet–Biasing of BJTs– operating point– stabilization of operating point– different biasing circuits and DC load line characteristics –Bias compensation techniques–thermal stability and thermal runaway			**CO2**
UNIT-III	**Field Effect Transistors**		**Periods: 09**
Construction and operation of JFET – drain and transfer characteristics – Shockley's equation– comparison between JFET and BJT – MOSFET – Construction and operation - depletion and enhancement types – Biasing of FETs – biasing circuits			**CO3**
UNIT-IV	**Power Devices and Rectifiers& Power Supplies**		**Periods: 09**
Introduction to power devices– SCR, SCS, GTO, Shockley diode-DIAC- TRIAC and UJT. Half-wave and full-wave rectifiers–ripple reduction using filter circuits– Shunt and series voltage regulators - Regulated power supplies.			**CO4**
UNIT-V	**Special Two-Terminal Devices**		**Periods: 09**
Principle of operation of Schottky diode, Varactor diode, Zener diode, Tunnel diode and PIN Diodes. OPTO ELECTRONIC DEVICES: Principle of operation and characteristics of Photo diodes, Phototransistors, Photo conductive cells, LEDs and LCDs, Opto-couplers, Solar cells and thermistors			**CO5**
Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:
1. Jacob Millman and Christopher C Halkias, Electronic Devices and Circuits, Tata-McGraw Hill, 2003. 2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice-Hall India, 2009. 3. David A Bell, Electronic Devices and Circuits, PHI, 4thEdition, 2006. 4. J. D. Ryder, Electronic Fundamentals and Applications, Pearson Education, Canada, 1976. 5. Allen Mottershed, Electronic Devices and Circuits: An Introduction, PHI Learning, 2011

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	3	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	3	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA106	**ELECTRICAL MACHINES -I**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Apply the basic concepts of magnetic circuits in transformers and electromechanical energy conversion in rotating machines.	Apply
CO2	Explain the construction and working principle of DC machines.	Understand
CO3	Analyse various operational characteristics of DC machines.	Analyse
CO4	Assess various performance parameters of the machine, by conducting suitable tests.	Evaluate
CO5	Analyse the equivalent circuit of transformer and predetermine the efficiency and regulation.	Analyse
CO6	Explain the working principle of auto transformer, three phase transformer with different types of connections.	Understand

UNIT-I	**Magnetic Circuits And Electro Mechanical Energy Conversion**	**Periods: 09**
Simple magnetic circuit calculations– B-H Relationship – Magnetically induced emf and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses - Energy in magnetic system – Field energy and mechanical force – Multiply Excited Magnetic field systems.		**CO1**
UNIT-II	**DC Generator**	**Periods: 09**
Construction and principle of operation of DC Machine – Lap and wave winding – Excitation and types of generators – Circuit Model – Armature reaction – Compensating Winding – Commutation – Characteristics – Efficiency – Applications.		**CO2**
UNIT-III	**DC Motor**	**Periods: 09**
EMF and Torque – Circuit Model – Characteristics – Starting – Speed control – Efficiency – Testing direct, indirect and regenerative Tests – Braking - DC machines dynamics – Applications.		**CO3**
UNIT-IV	**Transformers**	**Periods: 09**
Review of Transformer operation, equivalent circuit – Construction – Phasor diagram – Testing – Parallel operation and load sharing of single-phase transformers – Per Unit system – Losses – Efficiency and Voltage Regulation - All day efficiency – Excitation phenomenon in Transformers – Applications.		**CO4**
UNIT-V	**Polyphase Transformers and Special Transformers**	**Periods: 09**
Auto-transformer – Construction and saving in copper – Three phase transformers – Phase Conversion – Tap changing – Variable frequency transformer – Voltage and Current Transformers – Audio frequency transformer.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. I.J. Nagrath and D.P. Kothari, Electric machines, T.M.H. Publishing Co.Ltd., New Delhi, 4th Edition, 2017.
2. B.L. Theraja, Electrical Technology - Vol.II AC and DC Machines, S. Chand, 2008.
3. Battacharya S K, Electrical Machines, Technical Teachers Training Institute, 2nd Edition, 2003.
4. P.C. Sen, Principles of Electric Machines and Power Electronics, Wiley Student Edition, 2nd Edition, 2008.
5. M.N. Bandyopadhyay, Electrical Machines - Theory and Practice, PHI, 2007.
6. J.B. Gupta, Theory and Performance of Electrical Machines, J.K. Kataria& Sons, 13th Edition, 2004.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO6	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	3	2.67	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA107	**SIGNALS AND SYSTEMS**	3	-	-	3	25	75	100
Prerequisite	Differential and integral calculus, Partial differentiation and Transforms.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Classify different types of signals-continuous and discrete, odd and even, periodic and aperiodic etc. and able to classify systems based on their properties.	Understand
CO2	Analyze continuous-time signals using Fourier series (for periodic signals), Fourier transform (for aperiodic signals) and Laplace transform.	Analyse
CO3	Apply the concepts of convolution integral and modelling of continuous-time systems using differential equation and interpretation of the solution.	Apply
CO4	Analyze discrete-time signals using Fourier series (for periodic signals) and discrete-time Fourier transform (for aperiodic signals) and Z transform for discrete-time signals.	Analyse
CO5	Analyse and realize LTI system using Z-Transforms	Analyse

UNIT-I	**Introduction to Signals and Systems – Classification**	**Periods: 09**
Introduction: Signals and systems as seen in everyday life, and in various branches of engineering and science electrical, mechanical, hydraulic, thermal, biomedical signals and systems as examples. Classification of Signals: Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids – Basic operation of signals. Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic and Aperiodic signals, Deterministic and Random (stochastic) signals, Energy and Power signals. Classification of Systems - CT systems and DT systems – Linear and Nonlinear systems, Time-variant and Time-invariant systems, Causal and Non-causal systems, Stable and Unstable systems.		**CO1**
UNIT-II	**Analysis of Continuous-Time Signals**	**Periods: 09**
Fourier series representation of continuous-time periodic signals – Fourier transform representation for continuous-time non-periodic signals – Properties of Fourier representations – linearity, symmetricity, convolution property, differentiation and integration properties, time and frequency shift properties and scaling properties. Inverse Fourier transform – Duality property of Fourier transform. Laplace transform – properties – Inverse Laplace transform.		**CO2**
UNIT-III	**Linear Continuous-Time Systems**	**Periods: 09**
Continuous - time linear time-invariant (LTI) systems – Convolution integral – evaluation of convolution integral – system realization through block diagram - interconnection of LTI systems. Differential equation representation of LTI systems. Solution to differential equation – natural and forced response. State - variable representation of LTI systems		**CO3**
UNIT-IV	**Analysis of Discrete-Time Signals**	**Periods: 09**
Fourier series representation of Discrete-time signals – Discrete-time Fourier transform (DFT) for Discrete-time non-periodic signals – properties of discrete-time Fourier representations. z-transform of discrete-time systems and its properties – Inverse z-transform		**CO4**
UNIT-V	**Linear Discrete-Time Systems**	**Periods: 09**
Discrete-time LTI systems – convolution summation – system interconnection. Difference equation representation of discrete-time LTI system – solution to differential equation – natural and forced response. State variable representation of discrete-time systems		**CO 5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:
1. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, Second Edition – Reprint 2014. 2. Allan V. Oppenheim, Allan S. Willsky and S. Hamid Nawab, “Signals and Systems”, Prentice-Hall India Learning, Second Edition, New Delhi, 2007. 3. I. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2001. 4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998. 5. Ramesh Babu, “Signalsand Systems”, Scitech Publications, Chennai, 4th edition, 2011. 6. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, “Feedback Control of Dynamic Systems”, 8th Edition, Pearson, 2018

MAPPING OF CO’S WITH PO’S AND PSO’S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	-
AV	3	3	1	1	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA108	**Electronics Laboratory-I**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Demonstrate the working of PN junction diode and Zener diode, and to devise simple clipper and clamper circuits to understand the concept of wave shaping.	Understand
CO2	Demonstrate the working of Bipolar Junction Transistors in Common-Base and Common-Emitter configuration, and able to construct fixed bias and voltage-divider bias for understanding the biasing of transistor based amplifier circuits.	Understand
CO3	Determine the V-I characteristics of voltage (field) controlled devices like JFET and MOSFET, and the concept of negative resistance characteristics of UJTs.	Understand
CO4	Apply the firing characteristics of power devices like SCR and TRIAC for different values of gate currents and design simple rectifier circuits using PN junction diodes and compute their ripple factors with capacitance filter connected and detached.	Apply
CO5	Outline the working of photo devices, the working principle of measurement devices like CRO and DSO.	Understand

Any 10 Experiments	
1. V-I Characteristics of PN junction diode and voltage regulation characteristics of Zener diode.	**CO1**
2. Clipper and Clamper circuits using diodes.	
3. V-I Characteristics of Bipolar Junction Transistor (BJT) in Common-Base configuration.	**CO2**
4. V-I Characteristics of BJT in Common-Emitter configuration.	
5. Biasing circuits for Transistor amplifiers (Fixed biasing and Voltage-divider biasing)	
6. Drain and Transconductance characteristics of Junction Field Effect Transistor (JFET).	**CO3**
7. Drain and Transconductance characteristics of Metal Oxide Semiconductor Junction Field Effect Transistor (MOSFET).	
8. Negative resistance characteristics of Uni-Junction Transistor and determination of intrinsic stand-off ratio.	
9. Triggering characteristics of Silicon-Controlled Rectifier (SCR).	**CO4**
10. V-I Characteristics of TRIAC for two quadrant operation.	
11. Determination of ripple factor for half-wave and full-wave rectifiers (centre-tapped and bridge configuration) with and without filter.	
12. Characteristics of Photo-diodes and Photo-transistors.	**CO5**
13. Study of Cathode Ray Oscilloscope (CRO)	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	-	-	1	3	1
CO2	3	3	2	3	3	-	-	-	-	-	-	1	3	1
CO3	3	3	2	3	3	-	-	-	-	-	-	1	3	1
CO4	3	3	3	3	3	-	-	1	-	-	-	1	3	2
CO5	3	3	1	3	3	-	-	-	-	-	-	1	3	1
AV	3	3	2	3	3	-	-	0.2	-	-	-	1	3	1.2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA109	**Electrical Machines Laboratory-I**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Analyse the operation and the characteristics of different types of DC machine under loaded and unloaded conditions.	Analyse
CO2	Analyse the operation and the characteristics of different types of DC generators under loaded conditions.	Analyse
CO3	Apply various speed control measures of DC shunt motors.	Apply
CO4	Predetermine the performance parameters of transformers.	Analyse
CO5	Perform parallel operation of single-phase transformers and 3 phase transformer connections.	Apply

Any 10 Experiments	
1. Performance determination of DC Motors by load test	**CO1**
2. Performance determination of DC shunt machine by Swinburne's (non-loading) test	
3. Performance determination of DC machine by Hopkinson's (regenerative) test	
4. Open circuit characteristics of self-excited DC shunt Generator	**CO2**
5. Performance determination of DC Generators by load test	
6. Study of speed control of DC Motors	**CO3**
7. Study of Retardation test	
8. Performance determination of single phase and three phase transformers by load test	**CO4**
9. Performance determination of single-phase transformer by non-loading (OC and SC) test	
10. Performance determination of single-phase transformer by Back-to-Back (Sumpner's) test	
11. Determination of Load sharing of single-phase transformers by Parallel operation	**CO5**
12. Study of three phase transformer connections	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	-	-	-	-	1	3	2
CO2	3	3	2	3	3	-	-	-	-	-	-	1	3	2
CO3	3	3	2	3	3	-	-	-	-	-	-	1	3	2
CO4	3	3	3	3	3	-	-	1	-	-	-	1	3	2
CO5	3	3	3	3	3	-	-	1	-	-	-	1	3	2
AV	3	3	2.4	3	3	-	-	0.4	-	-	-	1	3	2

Department: **Humanities and Social Science**		Programme: **B.Tech., (EE)**						
Semester: **Third**		Subject Category: **MCC**			Semester Exam Type: **-**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
SHA102	**INDIAN CONSTITUTION**	3	-	-	-	-	-	-
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Outline the essence and significance of the constitution	Understand
CO2	Recognize one's fundamental duties and rights	Understand
CO3	Appreciate the structure and functions of legislature, executive and judiciary	Understand
CO4	Explain the functioning of state governments and union territories	Understand
CO5	Describe the centre-state relations and functioning of constitutional bodies	Understand

UNIT-I	**Introduction of Indian Constitution**	**Periods: 09**	
The Making of Indian Constitution - The Constituent Assembly - Sources of Indian Constitution - Preamble and the Supreme Court's Judgments on Preamble.			**CO1**
UNIT-II	**State, Rights and Duties**	**Periods: 09**	
State and Union Territories – Citizenship - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties.			**CO2**
UNIT-III	**Union Government**	**Periods: 09**	
Union Government - The Powers and Functions of the President, Vice–President, Council of Ministers, Prime Minister, Judiciary, Supreme Court - Judicial Review - Judicial Activism- Public Interest Litigation - Power and Functions of the Parliament - Budget Power and Functions of Parliament, Speaker of Lok Sabha.			**CO3**
UNIT-IV	**State Governments**	**Periods: 09**	
State Governments – Governor - State Council of Ministers - Chief Minister- Legislative Assembly- High Courts - Union Territories - Panchayati Raj Institutions - 73th and 74th Constitutional Amendment - Gram Panchayats - Block Panchayats - Municipalities.			**CO4**
UNIT-V	**Union- State Relations, Constitutional Bodies**	**Periods: 09**	
Centre – State Relations - Public Service - Election Commission - NITI Ayog, Emergency Powers of the President- Constitution Amendment Procedure- Right to Information Act - Right to Education. Major Constitutional Amendments and their impact on Indian Political System.			**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. Oxford University Press, 1999.
2. Basu, Durga Das, et al. Introduction to the Constitution of India. 20th ed., Thoroughly Rev, Lexis NexisButterworths Wadhwa Nagpur, 2008.
3. Choudhry, Sujit, et al., editors. The Oxford Handbook of the Indian Constitution. Oxford University Press,2016.
4. Bakshi, ParvinraiMulwantrai, and Subhash C. Kashyap, The Constitution of India (Universal Law Publishing, 2016)
5. Bhargava, Rajeev, 'Politics and Ethics of the Indian Constitution', 2009
6. Rajeev Bhargava - 'The Promise of India's Secular Democracy', 2010
7. Chakrabarty, Bidyut, India's Constitutional Identity: Ideological Beliefs and Preferences (Routledge, 2019)
8. Jayal, Niraja Gopal, and Pratap Bhanu Mehta, The Oxford Companion to Politics in India, Oxford University Press, 2010
9. Kashyap, Subhash C., Our Constitution: An Introduction to India's Constitution and Constitutional Law (NBTIndia, 1994)
10. Kashyap, Subhash C. Our Parliament: An Introduction to the Parliament of India. Revised edition, National Book Trust, India, 2011.
11. Subhash C. Kashyap Our Constitution Paperback –. (NBT India, 2012).
12. Laxmikanth, M. "INDIANPOLITY". McGraw-Hill Education "Constitution of India". Ministry of Law and Justice, Govt. of India.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-	-	-
AV	-	-	-	-	-	1	-	-	-	-	-	-	-	-

IV SEMESTER

Department: **Chemistry**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **BSC**				Semester Exam Type: **TY**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
SHA101	**Biology for Engineers**	3	-	-	2	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Classify the basic biological principles and organizational structure of living systems at molecular level.	Understand
CO2	Explain the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring	Understand
CO3	Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine	Understand
CO4	Outline understanding of enzyme action and factors affecting their activity.	Understand
CO5	Identify and classify microorganisms.	Understand

UNIT-I	**Classification**	**Periods: 9**	
Classification outline based on (a) cellularity- Unicellular or multicellular (b) ultrastructure prokaryotes or eukaryotes (c) Energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitats- acquatic or terrestrial (e) Molecular taxonomy three major kingdoms of life.			CO1
UNIT-II	**Genetics**	**Periods: 9**	
Mendel's laws, Concept of segregation & independent assortment. Concept of allele. Recessiveness, and dominance. Single gene disorders in humans – Sickle cell disease, Phenylketonuria.			CO2
UNIT-III	**Biomolecules**	**Periods: 9**	
Carbohydrates: Types, Structural & functional importance. Lipids: Classification - Simple, compound, & derived, Importance of lipid soluble vitamins. Amino acids – general structure, essential amino acids. Proteins - Levels of protein structure, structural & functional importance of proteins, Enzymes-Definition, Enzyme Activity & Units, Specific Activity, Specificity, Factors affecting enzyme activity. Nucleic acids: Types and importance.			CO3
UNIT-IV	**Metabolism**	**Periods: 9**	
Introduction: Food chain & energy flow. Definitions - Anabolism & Catabolism. Photosynthesis: Reaction and importance. Glycolysis & TCA cycle. ATP – the energy currency of cells			CO4
UNIT-V	**Microbiology**	**Periods: 9**	
Concept of single celled organisms. Concept of species & strains. Identification & classification of microorganisms. Virus – Definition, types, examples.			CO5

Total Contact Hours: 45	**Tutorial Hours: -**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd.
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman andcompany, Distributed bySatish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	2	-	-	-	-	-	-	-
AV	-	-	-	-	-	1	2	-	-	-	-	-	-	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA110	**ANALOG ELECTRONICS**	3	-	-	3	25	75	100
Prerequisite	Biasing of BJT and FET circuits.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Develop small signal hybrid model for BJT and FET which are used in the analysis of linear amplifiers	Apply
CO2	Analyze the operation and characteristics of multi transistor and multistage amplifiers and understand the advantages of these circuits over single – transistor amplifier and analyse the single stage amplifiers.	Analyse
CO3	Analyse the concepts of a tuned amplifier and power amplifier	Analyse
CO4	Explain feedback concepts and analyze the four ideal feedback circuit configurations and determine circuit characteristics	Understand
CO5	Analyze and design oscillators that provide sinusoidal signals at specified frequencies	Analyse

UNIT-I	**Small Signal Amplifiers**	**Periods: 09**
Two port devices and hybrid model– transistor hybrid model and H-parameters – determination of H-parameters from transistor characteristics–Analysis of CB, CE and CC circuits using H-parameter model–Comparison of CB, CE and CC circuits–CE amplifier with unbiased emitter resistance. Low frequency FET model– analysis of common source and common drain circuits.		**CO1**
UNIT-II	**Differential and Multistage Amplifiers**	**Periods: 09**
Differential amplifier – Basic BJT differential pair – Operation – DC Transfer Characteristics – small signal equivalent circuit analysis – Common mode rejection ratio – Differential and Common mode gains – Differential and common mode input impedances – Differential amplifier frequency response. Multi stage amplifier - Cascading amplifier–direct coupled and capacitor coupled two stage CE amplifiers–Darlington pair–Cascode amplifier.		**CO2**
UNIT-III	**Tuned and Large Signal Amplifiers**	**Periods: 09**
Tuned amplifier circuits–single tuned–double tuned–stagger tuned amplifiers Classification of Power amplifiers–Class A power amplifier–direct coupled and transformer coupled–Class B amplifier–push-pull arrangement and complementary symmetry amplifiers– Conversion efficiency calculations – cross-over distortion–Class AB amplifier–Amplifier distortion – Power transistor heat sinking – Class C and Class D amplifiers.		**CO3**
UNIT-IV	**Feedback Amplifiers**	**Periods: 09**
Feedback concept–Gain with feedback–General characteristics of negative feedback amplifiers–Four basic types of feedback and the effect on gain, input and output resistances. Multistage feedback amplifiers–Two stage CE amplifier with series voltage negative feedback – frequency response and stability.		**CO4**
UNIT-V	**Oscillators**	**Periods: 09**
Conditions for sustained oscillations–Barkhausen criterion–LC oscillators–analysis of Hartley, Colpitt and Tuned oscillators–RC oscillators–Phase shift and Wein-bridge types–analysis of the circuits–Crystal oscillators and frequency stability– UJT relaxation oscillator.		**CO5**

Total Contact Hours: 45	**Tutorial Hours: -**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Prentice-Hall India, 2009.
2. David A Bell, Electronic Devices and Circuits, PHI, 4thEdition, 2006.
3. Jacob Millman and Christos C. Halkias, Electronic Devices and Circuits, Tata-McGraw Hill, 2003.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	0	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	1
AV	3	2.8	1.8	0.6	-	-	-	-	-	-	-	1	2	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA111	**PULSE AND DIGITAL CIRCUITS**	3	-	-	3	25	75	100
Prerequisite	Vector Calculus and Material Science							

Course Outcome	Course Outcome Statement	Level
CO1	Explain about wave shaping and sweep circuits	Understand
CO2	Design and implement different types of combinational circuits using logic gates'	Apply
CO3	Design and implement different types of counters using flip flops	Apply
CO4	Design and implement different types sequential circuits using flip flops	Apply
CO5	Illustrate the features about various types of memories	Understand

UNIT-I	**Pulse Circuits**	**Periods: 09**
Linear wave shaping circuits: RC, RL and RLC circuits – Pulse transformer - Bistable, monostable and astable multi-vibrators using BJT– Schmitt trigger circuit using BJT– Voltage and current sawtooth sweeps – Fixed amplitude sweep – Constant current sweep. Multivibrators using negative resistance device – UJT.		**CO1**
UNIT-II	**Combinational Circuits**	**Periods: 09**
Binary arithmetic–BCD addition and subtraction–Code converters-Parity generator–Binary to BCD and BCD to binary conversions–Design of combination circuits using NAND and NOR gates–Design of encoders, decoders, multiplexers, de-multiplexer–Serial adders–Binary multiplier – Simplification of k-map, Flip-Flops: RS, D, JK and T types – IC details of 7474, 7476 and 7490		**CO2**
UNIT-III	**Sequential Circuits**	**Periods: 09**
Design of counters using Flip-flops– Synchronous, asynchronous, Up/Down counters, decade counter, ring counter, Johnson counter, BCD counter–Shift registers - Parallel/serial and bi-directional shift registers.		**CO3**
UNIT-IV	**Design of Sequential Circuits**	**Periods: 09**
Design of Synchronous sequential circuits: Model Selection– State transition diagram – state synthesis table – Design equations and circuit diagram– State reduction technique. Asynchronous sequential circuits – Analysis – Problems with asynchronous sequential circuits – Design of asynchronous sequential circuits State transition diagram, Primitive table, State reduction, state assignment and design equations.		**CO4**
UNIT-V	**Semiconductor Memories and Programmable logic devices**	**Periods: 09**
Memory types and terminologies – ROM – PROM, EPROM, EEPROM, RAM- Static RAM, Dynamic RAM, - sequential memories, Charge coupled device (CCD)–Block diagram based introduction to Programmable logic devices(PLD).		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:

1. David A Bell, Solid State Pulse Circuits, 4th Edition, PHI, 2008.
2. A. P. Malvino and D.P. Leach, Digital Principles and Applications, TMH, 2006
3. Floyd & Jain, Digital Fundamentals, Pearson Education, 2007.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	1
AV	3	2.8	1.2	0.6	-	-	-	-	-	-	-	1	2	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA112	**Electrical Machines - II**	3	-	-	3	25	75	100
Prerequisite	Electrical Machines-I							

Course Outcome	Course Outcome Statement	Level
CO1	Explain the construction and operation of induction motor, special motors and synchronous machines.	Understand
CO2	Analyse the performance of three phase induction motor using equivalent circuit.	Analyse
CO3	Explain suitable starting and speed control methods to enhance the performance of three phase induction motors	Understand
CO4	Compute voltage regulation of alternator by conducting suitable test using various methods.	Apply
CO5	Analyse the performance of Synchronous motor by varying the excitation and load.	Analyse

UNIT-I	**Three Phase Induction Motor**	**Periods: 09**
AC windings – MMF of distributed winding - Rotating magnetic field - Construction, types and operation of 3-ph induction motors – Equivalent circuit – Torque-Power relationships – Performance characteristics - Effect of supply voltage and rotor resistance on torque – Tests		**CO1**
UNIT-II	**Induction Motor Starting and Speed Control**	**Periods: 09**
Circle diagram – Starting methods– braking-Cogging and crawling – Speed control methods and influence on speed-torque curve– Double cage rotor – Induction generator – types – Induction machine dynamics – Synchronous induction Motor		**CO2,3**
UNIT-III	**Synchronous Generator**	**Periods: 09**
Types, construction and principle of operation – EMF equation – armature reaction – Voltage regulation by synchronous impedance, MMF and Potier triangle methods - Load characteristics –Synchronizing to infinite bus-bars – Power transfer equations, capability curve – Two reaction model of salient pole synchronous machines and power angle characteristics - Determination of Xd & Xq by slip test.		**CO1,4**
UNIT-IV	**Synchronous Motor**	**Periods: 09**
Principle of operation – Power flow – phasor diagrams – Torque angle characteristics – Effect of varying load and Excitation – Excitation and power circles for synchronous machine – ‘V’ and inverted ‘V’ curves – hunting – Synchronous phase modifier – Induction motor Vs Synchronous motor.		**CO5**
UNIT-V	**Single Phase and Special Machines**	**Periods: 09**
Single phase induction motors – Rotating magnetic Vs alternating magnetic field - Double revolving field theory – Torque - speed characteristics – Types – Reluctance motor– Two phase Servo motor– Stepper motors – Universal motor- linear induction motor - permanent magnet DC motor.		**CO1**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:

1. I.J. Nagrath and D.P. Kothari, Electric machines, T.M.H. Publishing Co.Ltd, New Delhi, 4th Edition, 2017.
2. B.L. Theraja, Electrical Technology - Vol.II AC and DC Machines, S. Chand, 2008.
3. Battacharya S K, Electrical Machines, Technical Teachers Training Institute, 2nd Edition, 2003.
4. P.C. Sen, Principles of Electric Machines and Power Electronics, Wiley Student Edition, 2nd Edition,2008.
5. M.N. Bandyopadhyay, Electrical Machines - Theory and Practice, PHI, 2007
6. J.B. Gupta, Theory and Performance of Electrical Machines, J.K.Kataria& Sons, 13th Edition,2004.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	2	1	-	-	-	-	-	-	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1	2	1
AV	3	1.8	1.8	0.8	-	-	-	-	-	-	-	1	2	1

<table>
<tr><td colspan="2">Department: Computer Science and Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: Fourth</td><td colspan="3">Subject Category: ESC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>CSA234</td><td>Data Structures and Object-Oriented Programming</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
</table>

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Choose appropriate Searching and Sorting techniques.	Apply
CO2	Compare and demonstrate Linear and Non-linear data structures.	Understand
CO3	Apply Linear and Non-linear data structures for a given problem.	Apply
CO4	Define Object-Oriented Programming concepts.	Understand
CO5	Develop C++ programs using the concepts of Inheritance and Polymorphism.	Apply

<table>
<tr><td>UNIT-I</td><td>Arrays, Searching and Sorting</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Algorithm: Characteristics –Representation – Efficiency of Algorithms– Data Structures: Characteristics –Types –Arrays: Introduction – Types – Representation –Operations – Applications: Sparse Matrix – Searching: Linear Search and Binary Search– Sorting techniques: Insertion Sort, Selection Sort, Bubble Sort, Quick Sort and Heap Sort.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td>Linear Data Structures</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Stacks: Introduction – Operations – Applications: Evaluation of Expressions – Queues: Introduction – Operations– Circular queues – Priority queues – Double ended queues – Applications: Job Scheduling– Linked List: Introduction – Singly Linked List –Circularly Linked List and Doubly Linked List– Applications: Polynomial Addition.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td>Non-Linear Data Structures</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Trees: Introduction –Terminology – Binary tree –Representation – Traversals– Graph: Introduction – Terminology – Representation – Traversals – Single Source and All Pairs Shortest path algorithms.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td>Introduction to Object-Oriented Programming</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Basics Concepts of Object-Oriented Programming – Structure of C++ – Tokens-Expressions-Control Structures – Functions in C++: Inline Functions – Recursion– Function Overloading – Classes and Objects– Constructors and Destructors– Friend Functions.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td>Concepts of Object-Oriented Programming</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Operators Overloading: Unary and Binary Operators– Type Conversions – Inheritance–Types – Polymorphism– Virtual Functions – Exception Handling: Basics and Mechanism.</td><td>CO5</td></tr>
</table>

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. E Balagurusamy, Data Structures, McGraw Hill Education (India) Private Limited, 2018.
2. G A VijayalakshmiPai, Data Structures and Algorithms: Concepts, Techniques and Applications, McGraw Hill Education (India) Private Limited, 2008.
3. Ellis Horowitz, Sartaj Sahni and Susan Anderson Freed, Fundamentals of Data Structures in C, Second Edition, Universities Press (India) Private Limited,2018.
4. E. Balagurusamy, Object Oriented Programming with C++, Seventh Edition, McGraw Hill Education (India) Private Limited,2017.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	1	-	-	-	-	-	-	-	1	1	1
CO4	3	3	1	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	1	-	-	-	-	-	-	-	1	1	1
AV	3	3	1.8	0.4	-	-	-	-	-	-	-	1	1	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA113	**Electronics Laboratory-II**	-	-	3	1.5	25	75	100
Prerequisite	Electron Devices and Circuits Course (Third semester), Analog Electronics (Fourth Semester), Electronics Lab – I (Fourth semester) and Pulse and Digital Electronics (Fourth semester).							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Design and implement single-stage RC coupled amplifier and the Barkhausen criterion for oscillator operation.	Apply
CO2	Design and implement transistor based Astable and Monostable multivibrators.	Apply
CO3	Design circuits for detection of arbitrary levels in a continuous-time analog signal using Schmitt trigger circuit and construct a relaxation oscillator circuit making use of negative resistance characteristics of UJT.	Apply
CO4	Design and implement combinational logic circuits like adder, subtractor, encoder, decoder, multiplexer and demultiplexer circuits using logic gates. Able to construct different categories of flip-flops and digital code-converters using logic gates.	Apply
CO5	Design and implement sequential logic circuits like Up/Down/MOD-10, Ring and Johnson counters using IC 7476, and test the operation of the decade counter IC 7490.	Apply

Any 10 Experiments	
1. Frequency response of transistor based single stage RC coupled amplifier.	**CO1**
2. Transistor based RC phase-shift oscillator.	
3. Transistor based Astable and Monostable Multivibrator.	**CO2**
4. Transistor based Schmitt trigger.	
5. UJT relaxation oscillator.	
6. Study of logic gates, verification of De-Morgan's laws and realization of basic gates using universal gates.	**CO3**
7. Combinational logic circuits – full and half Adder/Subtractor, arbitrary combinational logic circuit.	
8. Encoder and decoder using logic gates.	
9. Multiplexer and de-multiplexer using logic gates.	**CO4**
10. Realization of R-S, D, J-K and T flip-flops using logic gates.	
11. Code converters (BCD-to-GRAY, BCD-to-Excess 3) using logic gates	
12. Sequential logic circuits: Up/Down counters/MOD-10 counters using IC 7476 (J-K Mater-Slave Flip-flop).	**CO5**
13. Ring counter and Johnson counter using IC7476.	
14. Decade counter using IC7490.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	1	-	-	-	1	3	2
CO2	3	3	2	3	3	-	-	1	-	-	-	1	3	2
CO3	3	3	2	3	3	-	-	1	-	-	-	1	3	2
CO4	3	3	2	3	3	-	-	1	-	-	-	1	3	2
CO5	3	3	2	3	3	-	-	1	-	-	-	1	3	2
AV	3	3	2	3	3	-	-	1	-	-	-	1	3	2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA114	**Electrical Machines Laboratory-II**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Analyse the operation, performance and the characteristics of different types of Induction machines under loaded and unloaded conditions.	Analyse
CO2	Apply suitable starting and speed control methods to enhance the performance of three phase induction motors.	Apply
CO3	Analyze the speed control techniques induction motor.	Analyse
CO4	Perform the power exchange operation with busbar by synchronizing alternators.	Apply
CO5	Analyse the performance and the characteristics of Synchronous motor and universal motor.	Analyse

Any 10 Experiments	
1. Performance determination of 3-phase squirrel cage Induction Motor by load test	**CO1**
2. Performance determination of 3-phase slip ring Induction Motor by load test	
3. Performance determination of 3-phase squirrel cage Induction Motor by non-loading (No load and Blocked Rotor) tests using equivalent circuit and circle diagram	
4. Performance determination of single-phase Induction Motor by load test	
5. Study of starters and speed control of Induction Motor	
6. Synchronization of three phase Alternator with bus bars	**CO2**
7. Performance determination of 3-phase Induction Generator under grid connected mode	**CO3**
8. Performance determination of 1-phase Alternator by load test	
9. Performance determination of 3-phase Alternator by load test	**CO4**
10. Performance determination of 3-phase Alternator by non-loading (OC & SC) tests by EMF, MMF &Potier Triangle methods	
11. Determination of direct axis reactance and quadrature axis reactance of a salient pole alternator by slip test.	
12. Performance characteristics of an auto synchronous motor	**CO5**
13. Performance characteristics of Universal Motor	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	1	-	-	-	1	3	1
CO2	3	3	2	3	3	-	-	1	-	-	-	1	3	1
CO3	3	3	3	3	3	-	-	1	-	-	-	1	3	1
CO4	3	3	3	3	3	-	-	1	-	-	-	1	3	1
CO5	3	3	2	3	3	-	-	1	-	-	-	1	3	1
AV	3	3	3	3	3	-	-	1	-	-	-	1	3	1

Department: **Computer Science and Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fourth**		Subject Category: **ESC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CSA235	**Data Structures and Object - Oriented Programming Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Choose and implement appropriate Searching/sorting algorithms for an application	Apply
CO2	Implement data structures using C	Apply
CO3	Apply Linear and Non-linear data structures for a given problem.	Apply
CO4	Develop and implement C++ programs using of classes and objects, constructors and destructors.	Apply
CO6	Design C++ programs with inheritance and run time polymorphism.	Apply

Experiments for Cycle 1	
1. Implementation of Linear search and binary search.	**CO1**
2. Implementation Insertion sort, Selection sort, Bubble sort, Quick sort and Heap Sort.	
3. Array implementation of Stacks and Queues.	**CO2,3**
4. Implementation of Singly and Doubly Linked List.	
5. Implementation of Binary Tree Traversals.	**CO2,3**
6. Implementation of Graph Traversals and shortest path Algorithms.	
Experiments for Cycle 2	
7. Programs to implement classes and objects.	**CO4,5**
8. Programs to implement constructors and destructors.	
9. Programs to implement different types of inheritance.	**CO5**
10. Programs to implement virtual functions to demonstrate the use of run time polymorphism.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	2	-	-	-	1	2	1
CO2	3	3	3	3	3	-	-	2	-	-	-	1	2	1
CO3	3	3	3	3	3	-	-	2	-	-	-	1	2	1
CO4	3	3	3	3	3	-	-	2	-	-	-	1	2	1
CO5	3	3	3	3	3	-	-	2	-	-	-	1	2	1
AV	3	3	3	3	3	-	-	2	-	-	-	1	2	1

V SEMESTER

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: Fifth</td><td colspan="4">Subject Category: PCC</td><td colspan="3">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA115</td><td>Analog and Digital Integrated Circuits</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">Fundamentals of Analog circuits and Digital circuits</td></tr>
<tr><td>Course Outcome</td><td colspan="7">Course Outcome Statement</td><td>Level</td></tr>
<tr><td>CO1</td><td colspan="7">List Digital IC families and outline IC fabrication techniques</td><td>Understand</td></tr>
<tr><td>CO2</td><td colspan="7">Interpret operational amplifier IC data sheet and analyse its working in open and closed loop configurations</td><td>Analyse</td></tr>
<tr><td>CO3</td><td colspan="7">Experiment with different types of A-D and D-A converters and voltage regulators.</td><td>Analyse</td></tr>
<tr><td>CO4</td><td colspan="7">Design IC based filters and waveform generators</td><td>Create</td></tr>
<tr><td>CO5</td><td colspan="7">Construct multivibrators using timers and build applications using PLL</td><td>Create</td></tr>
<tr><td>UNIT-I</td><td colspan="7">IC Fabrication and Logic Families</td><td>Periods: 9</td></tr>
<tr><td colspan="8">Monolithic IC technology planar process Bipolar junction transistor, FET fabrication, MOS and CMOS technology. Digital Logic families- terminologies; DTL, HTL, TTL, ECL, PMOS, NMOS, CMOS, I2L – basic gates, circuit operation, configurations/improved versions, characteristics, advantages, limitations, Comparison, applications.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="7">Operational Amplifiers and Its Characteristics</td><td>Periods: 9</td></tr>
<tr><td colspan="8">Introduction to Linear ICs -Operational amplifier IC 741 Block diagram and Characteristics – Ideal and practical. Inverting, non-inverting and difference amplifier. Adder, Subtractor, Integrator, Differentiator- Comparator- Window detector- Regenerative comparator (Schmitt trigger) - Precision rectifier- Log and antilog amplifiers, Instrumentation amplifiers.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="7">Voltage Regulators & A-D and D-A Converters</td><td>Periods: 9</td></tr>
<tr><td colspan="8">Voltage Regulators-Series /shunt op-amp regulator, IC Voltage Regulator. Digital to Analog converters: specifications-types- weighted resistor type, binary ladder, testing of DAC. Analog to Digital converter: specifications-types- counter ramp, flash converter, successive approximation and dual slope converters.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="7">Active Filters and Waveform Generators</td><td>Periods: 9</td></tr>
<tr><td colspan="8">First and second order Active filters-Low pass, Highpass, Bandpass and Band reject filters- characteristics, Higher order filters. Oscillators-RC Phase shift and Wien-bridge oscillators. Multivibrators - Monostable and Astable operation. Waveform generator-Square, Triangular and sawtooth waveform generators.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="7">Phase Lock Loop and Timers</td><td>Periods: 9</td></tr>
<tr><td colspan="8">Building blocks of PLL - Characteristics - Derivations of expressions for Lock and Capture ranges. PLL IC 565, Applications- Frequency Synthesis - Frequency Translation- FM/AM Demodulation.
555 Timer- Functional block diagram, pin details and description-Monostable and Astable operation - Schmitt trigger-Missing pulse detector-dual timer IC556-Applications</td><td>CO5</td></tr>
<tr><td colspan="2">Total Contact Hours: 45</td><td colspan="2">Tutorial Hours: 00</td><td colspan="3">Practical Hours: 00</td><td colspan="2">Total Hours: 45</td></tr>
<tr><td colspan="9">Reference Book:</td></tr>
<tr><td colspan="9">1. Ramakant A. Gayakwad, “Op-Amps and Linear integrated circuits”, PHI Pvt Lid, Fourth Edition, 2002
2. Robert F. Coughlin, Frederick F. Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2009.
3. D. Roy Choudhury, Shail B. Jain, Linear Integrated Circuits, New Age International (P) Ltd, Fourth Edition, paperback 2017.
4. Paul R. Gray, Paul J. Hurst , Stephen H. Lewis, Robert G. Meyer , “Analysis and Design of Analog Integrated Circuits”, Wiley International, Fifth Edition , 2009
5. Herbert Taub and Donald Schilling, Digital Integrated Electronics, Tata McGraw Hill Edition,</td></tr>
</table>

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	-	1	2	-	-	2	2	3
CO2	3	3	3	3	3	1	-	1	2	-	-	2	2	3
CO3	2	2	2	2	2	1	-	1	2	-	-	2	2	2
CO4	3	3	3	2	2	1	-	1	2	-	-	2	3	3
CO5	3	3	3	3	2	1	-	1	2	-	-	2	3	3
AV	2.8	2.6	2.6	2.4	2.2	1	-	1	2	-	-	2	2.4	2.8

Department: **Electrical and Electronics Engineering**	Programme: **B.Tech., (EE)**	
Semester: **Fifth**	Subject Category: **PCC**	Semester Exam Type: **TY**

Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA116	**POWER ELECTRONICS**	3	-	-	3	25	75	100

Prerequisite	Should have through knowledge and completed the basic courses on Electrical Circuits Analysis and Electronic Devices and Circuits.

Course Outcome	Course Outcome Statement	Level
CO1	Explain the characteristics of modern power electronic devices and the basic principle of operation of various power-electronic circuits	Understand
CO2	Extend the fundamental principles involved in the operation of power electronic switches and the different methods to control them	Analyse
CO3	Design different types of phase-controlled single phase and three phase converters along with necessary protective circuits for application in different domains of engineering	Create
CO4	Design different types of DC-DC converter and inverter	Evaluate
CO5	Design single phase and three phase step up/step down AC controller	Evaluate

UNIT-I	**Power Semiconductor Devices**	**Periods: 09**
Power switching devices overview: ideal & real switching characteristics - power diode - BJT - SCR - TRIAC - MOSFET - GTO - IGBT- V-I characteristics - turn-on - turn-off methods; Thyristor protection-di/dt - dv/dt - over current - over voltage; specifications - losses - thermal characteristics - series and parallel operation – SCR triggering circuits.		**CO1**
UNIT-II	**Controlled Rectifiers**	**Periods: 09**
Operation and analysis of single and three phase rectifiers - half and fully controlled converters with R and RL loads with and without freewheeling diodes; converter and inverter operation - waveforms - gate time control - output voltage - input current - power factor - effect of load and source inductances. Power factor and harmonic improvement methods - series converter - dual converters - four-quadrant operation with and without circulating current.		**CO2**
UNIT-III	**Choppers**	**Periods: 09**
Principles of high power chopper circuits - class A, B, C, D & E - voltage commutated - current commutated chopper - multi-phase chopper - multi-quadrant operation - switched mode regulators - principle of operation of buck - boost and buck boost regulators; time ratio control - variable frequency control - duty cycle.		**CO3**
UNIT-IV	**Inverters**	**Periods: 09**
Principles of high power VSI and CSI inverters - Modified McMurray - auto sequential inverter - waveforms at load and commutating elements; inverters: analysis of three phase inverter circuits with star and delta loads; control and modulation techniques: unipolar - bipolar schemes– voltage and frequency control; harmonics study.		**CO4**
UNIT-V	**AC Chopper and Cycloconverters**	**Periods: 09**
Principle of single-phase AC voltage controller - ON/OFF and phase angle control output voltage and power factor relation; Different configurations of three-phase AC voltage controller; principle of single-phase to single-phase and three-phase to single-phase cycloconverter circuits – Waveforms and output voltage expression. Applications: regulated power supply - UPS - solid-state motor starters - static circuit breakers - HVDC systems - reactive power compensation.		**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours: 00**

Reference Book:
1. M.H. Rashid, "Power Electronics", PHI, New Delhi, 2007. 2. P.S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi, 2008. 3. Ned Mohan, M. Underland, William P. Robbins, "Power Electronics Converters, applications and design", JohnWiley & sons, Singapore, 2001. 4. M.D. Singh, K.B. Khanchandani, "Power Electronics", Tata McGraw Hill, New Delhi,2007. 5. Cyril W. Lander, "Power Electronics", McGraw Hill Book Company, Singapore (1993). 6. Williams B.W., "Power Electronics Devices, drivers, applications and passive components", McMillan Press Ltd., London, 1992.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	1	-	-	1	1	1	1	-	2	2
CO2	3	2	3	2	1	-	-	-	-	1	1	-	1	2
CO3	3	3	2	1	3	-	-	-	1	1	1	1	1	3
CO4	3	3	2	1	3	-	-	-	1	1	1	1	2	2
CO5	3	3	2	1	3	-	-	-	1	1	1	1	2	2
AV	3	2.8	2.2	1	2.2	-	-	0.2	0.8	1	1	0.6	1.6	2.2

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="8">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: Fifth</td><td colspan="4">Subject Category: PCC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA117</td><td>Measurement and Instrumentation</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
<tr><td>Course Outcome</td><td colspan="6">Course Outcome Statement</td><td colspan="2">Level</td></tr>
<tr><td>CO1</td><td colspan="6">Describe the basic functional elements of instrumentation, characteristics of measuring instruments and different error in measurement.</td><td colspan="2">Understand</td></tr>
<tr><td>CO2</td><td colspan="6">Analyse the suitable instrument for measuring different and magnetic parameters.</td><td colspan="2">Analyse</td></tr>
<tr><td>CO3</td><td colspan="6">Implement a suitable circuit for measuring unknown resistance, capacitance, inductance values and magnetic parameters.</td><td colspan="2">Apply</td></tr>
<tr><td>CO4</td><td colspan="6">Explain the construction and working principles of various types of storage and display devices and compare them.</td><td colspan="2">Understand</td></tr>
<tr><td>CO5</td><td colspan="6">Apply the various types of transducers and explain the function of different blocks in data acquisition systems.</td><td colspan="2">Apply</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Introduction to Measurement</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Elements of Generalized measurement system- Methods of measurement- Classification of instruments– Mean, Standard deviation- Probability of errors- problems- Types of error and remedial measures, Static & Dynamic characteristics of instruments.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Electrical Measuring Instruments</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Basic effects of electromechanical instruments–Ammeter and voltmeter–Moving coil–Moving Iron–Electro dynamo meter–Extension of range. Wattmeter–Dynamometer and induction type energy meter-Instrument transformers. Power factor meter– Synchroscope– Frequency meter.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Bridges and Magnetic Measurement</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Measurement of resistance- Low, Medium and High- AC bridges- Maxwell, Hay’s and Anderson’s bridge for inductance. Desauty’s bridge and Schering Bridge for Capacitance and Wien’s bridge for measurement of frequency. B-H curve and hysteresis loop using ballistic galvanometer, and Loss measurement using wattmeter method.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Display and Recording Devices</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">LED & LCD Display, Dot Matrix Display, 7-Segment Display, Strip Chart Recorders, Single point and multipoint Recorders– X-Y Recorders-Magnetic Tape Recorders-Data Loggers– Electromagnetic and Electrostatic interference, Data Acquisition system.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Transducers</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Temperature transducers-RTD, thermistor, Thermocouple-Displacement Transducer-Inductive, capacitive, LVDT, Pressure transducer–Bourdon tube, Bellows–Flow transducer– Electromagnetic flow meter – Strain gauges– Piezoelectric and Hall Effect transducer.</td><td>CO4</td></tr>
<tr><td colspan="2">Total Contact Hours: 45</td><td colspan="2">Tutorial Hours:00</td><td colspan="3">Practical Hours: 00</td><td colspan="2">Total Hours: 45</td></tr>
<tr><td colspan="9">Reference Book:</td></tr>
<tr><td colspan="9">1. A.K. Sawhney, A course of Electrical & Electronics Measurements & Instrumentation, Dhanpat Rai & sons, 2010.
2. Arun K. Ghosh, Introduction to Measurements and Instrumentation, Prentice Hall of India private limited, 2012.
3. R.K. Rajput, Electrical and Electronic Measurement and Instrumentation, S. Chand and Co. Pvt ltd,2016.
4. John P. Bentley, Principles of Measurement System, Addison Wesley Longman Pvt. Ltd., 2002.
5. G.S. Rangan, G.R. Sharma and V.S.V. Mani, Instrumentation Devices and Systems, Tata McGraw Hill, 2001.
6. D.V.S. Moorthy, Transducers & Instrumentation, Prentice Hall of India, 2008.</td></tr>
</table>

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	2	1	-	-	-	-	-	-	-	1	2	1
AV	3	2.2	1.4	0.8	-	-	-	-	-	-	-	1	2	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fifth**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA118	**TRANSMISSION AND DISTRIBUTION**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explain the importance and the functioning of transmission line parameters.	Understand
CO2	Outline the basics of corona, sag and other problems arise in transmission lines	Understand
CO3	Analyze mechanical design of transmission lines and insulated cables.	Analyse
CO4	Analyse the voltage distribution in insulator strings and cables and method to improve the same.	Analyse
CO5	Explain the various types of distribution system and power factor improvement techniques.	Understand

UNIT-I	**Transmission Line Parameters**	**Periods: 09**
Structure of Power System - Parameters of single and three phase transmission lines -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.		**CO1**
UNIT-II	**Performance of Transmission Lines & Corona**	**Periods: 09**
Performance of Transmission 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 - Power Circle diagrams - Formation of Corona – Factors affecting corona-Critical Voltages – Effect on Line Performance.		**CO2**
UNIT-III	**Mechanical Design of Lines**	**Periods: 09**
Mechanical design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.		**CO3**
UNIT-IV	**Underground Cables**	**Periods: 09**
Underground cables - Types of cables – Construction of single core cable - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cable - Power factor and heating of cable. Testing of Cables.		**CO4**
UNIT-V	**Distribution Systems**	**Periods: 09**
Distribution Systems – General Aspects –AC and DC distributions –Radial and Ring main systems – Concentrated, uniform and combines loading - Kelvin’s law – Techniques of voltage control and power factor improvement – Recent trends in transmission and distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).		**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:
1. D.P. Kothari, I.J. Nagarath, 'Power System Engineering', McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2008 2. C.L. Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009. 3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011. 4. V.K. Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013. 5. Luces M. Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO4	2	1	-	1	-	-	-	-	-	-	-	1	2	-
CO5	3	1	-	1	-	-	-	-	-	-	-	1	2	-
AV	2.6	1.6	0.4	0.8	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fifth**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA119	**CONTROL SYSTEMS**	3	1	-	4	25	75	100
Prerequisite	Vector algebra and Matrix analysis; Laplace transform and Fourier transform.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Develop mathematical models of electrical and mechanical systems	Apply
CO2	Estimate the time domain and frequency domain specifications	Apply
CO3	Analyze simple systems in frequency domain.	Analyse
CO4	Interpret characteristics of the system to develop mathematical model and design appropriate compensator for the given specifications.	Apply
CO5	Solve complex control problemin time domain using state-space approach.	Apply

UNIT-I	**Introduction to Classical Control Theory**	**Periods: 12**
Introduction to Control systems – Classical control theory concepts – linearity and time-invariance (LTI) – Physics based mathematical modelling of dynamical systems (mechanical and electrical systems) in transfer function approach – pole-zero form and time-constant form - concept of poles and zeros – open and closed loop control systems. Analogous systems – force-current and force-voltage analogy. Modelling of electro-mechanical systems (DC servo systems with armature and field control topologies). Simplification of interconnected systems using block diagram reduction technique and Mason's gain formula (signal flow graphs).		**CO1**
UNIT-II	**Time-response Analysis**	**Periods: 12**
Standard test signals–Transient response analysis of first and second order systems using standard test signals (step, impulse and ramp) –correlation between pole location in s-plane and time-response–transient response specification for second-order systems. Steady state analysis– error constants.		**CO2**
UNIT-III	**Root Locus and Frequency Response Analysis**	**Periods: 12**
Root locus concepts–construction of root loci–root contours. Frequency response analysis: Frequency response and its importance–correlation between frequency response and time-response analysis–frequency response specifications. Frequency response plots– Polar plot, Bode plot and log-magnitude versus phase plot. All pass and minimum phase systems.		**CO3**
UNIT-IV	**Stability of Dynamic Systems**	**Periods: 12**
Concept of stability of LTI systems–Routh and Hurwitz stability criteria – relative stability analysis using Routh's stability criterion. Stability analysis in frequency domain–Nyquist stability criterion– Relative stability analysis of dynamic systems using phase margin and gain margin specifications– Closed-loop frequency response – constant M and N circles – Nichols chart (qualitative treatment only).		**CO4**
UNIT-V	**State-space Approach for Modelling Dynamic Systems**	**Periods: 12**
Modelling of physical systems using state-space approach – advantages of state-space approach over transfer function approach. State-space model using physical variable approach for SISO and MIMO systems, and phase variable and canonical variable approaches for SISO systems. Derivation of transfer functions from state-space model for LTI systems. Solution to state equation–homogenous system and forced system– state transition matrix and its properties– ascertaining stability from eigen values of the system matrix. Introduction to controllability and observability.		**CO6**

Total Contact Hours: 45	**Tutorial Hours:15**	**Practical Hours: 00**	**Total Hours:60**

Reference Book:
1. Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Prentice Hall, 2010. 2. I J Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, 2008. 3. Norman S Nise, "Control Systems Engineering", 7th Edition, Wiley, 2015. 4. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 8th Edition, Pearson, 2018. 5. Joseph J. Distefano, III, Allen R. Stubberud and Ivan J. Williams, 'Feedback and Control Systems", Schaum's Outlines, Second Edition, Tata-McGraw Hill Edition, 2003. 6. Raymod T. Stefani, Bahram Shahian, Clement J. Savant, Jr. and Gene H. Hostetter, "Design of Feedback Control Systems", Oxford University Press, 2004

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1	2	1
AV	3	3	2	1	-	-	-	-	-	-	-	1	2	1

Department: **Humanities Social Science and Management Course.**			Programme: **B.Tech., (EE)**						
Semester: **Fifth**			Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course		Period / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HSA102	**Industrial Economics and Management**		3	-	-	3	25	75	100
Prerequisite	-								

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Outline the industrial micro economics/macroeconomics.	Understand
CO2	Explain various management techniques based on the needs.	Understand
CO3	Explain various investment evaluation based on the needs	Understand
CO4	Explain the steps in production, process planning, scheduling and despatch.	Understand
CO5	Discuss the various marketing strategy.	Understand

UNIT-I	**Micro And Macro Economics and Its Applications**	**Periods: 09**
Nature and Scope of Economic science: Micro – Macro Economics, Economic decisions and Technical decisions. Demand and Supply concepts: Types of Demand, Determinants of Demand and Supply, concept of Equilibrium, Elasticity of Demand, cost components, Concepts of ISO-Quant – Break Even Analysis – Market structure – Price of Product Nature of pricing in different types of competition Small Scale Industries – Role of SSI in Indian Economy. Macro Economics: Nature and functions of Money – National Income – GNP and Savings – Inflation and Deflation concept – Business Cycle – Foreign Trade and Balance of payment.		**CO1**
UNIT-II	**Management Techniques**	**Periods: 09**
Types and Principles of Management – Elements of Management – Planning, Organising, Staffing, Directing, Coordinating Controlling - Scope of Management – Types of Organization Merits and Demerits – Types of (Ownership) of a firm Merits and Demerits.		**CO2**
UNIT-III	**Industrial Finance**	**Periods: 09**
Need for Finance – Types of finance – Sources of finance – Types of Investment – Evaluation of Investment – Preparation of Trading, Profit and loss Account and Balance Sheet – types of accounting and significance of each type.		**CO3**
UNIT-IV	**Production Management**	**Periods: 09**
Theory of Production Function – Types of Production Merits and Demerits – Process Planning – Routing – Scheduling – Material Control Concepts of Productivity – Measurement of Productivity – Inspection and Dispatches.		**CO4**
UNIT-V	**Marketing Management**	**Periods: 09**
Core Concepts of Marketing - Needs – Wants – Demand, Marketing Vs Selling – Products and Markets – Pricing and related factors – Channels of Distribution – Promotion Advertising – Market Research Vs Marketing Research		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Varshney Maheswari “Managerial Economics” S Chand & Co, New Delhi 2011
2. Dutt & Sundaram, “Indian Economy” S Chand & Co New Delhi 2015
3. Pandey I.M, “Elements of Financial Management” Wiley Eastern Ltd New Delhi 2015
4. H.L. Ahuja, “Macro Economics for Business and Management, S Chand & Company Ltd 2011
5. O.P Khanna, “Industrial Engineering and Management, DhanpatRai and Sons, 2009.
6. Philip B Kotler, “Marketing Management, Mac Millan, New York 2011.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3	-	-	-
AV	-	-	-	-	-	-	-	-	-	-	3	-	-	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fifth**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA120	**Electronics Laboratory-III**	-	-	3	1.5	25	75	100
Prerequisite	Analog Electronics Course and Pulse and Digital Course (Fourth Semester), Analog and Digital ICs (Fifth Semester).							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Design and implement the elementary OPAMP based circuits like inverting, non-inverting amplifier, voltage follower (buffer), analog adder, subtractor, and difference amplifier circuits. Design and test analog integrator and differentiator circuits using OPAMP.	Apply
CO2	Construct and test the operation of little advanced OPAMP based circuits like logarithmic and antilog amplifier, precision rectifiers and DACs.	Apply
CO3	Design and verify the frequency response characteristics of first and second order active filter circuits. Design and test the operation of oscillator circuits using OPAMP.	Apply
CO4	Design instrumentation amplifier, comparator circuits and Schmitt trigger using OPAMP. Design and verify the operation of Monostable and Astable circuits using general purpose timer IC 555.	Apply
CO5	Design and implement VCO, Optocoutpler and Voltage regulator using ICs.	Apply

Any 10 Experiments	
1. Inverting and Non-Inverting Amplifier using IC 741	**CO1**
2. Analog Adder, Subtractor and Difference Amplifier using IC 741.	
3. Integrator and Differentiator using IC 741.	
4. Log and Antilog amplifier circuits using IC741.	**CO2**
5. Precision rectifiers using IC741.	
6. Digital to Analog Converter circuits using IC 741.	
7. Active filter circuits using IC741.	**CO3**
8. Wein-bridge oscillator using IC741.	
9. RC Phase-shift oscillator using IC741.	
10. Instrumentation amplifier using IC741.	**CO4**
11. Comparator and Schmitt trigger using IC741.	
12. Monostable and Astable circuits using IC555.	
13. Voltage Controller Oscillator (VCO) using Phase-locked loop IC NE 565.	**CO5**
14. Optocoupler IC 6N137 based driver circuit.	
15. Voltage regulator using IC723.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2	-	-	-	2	-	-	1	2	2
CO2	3	3	2	1	2	-	-	-	2	-	-	1	2	2
CO3	3	3	2	1	2	-	-	-	2	-	-	1	2	2
CO4	3	3	2	1	2	-	-	-	2	-	-	1	2	2
CO5	3	3	2	1	2	-	-	-	2	-	-	1	2	2
AV	3	3	2	1	2	-	-	-	2	-	-	1	2	2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Fifth**		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA121	**Measurement and Control Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	Analog Electronics course, Signal and Systems course and Control System course.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Measure various electrical and Magnetic quantities using various bridges.	Apply
CO2	Calibrate the energy meter and extend the range of voltmeter and ammeter.	Apply
CO3	Identify suitable transducer for measurement of physical quantities.	Apply
CO4	Analyse the properties of signals and systems; to analyze a dynamic system in classical approach (Transfer function approach).	Analyse
CO6	Analyze a dynamic system in state-space approach and to use schematic (block diagrammatic) approach for analyzing a dynamic system.	Analyse

Any 10 Experiments	
1. Measurement of medium resistance using bridge.	**CO1**
2. Determination of Hysteresis loop using Transformer core.	
3. Calibration of single phase/three phase energy meter.	**CO2**
4. Experiment on extending the range of Voltmeter and voltmeter by multiplier and shunt.	
5. Measurement of Temperature using Transducer.	**CO3**
6. Measurement of Displacement using Transducer.	
7. Determination of the characteristics of Instrumentation amplifier.	
8. Time-response and frequency response analysis of first-order and second-order systems. Correlation between time response and frequency response specification of standard second order system. Steady state analysis – computation of error criteria and steady state error for type -0, -1 and -2 systems.	**CO4**
9. Analysis of dynamic systems using root-locus. Design of controller using root locus method. Study of Root contours.	
10. Analysis of dynamic systems in frequency domain using Bode plot. Study of the impact of compensator on closed-loop performance – tracking and disturbance rejection.	
11. Design of PID controller and its variant (I-PD control) for a DC motor system for a specified closed-loop performance using root locus and pole-placement approach.	
12. State-space analysis of dynamic systems. Realization in all three canonical forms of state-space representation. Solution to state equation.	**CO5**
13. Modelling and analysis of Mechanical (translational and rotational systems) and Electrical systems (Electrical Circuits, DC Motor – armature and field control and state-space averaging method for power electronic converter circuits – buck, boost etc.) using classical and/or modern approaches.	
14. Stability of nonlinear systems using phase-plane plots based on Lyapunov energy function approach. Study of Limit Cycles using Van der Pol's nonlinear system.	
15. Dynamic analysis of open-loop power electronic converter circuits (buck, boost and buck-boost) using SIMULINK.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	3	-	-	-	1	-	-	1	2	1
CO2	3	3	1	3	3	-	-	-	1	-	-	1	2	1
CO3	3	3	1	3	3	-	-	-	1	-	-	1	2	1
CO4	3	3	1	3	3	-	-	-	1	-	-	1	2	1
CO5	3	3	1	3	3	-	-	-	1	-	-	1	2	1
AV	3	3	1	3	3	-	-	-	1	-	-	1	2	1

VI SEMESTER

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester:Sixth</td><td colspan="3">Subject Category: PCC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA122</td><td>Power System Analysis</td><td>3</td><td>1</td><td>-</td><td>4</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
<tr><td>Course Outcome</td><td colspan="6">Course Outcome Statement</td><td colspan="2">Level</td></tr>
<tr><td>CO1</td><td colspan="6">Model the Power System components including generator, line/cable, and transformer, shunt element, and load.</td><td colspan="2">Analyse</td></tr>
<tr><td>CO2</td><td colspan="6">Distinguish between different methods of power flow analysis</td><td colspan="2">Analyse</td></tr>
<tr><td>CO3</td><td colspan="6">Analyze the symmetrical components using positive, negative and zero sequence network.</td><td colspan="2">Analyse</td></tr>
<tr><td>CO4</td><td colspan="6">Analyze the nature of the system under various fault conditions.</td><td colspan="2">Analyse</td></tr>
<tr><td>CO5</td><td colspan="6">Analyze the stability of power system using different methods.</td><td colspan="2">Analyse</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Modelling of Power Systems Components</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Need for system planning and operational studies – single line diagram of power system components – per unit quantities – reactance diagram - Bus admittance matrix – Bus impedance matrix representation.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Load Flow Studies</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Bus Classification - Formulation of load flow equations using Gauss-Seidel, Newton-Raphson and Fast Decoupled method for the computation of slack bus power - line voltages, line losses and real and reactive powers transmitted through the line - Comparison of the above methods.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Symmetrical Components</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Introduction of symmetrical components - Transformation matrices used in resolution of unbalanced voltages and currents- Positive, Negative and Zero sequence networks of power system components like synchronous machines, induction machines, transformers, transmission lines, loads.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Symmetrical and Unsymmetrical Fault Analysis</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Symmetrical fault analysis - analysis through impedance matrix - circuit breaker rating - current limiting reactors. Unsymmetrical fault analysis - LG, LL, LLG and open circuit faults – analysis through sequence components</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Power System stability</td><td colspan="2">Periods: 12</td></tr>
<tr><td colspan="8">Stability studies - steady state and transient stability – Power Angle Curve -swing equation – Swing Curve –solution of swing equation by step by step method -equal area criterion – critical clearing angle and clearing time</td><td>CO5</td></tr>
<tr><td colspan="2">Total Contact Hours: 45</td><td colspan="2">Tutorial Hours:15</td><td colspan="3">Practical Hours: 00</td><td colspan="2">Total Hours:60</td></tr>
<tr><td colspan="9">Reference Book:</td></tr>
<tr><td colspan="9">1. John J. Grainger & Stevenson. W.D., “Power System Analysis”, McGraw Hill International editions, 1994.
2. Hadi Saadat, “Power System Analysis”, Tata McGraw-Hill, 2002.
3. D. P. Kothari, I.J. Nagrath, “Modern Power System Analysis”, Tata McGraw-Hill, 4th edition 2011.
4. Duncan Glover, J. Mulukutla S. Sarma & Thomas J. Overbye “Power System Analysis and Design”, Cengage Learning, 4th edition, 2008.
5. Arthur R. Bergen and Vijay Vittal, “Power System Analysis”, 3rd Edition, PHIU Private Limited, New Delhi, 2001.</td></tr>
</table>

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	-
CO2	3	3	2	1	-	-	-	-	-	-	-	1	1	-
CO3	3	3	2	1	-	-	-	-	-	-	-	1	1	-
CO4	3	3	2	1	-	-	-	-	-	-	-	1	1	-
CO5	3	3	2	1	-	-	-	-	-	-	-	1	1	-
AV	3	2.8	2	1	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**				Programme: **B.Tech., (EE)**				
Semester:**Sixth**		Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA123	**Microprocessors and Microcontrollers**	3	-	-	3	25	75	100
Prerequisite	Basic Electrical Engineering, Laplace Transform							

Course Outcome	Course Outcome Statement	Level
CO1	Outline the architecture description, software instructions & various addressing modes of 8085	Understand
CO2	Make use of instruction sets and develop skill in assembly level language programs for any given applications using 8085 processor.	Apply
CO3	Design the interfacing of Peripheral Devices with 8085 Processor.	Create
CO4	Develop programming of 8051 microcontroller based on its architecture.	Apply
CO5	Design and Implement the interfacing scheme for memory and peripheral devices with 8051.	Create

UNIT-I	Introduction to Microprocessors and Microcontrollers	Periods: 09
Fundamentals of Microprocessor: Block diagram, general building blocks- Register section, Arithmetic and Logic unit, Timing and Control unit and Interface section- features concepts common to all microprocessors. Comparison of 8 bit processors: 8085, Z80 and 6800. Microcontroller- general building blocks - features. Comparison of microprocessors and microcontrollers. Overview of the 8051 family.		**CO1**
UNIT-II	**Microprocessor Instruction Set and Programming**	**Periods: 09**
Instruction set of 8085-Addressing modes- Direct, Indirect, Immediate and register addressing. Condition flags- Timing Diagrams -Programming techniques– Arithmetic and logic operations on 8/16-bit binary/BCD numbers, Counters and time delay programs–Stack and subroutines -Code conversion. Software development systems and assemblers. Memory and I/O interfacing		**CO2**
UNIT-III	**Interrupts, Communication and Peripheral ICs**	**Periods: 09**
Interrupt structure of 8085 microprocessor - interrupt routines, Data transfer techniques- Serial communication. Peripheral ICs (Block diagram, features and interfacing only)-Programmable Peripheral device (8255), Timer/ Counter (8253), Programmable keyboard display interfaces (8279). Programmable interrupt controller (8259) - Serial communication USART (8259). Interfacing Data converters, stepper motor interfacing, and traffic lights.		**CO3**
UNIT-IV	**The 8051 Microcontroller- Architecture & Programming**	**Periods: 09**
Block Diagram of 8051 Microcontroller -CPU, Oscillator, Program memory, Data memory, Stack Pointer, Special Function Registers, I/O ports. Addressing modes- Immediate, Register, Direct, Indirect, Relative and Indexed addressing, bit inherent addressing, bit direct addressing, PUSH and POP instructions. Logical operators-bit and byte level, bit level Boolean operators, Rotate and swap, Example programs. Arithmetic operations- addition, subtraction, multiplication, division, Decimal Arithmetic, searching and sorting. Jump and Call Subroutines.		**CO4**
UNIT-V	**Microcontroller Based Design**	**Periods: 09**
External Memory and memory space decoding, Testing the design- Timing subroutines, Look up Tables. Serial data transmission, reception- polling and Interrupt driven modes. Serial communication standards RS232, SPI, I2C. Introduction to protocols like Blue-tooth and Zig-bee.		**CO5**

Total Contact Hours: 45	Tutorial Hours:00	Practical Hours: 00	Total Hours: 45

Reference Book:
1. Ramesh Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, Sixth Edition 2013. 2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004. 3. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, Second Edition, 1991. 4. Kenneth L. Short, "Microprocessor and Programming Logic", 2nd Edition, Prentice Hall, 1987. 5. Mathur A P, "Introduction to Microprocessors", 24th Reprint, TMH, New Delhi , 2006. 6. N.Senthil Kumar, M.Saravanan and S.Jeevananthan, "Microprocessors and Microcontrollers", 2nd Edition, Oxford University Press.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	-	-	2	-	-	1	2	2
CO2	3	3	3	2	3	1	-	-	2	-	-	1	2	2
CO3	3	3	2	2	2	1	-	-	2	-	-	2	2	2
CO4	3	2	3	3	3	1	-	-	2	-	-	1	2	2
CO5	3	3	3	3	3	1	-	-	2	-	-	2	2	2
AV	3	2.6	2.6	2.4	2.6	1	-	-	2	-	-	1.4	2	2

<table>
<tr><td colspan="2">Department: IEDC</td><td colspan="8">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: Sixth</td><td colspan="4">Subject Category: PAC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EPA101</td><td>Entrepreneurship</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
<tr><td>Course Outcome</td><td colspan="6">Course Outcome Statement</td><td colspan="2">Level</td></tr>
<tr><td>CO1</td><td colspan="6">Outline the basics of Entrepreneurship and design thinking.</td><td colspan="2">Understand</td></tr>
<tr><td>CO2</td><td colspan="6">Extend the knowledgeable to build business model and MVP</td><td colspan="2">Create</td></tr>
<tr><td>CO3</td><td colspan="6">Outline the costing and revenue.</td><td colspan="2">Apply</td></tr>
<tr><td>CO4</td><td colspan="6">Outline about marketing and sales.</td><td colspan="2">Analyse</td></tr>
<tr><td>CO5</td><td colspan="6">Explain about team formation and compliance requirements.</td><td colspan="2">Remember</td></tr>
<tr><td>UNIT-I</td><td colspan="6">Problem and Customer</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Effectuation, Finding the flow. Entrepreneurial style, business opportunity, problems worth solving, methods for finding problems, problem interviews. Design Thinking, Consumer and customer, market types, segmentation and targeting, early adopters, Gains, Pains and “Jobs-To be done”, Value Proposition Canvas (VPC), Identifying Unique Value Proposition (UVP).</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="6">Business Model and Validation</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Types of Business Models, Lean Canvas, Risks. Building solution demo, solution interviews, problem-solution test, competition, Blue Ocean Strategy. MVP- Build-Measure-Learn feedback loop, MVP Interviews, MVP Presentation.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="6">Revenue and Cost</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Revenue Streams-Income, costs, gross and net margins - primary and secondary revenue streams-Different pricing strategies - product costs and Operations costs; Basics of unit costing. Financing New Venture- various sources - investor expectation- Pitching to Investors.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="6">Marketing and Sales</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Difference between product and brand - positioning statement. Building Digital Presence, social media-company profile page –Sales Planning - buying decisions, Listening skills, and targets. Unique Sales Proposition (USP), sales pitch, Follow-up and closing a sale.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="6">Team and Support</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="8">Team Building - Shared leadership - role of a good team - team fit - defining roles and responsibilities - collaboration tools and techniques-project management, time management, workflow, delegation of tasks. Business regulations - starting and operating a business - compliance requirements.</td><td>CO5</td></tr>
<tr><td colspan="2">Total Contact Hours: 45</td><td colspan="2">Tutorial Hours:00</td><td colspan="3">Practical Hours: 00</td><td colspan="2">Total Hours: 45</td></tr>
<tr><td colspan="9">Reference Book:</td></tr>
<tr><td colspan="9">1. Nandan H, "Fundamentals of Entrepreneurship”, Prentice Hall India, 2013.
2. LearnWISE–Digital learning platform by Wadhwani Foundation, www.learnwise.org
3. Khanka S.S, "Entrepreneurial Development", S Chand & Company, 2007.
4. Sangeetha Sharma, “Entrepreneurship Development"– Prentice Hall India, 2017.
5. Anil Kumar.S, "Entrepreneurship Development"– New Age Publishers, 2003.</td></tr>
</table>

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	3	1	2	1	-	-	2	2	-	-	-
CO2	2	3	1	3	1	1	1	-	1	2	2	-	-	-
CO3	1	-	2	2	-	2	1	-	1	2	-	-	-	-
CO4	-	-	2	3	-	2	3	2	1	3	1	-	-	-
CO5	-	2	-	2	-	3	-	-	-	2	2	2	-	-
AV	0.8	1.2	1.4	2.6	0.4	2	1.2	0.4	0.6	2.2	1.4	0.4	-	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Sixth**		Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA124	**Microprocessors and Microcontrollers Laboratory**	-	-	3	1.5	25	75	100

Prerequisite	-	
Course Outcome	**Course Outcome Statement**	**Level**
CO1	Develop programming of 8085 microprocessor based on its architecture and instruction set.	Understand
CO2	Develop programming of 8051 microcontroller based on its architecture and instruction set.	Understand
CO3	Design and Implement the Peripheral Devices interface with 8085/8051 hardware components	Understand

Any 10 experiments:	
I: 8085 Microprocessor based experiments:	
1. Binary arithmetic operations (8/16-bit)	**CO1**
2. BCD arithmetic operations.	
3. Block operations	
4. Generation of Series(Fibonacci, prime)	
5. Message Display (Moving &Flashing).	
6. Digital clock Simulation using counters/interrupts.	
II. 8051 Microcontroller based experiments:	
7. Arithmetic operations	**CO2**
8. Code conversions	
9. Array operations (searching, sorting)	
III: Interfacing experiments (8085/8051 based):	
10. Traffic light interface.	**CO3**
11. Display Interface.	
12. Stepper motor interface.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	-	-	-	1	-	-	1	3	1
CO2	3	2	1	2	2	-	-	-	1	-	-	1	3	1
CO3	3	2	1	2	2	-	-	-	1	-	-	1	3	1
AV	3	2	1	2	2	-	-	-	1	-	-	1	3	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: Sixth		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA125	**Power Electronics Laboratory**	-	-	3	1.5	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Demonstrate the characteristics of power semiconductor devices and firing circuits.	Understand
CO2	Analyse commutation techniques and DC-DC converters.	Analyse
CO3	Correlate theoretical and practical results of AC-DC, AC-AC, DC-AC converters.	Evaluate
CO4	Develop analytical competence required for modelling and simulation of these converters.	Create
CO5	Outline the application of converters for motors & SMPS.	Apply

Any 10 experiments:	
1. Study of Switching characteristics of SCR, MOSFET and IGBT	CO1
2. Study of RC and UJT Triggering circuits for SCR	
3. Study of voltage commutated chopper	CO2
4. Study of current commutated chopper	
5. Experimental verification of Single-phase semi-converter with R and RL loads	CO3
6. Experimental verification of Single-Phase Full converter with R and RL loads	
7. Study of Three-phase Semi converter with R and RL loads	
8. Study of Three-phase Full converter with R and RL loads	
9. Experimental verification of single-phase AC Voltage controller with R and RL loads	
10.Study of single-phase VSI with different modulation techniques	
11. Simulation study of three-phase VSI under 120 and 180 degrees of operation	CO4
12. Simulation study of single-phase semi and full converters	
13. Simulation study of three phase semi and full converters	
14. Simulation study of Class A and B choppers	
15. Speed control of DC motor using Rectifier	CO5
16. Speed control of induction motor using Voltage source inverters	
17. Study of switched mode power supplies	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 45**	**Total Hours:45**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	3	2	-	1	-	-	1	3	1	3	2
CO2	2	3	3	3	2	-	1	-	-	1	3	1	3	2
CO3	2	3	3	3	2	-	1	-	-	1	3	1	3	2
CO4	2	3	3	3	2	-	1	-	-	1	3	1	3	2
CO5	2	3	3	3	2	-	1	-	-	1	3	1	3	2
AV	2	3	3	3	2	-	1	-	-	1	3	1	3	2

Department: **Humanities and Social Sciences**		Programme: **B.Tech., (EE)**						
Semester:**Sixth**		Subject Category: **MCC**			Semester Exam Type: **-**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
SHA103	**Essence of Indian Traditional Knowledge**	3	-	-	-	-	-	-
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Understand the basics of Indian traditional knowledge in modern scientific perspective	Understand

UNIT-I	**Periods: 23**
Basic structure of Indian knowledge system, Modern science and Indian knowledge system, Yoga and holistic health care.	**CO1**
UNIT-II	**Periods: 22**
Philosophical tradition, Indian linguistic tradition, Indian artistic tradition.	**CO1**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. N. Sivaramakrishnan (Ed.) Culteral Heritage of India – Course Materal, BharatiyaVidyaBhavan, Mumbai 5th edition, 2014.
2. Swami Jitatmanand, Modern Physics and Vedanta, BharatiyaVidyaBhavan.
3. Fritzof Capra, Tao of Physics.
4. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
5. R.N. Jha, Science of Conciousness Psychotherapy and yoga Practices, VidyanidhiPrakashan, Delhi 2016.
6. S.C Chaterjee and D.M Datta, An Introduction to Indian Philosophy, University of Calcutta, 1984.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AV	-	-	-	-	-	-	-	-	-	-	-	-	-	-

VII SEMESTER

Department: **Electrical and Electronics Engineering**	Programme: **B.Tech., (EE)**	
Semester: **Seventh**	Subject Category: **PCC**	Semester Exam Type: **TY**

Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA126	**Power System Operation and Control**	3	-	-	3	25	75	100

Prerequisite		
Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explain the significance of monitoring and control of a power system.	Understand
CO2	Explaining load forecast and unit commitment on power system.	Understand
CO3	Explain the modeling and analysis of Real Power and Frequency Control.	Analyse
CO4	Describe and Analyse the economic operation of power system.	Analyse
CO5	Explain the modeling and analysis of Reactive Power and Voltage Control.	Analyse

UNIT-I	**Preliminaries on Power System Operation and Control**	**Periods: 09**
Power scenario in Indian grid - Power system security- Factors affecting system security- Necessity for regulation of system frequency and voltage- P-F and Q-V control structure - Power systems control problems - Different operating states of power Systems- Energy control centres and its functions-Phasor measurement unit - SCADA systems.		**CO1**
UNIT-II	**Load Forecast and Unit Commitment**	**Periods: 09**
Load and load duration curves - Load forecasting - components of system load- classification of load, forecasting of the base load by method of least square fit-Introduction to unit commitments - constraints on unit commitment - unit commitment using priority list method and dynamic programming method.		**CO2**
UNIT-III	**Real Power - Frequency Control**	**Periods: 09**
Power control mechanism of individual machine- Mathematical model of speed governing mechanism- Speed load characteristics of governing mechanism-Regulation of two generators in parallel- Division of power system into control areas-LFC control of a single area; static and dynamic analysis of uncontrolled system- proportional plus integral control of a single area- LFC control of two area system - static and dynamic response-Tie line with frequency bias control of two area.		**CO3**
UNIT-IV	**Economic Operation of Power System**	**Periods: 09**
Statement of economic dispatch problem - input and output characteristics of thermal plant -incremental cost curve - co-ordination equations with losses neglected- solution by iteration- co-ordination equations with loss included - solution of co- ordination equations using Bmn co-efficient (No derivation of Bmn co-efficient) - Base point and participation factors - Special aspects of Emission constrained economic dispatch.		**CO4**
UNIT-V	**Reactive Power – Voltage Control**	**Periods: 09**
Fundamental characteristics of excitation system - Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis - Generation and absorption of reactive power- Methods of voltage control-tap changing transformer - Static VAR compensator sand STATCOMs - comparisons of different types of compensating equipment for transmission systems.		**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:
1. Olle. I. Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition, 2017. 2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016. 3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010. 4. Kothari D.P. and Nagrath I.J., 'Modern Power System Engineering', Tata McGraw-Hill Education, Standard Edition, 2022. 5. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010. 6. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd. New Delhi, 10th reprint, 2010.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	1	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-	1	-
AV	2	2	-	-	-	-	-	-	-	-	-	-	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**Seventh**		Subject Category: **PCC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA127	**Protection and Switchgear**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Select proper earthing and protection scheme for the power system apparatus and components.	Apply
CO2	Demonstrate the principles of Electromagnetic and Static Relays.	Understand
CO3	Analyse the applications of relays for the protection of power components.	Analyse
CO4	Identify Common faults in Transformers and Transmission lines and propose suitable protective schemes.	Apply
CO5	Explain operating principles of various switchgears for power system protection.	Apply

UNIT-I	**Protection Schemes**	**Periods: 09**
Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme		**CO1**
UNIT-II	**Electromagnetic Relays**	**Periods: 09**
Operating principles of relays - Universal relay – Torque equation – R-X diagram –Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.		**CO2**
UNIT-III	**Apparatus Protection**	**Periods: 09**
Current transformers and Potential transformers and their applications in protection schemes -Protection of transformer, generator, motor, bus bars and transmission line.		**CO3**
UNIT-IV	**Static Relays and Numerical Protection**	**Periods: 09**
Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.		**CO4**
UNIT-V	**Circuit Breakers**	**Periods: 09**
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 - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers –Rating and selection of Circuit breakers.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:

1. Sunil S. Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B. Rabindranath and N. Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. ArunIngole, 'Switch Gear and Protection' Pearson Education, 2017.
4. BadriRam, B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
5. Y.G. Paithankar and S.R. Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
6. Ravindra P. Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
7. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G.Chotani, 'Protection and Switchgear' Oxford University Press, 2011.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	1	0.8	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester :**Seventh**		Subject Category: **PCC**				Semester Exam Type: **TY**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA128	**Solid State Drives**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Demonstrate the Electrical drives dynamics and review of motor characteristics.	Understand
CO2	Utilize controlled rectifiers for the speed control of dc motors in different quadrants,	Apply
CO3	Design and Analyse the current and speed controllers for solid state DC motor drives.	Analyse
CO4	Apply power electronic converter for the speed control of Induction Motors.	Apply
CO5	Examine the open loop and closed loop operation of Synchronous Motor drives and gain knowledge of FOC.	Analyse

UNIT-I	**Fundamentals of Electric Drives**	**Periods: 09**
Solid State Electric Drives-Merits over conventional drives, elements, choices; Mechanical characteristics of electrical motors; Components of load torque and mechanical characteristics of different loads; Joint speed – torque characteristics with example. Motor power rating-classes of motor duty, selection of power rating for drive motors with regard to thermal overloading and load variation factors, thermal model of motor for heating and cooling; Steady state stability; Load equalization.		**CO1**
UNIT-II	**Phase Angle Controlled Rectifier DC Drives**	**Periods: 09**
History of DC drives, Ward–Leonard scheme; Speed control of DC motors-constant HP and constant torque operation. Phase angle-controlled rectifier DC Drives –Single phase and three phase semi & full controlled drives – quadrants of operation, waveforms, speed-torque characteristics, related numerical problems. Closed loop control of DC drive- regenerative braking and reversing.		**CO2**
UNIT-III	**DC Chopper Drives**	**Periods: 09**
Class A, B, C, D and E chopper drives- quadrants of operation, options in gate pulse pattern, waveforms, speed-torque curves, related numerical problems. Closed loop control of DC drive- Regenerative braking and reversing.		**CO3**
UNIT-IV	**Induction Motor Drives**	**Periods: 09**
Stator voltage control- principle, slip-torque characteristics, AC voltage controller drive and configurations. Stator frequency control - principle, slip-torque characteristics, cycloconverter drive, and drawbacks. V/f control- principle, slip-torque characteristics, constant HP and constant torque regions. Rotor resistance control- speed-torque characteristics, equivalent chopper resistance. Slip power control schemes- Kramer and Scherbius drives.		**CO4**
UNIT-V	**Synchronous Motor Drives, and FOC Concepts**	**Periods: 09**
Synchronous Motor Drives: Open loop volts/hertz control, true synchronous and self-controlled modes of operations, Marginal angle control. FOC in Induction Motor Drives: Vector control concept; DC motor analogy; Scalar versus vector control, Phasor diagram of vector controller and principle steps; Direct vector control (Rotor flux oriented) in VSI fed Induction motor drive system.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours: 45**

Reference Book:
1. Dubey G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, Second Edition ,2015
2. Krishnan R., “ Electric Motor & Drives: Modelling, Analysis and Control”, Pearson Education, 2015
3. Bimal K Bose, “Modern Power Electronics and AC Drives” Pearson Education, 2016
4. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, McGraw Hill, Second Edition ,2010
5. Pillai S.K., “A First Course on Electrical Drives”., New Age International Publishers, Third Edition, 2013.
6. Muhammad H. Rashid, “Power Electronics: Circuits, Devices and Applications”, Pearson Education, 4th Edition, 2017.

MAPPING OF CO’S WITH PO’S AND PSO’S

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	1	-	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **Seventh**		Subject Category: **PCC**				Semester Exam Type: **LB**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA129	**Power Systems Laboratory**	-	-	4	2	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Model and analyze the performance of the transmission lines.	Analyse
CO2	Perform power flow, short circuit, and stability analysis for any power system network.	Analyse
CO3	Design, and analyze the load frequency control mechanism	Analyse
CO4	Perform optimal scheduling of generators and compute the state of the power system.	Apply
CO5	Understand, analyze, and apply the relays for power system protection.	Apply

Any 12 experiments:		
1.	Computation and modelling of transmission Lines.	**CO1**
2.	Formation of Bus Admittance and Impedance Matrices.	
3.	Power Flow Analysis Using Gauss-Seidel Method.	**CO2**
4.	Power Flow Analysis Using Newton Raphson Method.	
5.	Symmetric and Unsymmetrical Fault Analysis.	
6.	Short circuit studies of Power System.	
7.	Transient Stability Analysis of SMIB System.	
8.	Load – Frequency Dynamics of Single- Area and Two-Area Power Systems.	**CO3**
9.	Numerical Integration of Swing equation	
10.	Economic Dispatch in Power Systems.	**CO4**
11.	Load curve and load duration curve	
12.	Performance and characteristics analysis of over current relay.	**CO5**
13.	Performance and characteristics analysis of over voltage and under voltage relay.	
14.	Testing of CT, PT, and Insulator string.	
15.	Relay Coordination in Radial Feeder Protection Scheme.	

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 60**	**Total Hours:60**

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	3	-	-	1	-	-	-	2	3	2
CO2	3	3	2	3	3	-	-	1	-	-	-	2	3	2
CO3	3	3	2	3	3	-	-	1	-	-	-	2	3	2
CO4	3	3	3	3	3	-	-	1	-	-	-	2	3	2
CO5	3	3	1	3	3	-	-	1	-	-	-	2	3	2
AV	3	3	2	3	3	-	-	1	-	-	-	2	3	2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**Seventh**		Subject Category: **PAC**			Semester Exam Type: **PR**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA130	**Seminar**	-	-	2	1	100	-	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	At the end of the course, the students will be able to independently comprehend advances in Electrical and Electronics Engineering and also be able to prepare presentations and deliver the concepts in a professional group.	Understand

The objective of seminar is to enable the students to carryout individual work and present a seminar on any chosen topic connected with Electrical & Electronics Engineering. The topic shall be chosen in consultation with the Faculty coordinators. Each student is expected to make a critical review of literature and prepare a report on the topic. The students are expected to present a seminar. A departmental committee shall evaluate the performance of the students.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	3	1	3	3	3	3	3	3	2
AV	1	1	1	1	1	3	1	3	3	3	3	3	3	2

Department: **Humanities and Social Sciences**		Programme: **B.Tech., (EE)**						
Semester: Seventh		Subject Category: **PCC**			Semester Exam Type: **LB**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA131	**Professional Ethics**	-	-	2	0	-	-	-
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Outline the ethical and moral principles	Understand
CO2	Explain ethical problems and analyze them	Understand
CO3	Confront moral issues and dilemmas	Understand
CO4	Apply the ethical theories to resolve moral issues	Apply
CO5	Discus major ethical theories	Understand

The course should cover the following topics by way of Seminars, Expert Lectures and Assignments.	
Profession – Morals – Ethics and Moral – Professional Ethics – Ethics and Science. Types of Ethics – Normative Ethics, Meta-Ethics and Applied Ethics.	**CO1**
Ethical problems and analysis – Engineering Ethics – Micro-Ethics, Macro-Ethics. Ethical analysis – Normative Inquiry, Conceptual Inquiry and Factual Inquiry – Case Study.	**CO2**
Moral Dilemmas – definition – examples of moral dilemmas – methodology for resolving moral dilemmas. Kohlberg's theory of moral development – Heinz's dilemma – Gilligan's theory – Case study.	**CO3**
Consensus and Controversy – Authority and Autonomy – Multiple Motives – Safety in Engineering	**CO4**
Ethical Theories – Virtue Ethics: Aristotle and MacIntyre, Utilitarian Ethics: Act Utilitarian and Rule Utilitarian, Duty Ethics and Rights Ethics - Case Study. Engineering as Social Experimentation.	**CO5**

Total Contact Hours: 00	**Tutorial Hours:00**	**Practical Hours: 30**	**Total Hours:30**

Reference Book:

1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw-Hill, 2003
2. Charles B. Fleddermann, Engineering Ethics, Pearson Prentice Hall, New Jersey, 2004.
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, Engineering Ethics – Concepts and Cases, Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	3	-	-	-	2	1	-
CO2	-	-	-	-	-	-	-	3	-	-	-	2	1	-
CO3	-	-	-	-	-	-	-	3	-	-	-	2	1	-
CO4	-	-	-	-	-	-	-	3	-	-	-	2	1	-
CO5	-	-	-	-	-	-	-	3	-	-	-	2	1	-
AV	-	-	-	-	-	-	-	3	-	-	-	2	1	-

VIII SEMESTER

Department: **Electrical and Electronics Engineering**		Programme: B.Tech., (EE)						
Semester: **EIGHTH**		Subject Category: **PAC**				Semester Exam Type: **PR**		
Course Code	Course	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA132	**COMPREHENSIVE TEST**	-	-	-	1	100	-	100
Prerequisite								
Course Outcome	Summarise the fundamental concepts of all the core courses in Electrical and Electronics Engineering							
Students will prepare for objective type questions in all core courses. An end semester examination will be conducted to evaluate the critical thinking of the students and at the standard of national level competitive examinations.								

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
AV	3	2	2	3	3	3	3	3	3	3	3	3	3	3

Department: **Electrical and Electronics Engineering**		Programme: B.Tech., (EE)						
Semester: **EIGHTH**		Subject Category: **PAC**				Semester Exam Type: **PR**		
Course Code	Course	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA133	**INTERNSHIP**	-	-	-	2	100	-	100
Prerequisite	-							
Course Outcome	Discover the practical skills through internship/training at industries.							
The student is required to undergo 'internship' in industry / research laboratory / higher learning institution for a period of at least 6 weeks in a maximum of 3 spells during vacations. Each spell of internship shall be for a period of not less than 2 weeks. The main purpose of internship is to enhance the general professional outlook and capability of the student to advance his chances of improving the career opportunities. The student should get prior approval from the Head of the Department before undertaking the internship and submit a detailed report after completion for the purpose of assessment.								

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
AV	3	2	2	3	3	3	3	3	3	3	3	3	3	3

Department	: **Electrical and Electronics Engineering**	Programme: B.Tech., (EE)							
Semester	: **EIGHTH**	Subject Category: **PAC**				Semester Exam Type: **PR**			
Course Code	Course	Periods/Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EEA134	**PROJECT WORK**	16	-	-	8	40	60	100	
Prerequisite	Proficiency in Electrical and Electronics Engineering.								
Course Outcome	At the end of the course, the students will be able to work in any field of Electrical & Electronics Engineering with analytical, experimental, design and combination of these related to one or more areas.								

In this project work, the team would solve the problem taken up for study. Simulation studies and/or hardware development would be completed and the hardware results will be compared with the simulation results to validate the effectiveness of the developed set up. Necessary inferences have to be drawn from the studies carried out and the same should be presented before the committee members. If the project involves intensive analytical procedure, the analysis has to be completed and suitable comparison to existing methodologies reported in literature should be done to validate the correctness as well as effectiveness of the work. Rigorous review by the committee will be carried out in the process to ascertain whether the work qualifies as a suitable project at the graduate level. Each team is expected to present their work at National/International conferences or at the students' technical symposiums. Team that has come out with novel contribution will be encouraged to publish their work in any referred journals.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	3	3	3	3	3	3	3	3	3
AV	3	2	2	3	3	3	3	3	3	3	3	3	3	3

PROFESSIONAL ELECTIVE
(VI SEMESTER)

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA201	**Electrical Safety and Quality Management**	3	-	-	3	25	75	100
Prerequisite								

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Describe the Indian Electricity (IE) acts and various rules for electrical safety.	Understand
CO2	Expose the electrical safety in residential, commercial and agricultural installations.	Apply
CO3	Identify the electrical safety during installation, testing and commissioning, operation and maintenance.	Apply
CO4	Discus about electrical safety to plants and equipment in hazardous areas.	Apply
CO5	Discus about quality control and management due to powerfactor.	Understand

UNIT-I	**Review of IE Rules and Acts and Their Significance**	**Periods: 09**
Objective and scope– Ground clearances and section clearances– Standards on electrical safety- Safe limits of current, voltage-earthing of system neutral –Rules regarding first aid and firefighting facility.		**CO1**
UNIT-II	**Electrical Safety in Residential, Commercial and Agricultural Installations**	**Periods: 09**
Wiring and fitting–Domestic appliances– Water tap giving shock–Shock from wet wall–Fan Firing shock–Multi-storeyed building–Temporary installations–Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.		**CO2**
UNIT-III	**Safety During Installation, Testing and Commissioning, Operation and Maintenance**	**Periods: 09**
Preliminary preparations–safe sequence–Risk of plant and equipment–Safety documentation–Field quality and safety - Personal protective equipment – Safety clearance notice – Safety precautions – Safe guards CO3for operators– Safety		**CO3**
UNIT-IV	**Electrical Safety in Hazardous Areas**	**Periods: 09**
Hazardous zones–class 0,1 and 2– spark, flashovers and corona discharge and functional requirements– Specifications of electrical plants, equipments for hazardous locations– Classification of equipment enclosure for various hazardous gases and vapours– Classification of equipment/enclosure for hazardous locations.		**CO4**
UNIT-V	**Quality Management**	**Periods: 09**
Total quality control and management–Importance of high load factor– Disadvantages of low power factor – Causes of low P.F.– Power factor improvement– Equipment– Importance of P.F. improvement.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. S. Rao, R.K.Jain, H.L. Saluja, Electrical Safety, Fire Safety Engineering and Safety Management, Khanna Publishers, New Delhi, 1997.
2. Al Winfield, Mary Capelli-Schellpfeffer and Dennis Neitzel, Electrical Safety Hand Book, McGraw Hill Publications, 2018.
3. Martha J. Boss, Gayle Nicoll, Electrical Safety: Systems, Sustainability, and Stewardship, CRC Press, 2014.
4. Peter E. Sutherland, Principles of Electrical Safety, IEEE Press, Wiley, 2015.
5. W. Fordham-Cooper, Electrical Safety Engineering, Newnes, 2002.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	1	2	-	-	-	-	-	1	-
CO2	1	1	1	-	-	1	2	-	-	-	-	-	1	-
CO3	1	1	1	-	-	1	2	-	-	-	-	-	1	-
CO4	1	1	1	-	-	1	2	-	-	-	-	-	1	-
CO5	1	1	1	-	-	1	2	-	-	-	-	-	1	-
AV	1	1	1	-	-	1	2	-	-	-	-	-	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA202	**Digital System Design using VHDL**	3	-	-	3	25	75	100
Prerequisite	Digital circuits							

Course Outcome	Course Outcome Statement	Level
CO1	Compare architecture of different Programmable Logic devices	Understand
CO2	Recall the basic design units of a VHDL model and related syntax.	Understand
CO3	Outline VHDL constructs used in both the synthesis and simulation environments and to build complete logic structures	Understand
CO4	Demonstrate skill needed to build VHDL models for combinational circuits, flip flops, registers and counters	Apply
CO5	Develop VHDL code for synchronous and asynchronous circuits.	Create

UNIT-I	**Programmable Logic Devices**	**Periods: 09**
Digital Hardware-Standard chips, Programmable logic devices- PLA, PAL- advanced PALs, GAL, HCPLD- CPLD and FPGA. Custom chips, ASIC Chips, Gate Arrays. Digital Hardware Design-CAD Tools – Behavioural, structural simulation, Physical design, timing simulation, and chip configuration.		**CO1**
UNIT-II	**VHDL Design Units and Architecture Styles**	**Periods: 09**
Introduction- Design Units in VHDL: Entity, Architecture, Configuration, Packages. Signals and variables. Entity declaration, Architecture-styles: concurrent architecture, signals and variables. Dataflow architecture, Structural description of VHDL-component declaration and component instantiation. Object and Data Types. Behavioural description-concurrent statements, operators, sequential-process- if-then, case, loop, generics.		**CO2**
UNIT-III	**Subprograms and Packages used in VHDL**	**Periods: 09**
Subprograms and packages- functions, procedures, functions, package declaration and package body. Predefined Attributes: value, function and signal kind attributes. Configurations- default, component configuration and entity-architecture pair types. Generics. Aliases, Repetition logic- generate, synthesis-Timing constraints.		**CO3**
UNIT-IV	**Combinational Circuits, Flipflops, Registers and Counters.**	**Periods: 09**
Combinational circuit design using VHDL- Half/Full adder, subtractor, Multiplexers, Demultiplexer, Decoders, Encoders, Code converters. Latches, Flip Flops-JK, SR, T, D Flip Flops, shift register, parallel access shift register, Counters-Binary, BCD, Ring counter, Design Examples-Bus structure and simple processor.		**CO4**
UNIT-V	**Sequential Synchronous/Asynchronous Circuit Design**	**Periods: 09**
Synchronous Sequential Circuits-Design steps-state assignment problem- Finite state machines using CAD tools- MOORE and MEALY type FSM- Examples, Vending Machine. Asynchronous Sequential Circuits- analysis, concept of stable and unstable states, hazards and design example- SR latch and Vending machine controller		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Stephen Brown, ZvonkoVranesic, “Fundamentals of Digital Logic Design with VHDL”, Tata McGraw Hill, Third Edition, 2012.
2. Douglas L.Perry, VHDL Programming by Example, Tata McGraw Hill Fourth Edition, 2002.
3. Charles H. Roth.Jr, Digital Systems Design Using VHDL, Thomson Learning, 2007.
4. Ben Cohen, VHDL Coding Styles and Methodologies, Springer, 2nd Edition, 2005.
5. Stainley Mazor, Patricia Langstraat, A Guide to VHDL, Springer, 2nd Edition, 2007.
6. Website material.Hill 2013.7. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi,9thEdition, 2011.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	2	1	-	-	-	-	-	-	1	2	2
CO2	-	2	2	2	1	-	-	-	-	-	-	1	3	1
CO3	-	2	3	2	2	-	-	-	-	-	-	1	2	1
CO4	-	1	3	3	2	-	-	-	-	-	-	1	2	2
CO5	-	1	2	3	2	-	-	-	-	-	-	1	3	2
AV	-	1.4	2.4	2.4	1.6	-	-	-	-	-	-	1	2.4	1.6

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA203	**Special Electrical Machines**	3	-	-	3	25	75	100
Prerequisite	Basic knowledge in Electrical Machines							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explain the basic concepts of Single-phase machine and its application.	Understand
CO2	Demonstrate various types of stepper motor and apply power converters and logic circuits for speed of stepper motor,	Apply
CO3	Analyze the characteristics and different types of controllers for synchronous reluctance motors and linear motors.	Analyse
CO4	Apply power converter for the development of Brushless dc motors and analyse the characteristics.	Analyse
CO5	Analyze the operation and performance of permanent magnet synchronous motors and their applications	Understand

UNIT-I	**Single Phase Machines**	**Periods: 09**
Principle and construction of split phase motors - Shaded Pole motor - Repulsion motor – Universal motor – unexcited synchronous single-phase motor – AC and DC Servo motor – Linear Induction Motor – Applications.		**CO1**
UNIT-II	**Stepper Motor**	**Periods: 09**
Constructional features-principle of operation-Types of motors– Modes of operation–Drive system and circuit control of Stepper motor –Static and Dynamic Characteristics and Applications.		**CO2**
UNIT-III	**Switched Reluctance Motor**	**Periods: 09**
Constructional details-principles of operation- Torque production–drive circuits–Current regulation–Torque speed characteristics– Speed and torque control– Static observers for rotor position sensing–volt- ampere requirements– Applications		**CO3**
UNIT-IV	**Permanent Magnet Brushless DC Motor**	**Periods: 09**
Commutation in DC motors– Difference between mechanical and electronic commutators– Principle of operation- Construction–drive circuits–Torque and emf equation– Torque and Speed characteristics–sensors and sensor less systems– controllers and applications.		**CO4**
UNIT-V	**Permanent Magnet Synchronous Motor**	**Periods: 09**
Principles of operation–Constructional features– Phasor diagram–torque speed characteristics –torque and emf equations–vector controllers- applications. Doubly Fed Induction Generator–Principle – construction, characteristics and applications.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1.Venkataratnam K, Special Electrical Machines, Universities Press, Hyderabad,3rd Edition 2009.
2. P.P. Acarnley, Stepping Motors, A Guide to Modern theory and practice, Peter Peregrines, London, 2002.
3. A. Hughes, Electric Motors and Drives, Affiliated East-West Press Pvt., Ltd., 2007
4. R.Krishnan, Electric Motor Drives Modeling, Analysis, and Control, Prentice Hall of India
5. R.K.Rajput, Electrical Machines, Laxmi Publications, New Delhi, 2009
6. K.Dhayalini, Special Electrical Machines, Anuradha Publications 2007.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	1	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	2	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	2	-	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	2	-	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA204	**Digital Signal Processing**	3	-	-	3	25	75	100
Prerequisite	Fourier transforms							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Analyze the classifications of signals and systems in the time domains.	Analyse
CO2	Analyze the discrete-time systems using Z- transform	Analyse
CO3	Apply FFT algorithm for computing DFT of discrete signal	Apply
CO4	Design suitable digital FIR filter for the required specifications	Apply
CO5	Analyse the different realization methods for FIR and IIR filters and finite word length effects.	Analyse

UNIT-I	**Discrete Time Signals and Systems**	**Periods: 09**
Basic elements of signal processing-Sampling of analog signals–aliasing–standard discrete time signals -classification of discrete time signals-manipulations on discrete time signals- representation of discrete time signals. Discrete time systems-properties-Linear Time Invariant systems-convolution sum-properties of LTI systems-difference equation representation.		**CO1**
UNIT-II	**Discrete Time System Analysis**	**Periods: 09**
Z-transform–region of convergence – properties of z-transforms- inverse z-transform-difference equation– solution by z-transform- application to discrete systems-interpretation of stability in z domain -stability analysis- convolution.		**CO2**
UNIT-III	**DFT and FFT**	**Periods: 09**
Discrete Fourier Transform-properties - relationship between z- transform and DFT-Frequency analysis of signal using DFT. FFT algorithms-advantages over discrete computation of DFT –radix2 algorithms-Decimation In Time-Decimation In Frequency-Computation of IDFT using FFT.		**CO3**
UNIT-IV	**Design of Digital Filters**	**Periods: 09**
FIR filter design-linear phase FIR filters- Fourier series method-windowing techniques–frequency Sampling techniques. IIR filter design- analog filter design-Butterworth and Chebyshev approximations-digital filter design using impulse invariant technique and bilinear transformation method -warping, pre-warping-Frequency transformation.		**CO4**
UNIT-V	**Filter Implementation and Finite Word Length Effects**	**Periods: 09**
Structures for FIR systems-direct form, cascade and linear phase structures-structures for IIR systems-direct form, parallel, cascade and ladder structures- Representation of numbers-errors resulting in rounding and truncation quantization of filter coefficients-round off effects in digital filter–product quantization error, overflow limit cycle oscillations.		**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", PHI Learning, New Delhi, Fourth Edition, 2008.
2. Alan V. Oppenheim and W. Schafer, "Discrete Time Signal Processing", Prentice Hall of India Pvt. Ltd., 2001
3. Rabiner and Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India Pvt. Ltd., 2001.
4. SanjitK.Mitra, "Digital Signal Processing: A Computer Based Approach", Tata McGraw–Hill, Third Edition, 2005.
5. Emmanuel C. Ifeachor and Barrie W. Jervis, "Digital Signal Processing", Pearson Education, Second Edition, 2002
6. P. Ramesh Babu, "Digital Signal Processing", Scitech Publications, Fourth Edition, 2007.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	3	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	3	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA205	**Fuzzy Logic and Neural Networks**	3	-	-	3	25	75	100
Prerequisite	Set theory & Control systems							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Discus the fundamental concepts of Fuzzy logic	Understand
CO2	Outline the fuzzy relations, rules and inference mechanism and to comprehend fuzzy inference systems for fuzzy modelling and control.	Understand
CO3	Interpret the basic concepts in Neural Networks and applications	Understand
CO4	Interpret associative and competitive neural network architectures and learning algorithms	Understand
CO5	Design Fuzzy Logic and Neural Network applications.	Apply

UNIT-I	**Introduction to Fuzzy Logic Principles**	**Periods: 09**
Introduction to neuro- fuzzy and soft computing. Fuzzy sets-Definitions and Terminology-set operations. Membership function formulation and parameterization. Fuzzy operations: union, intersection and complement. Fuzzy relations, Fuzzy if then rules, Fuzzy Reasoning.		**CO1**
UNIT-II	**Fuzzy Inference Systems**	**Periods: 09**
Fuzzy Inference systems. Mamdami Fuzzy models, Sugeno Fuzzy models, Tsukamato Fuzzy models. Input space partitioning-Brief description of Grid partition, Tree partition and scatter partition. Data clustering techniques-Fuzzy k means and c-means clustering. Fuzzy modelling.		**CO2**
UNIT-III	**Introduction to Artificial Neural Networks**	**Periods: 09**
Fundamentals of Neural Networks –Comparison of a biological neuron and computer. Model of an Artificial Neuron – Neural Network Architectures – Learning Methods. Perceptron learning rule-limitations. Multilayer Perceptron- Back Propagation Algorithms– Variants of Back Propagation Algorithms. RBF networks		**CO3**
UNIT-IV	**Other ANN Architectures**	**Periods: 09**
Types of Associative Memories –Bidirectional Associative Memories – Auto Associative Memory: Architecture, Algorithm and properties. Unsupervised learning- Neural Networks Based On Competition –Maxnet. Kohonens Self Organizing Maps, Learning Vector Quantization.		**CO4**
UNIT-V	**Recent Advances and Applications**	**Periods: 09**
Neuro Fuzzy Modelling- ANFIS architecture- algorithm. Fuzzy control systems design- Fuzzy logic controllers. Neural Networks for Modelling. Fundamentals of Genetic Algorithms– Ant Colony Optimization – Particle Swarm Optimization.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, Fourth edition 2016
2. J.S.R. Jang, C.T. Sun, E. Mizutani, "Neural Fuzzy and Soft Computing – A computational Approach to Learning and Machine Intelligence", Prentice Hall Edition 2002
3. Martin T. Hagam, Howard B. Demuth and Mark Beale, Neural Network Design –Thomson learning, Second Edition 2002.
4. Laurene Fausett, Fundamentals of Neural Network architectures, algorithm and application, Pearson Education 2004.
5. Xin-she-Yang, "Nature Inspired metaheuristic Algorithms", Second Edition, Luniver Press, 2010
6. Gen, M. And Cheng R. "Genetic Algorithm And Engineering Design", John Wiley 1997

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	3	2.8	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA206	**Modern Control Theory**	3	-	-	3	25	75	100
Prerequisite	Linear Control System course (IV Semester).							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Describe the mathematical concepts required for the analysis of dynamical systems modelled in state-space approach.	Understand
CO2	Illustrate the philosophy of modelling of dynamical systems in state-space. Knowledge of varied forms of mathematical model of dynamic systems.	Understand
CO3	Explain the various attributes of a dynamical system like stability, controllability, observability, stabilizability and detectability.	Understand
CO4	Identify asymptotic stability of linear and nonlinear systems using Lyapunov-Krasovakii approach.	Understand
CO5	Synthesize state-feedback controllers for stabilization of unstable or poorly stable system.	Analyse

UNIT-I	**Mathematical Fundamentals for Systems Theory**	**Periods: 09**
Vectors and vector spaces – linear dependence and independence of vectors – basis and span – change of basis – inner product, outer product and cross product of two vectors – norms – orthogonality and orthonormality of two vectors – linear operation of vectors. Matrix properties – rank, trace, inverse, eigen values, eigen vectors, symmetricity, Hermitian matrix – diagonalization of a matrix – singular values. Quadratic functions – definiteness of a matrix – Caley-Hamilton theorem and computation of arbitrary matrix functions using Caley-Hamilton theorem. Linearity and time-invariance (LTI) – Linearization of nonlinear function using Taylor series expansion.		**CO1**
UNIT-II	**Modelling of Dynamical Systems in State-space**	**Periods: 09**
Modelling of physical systems using state-space approach – advantages of state-space approach over transfer function approach. State-space model using physical variable approach for SISO and MIMO systems and phase variable approaches for SISO systems. Development of linear state-space models for nonlinear systems using Taylor series approach. State diagram, state space and state-trajectory. Canonical forms of state-space models for SISO LTI system: controllable, observable canonical forms and diagonal/Jordan's diagonal canonical forms – realization schematic. Similarity transformation of a given system into different canonical forms.		**CO2**
UNIT-III	**Analysis of Dynamical Systems**	**Periods: 09**
Solution of LTI state-equation – state-transition matrix – properties and computational techniques (Laplace transform technique and infinite series method, and similarity transformation approach). Computation of state transition matrix using Caley-Hamilton Theorem and Sylvester interpolation formula. Controllability and Observability – Tests (Kalman's test and Popov-Belavich-Hautus test) – Duality property – stabilizability and detectability properties.		**CO3**
UNIT-IV	**Stability Analysis**	**Periods: 09**
Equilibrium point of linear and nonlinear systems – Internal and BIBO stability. Nonlinear state-space equations - Stability in the sense of Lyapunov for nonlinear systems - Lyapunov and Krasovskii stability theorems. Lyapunov stability criterion for LTI systems (including LTI affine systems as well). Parametric optimization using quadratic cost function for LTI systems.		**CO4**

UNIT-V	Synthesis of Controllers – Observer based and Optimal Controller	Periods: 09
State-feedback control design: Introduction – relationship between pole location in s plane and system performance – control specifications – choice of desired closed loop poles based on dominant pole pair approach from controller specifications – regulation and reference tracking problems. State feedback control – necessary and sufficient condition – computational techniques of state-feedback gain matrix (direct substitution, using similarity transformation and Ackermann's formula). State estimation – Observer design - necessary and sufficient condition – computational techniques of observer gain matrix (direct substitution, using similarity transformation and Ackermann's formula) – Observer-based state-feedback control – separation principle - minimum order observer. Design of Servo systems – State-feedback control with integral error compensation. Optimal control: design of state feedback control using LQR approach.		CO5

Total Contact Hours: 45	Tutorial Hours:00	Practical Hours: 00	Total Hours:45

Reference Book:

1. Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Prentice Hall, 2010.
2. I J Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, 2008.
3. Norman S Nise, "Control Systems Engineering", 7th Edition, Wiley, 2015.
4. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 8^{th} Edition, Pearson, 2018.
5. BiswaNath Datta, "Numerical Methods for Linear Control Systems: Design and Analysis", Elsevier, 2004.
6. John S Bay, "Fundamentals of Linear State Space Systems", McGraw-Hill Series in Electrical Engineering, 1998.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1	-	-	-	-	-	-	-	1	2	2
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CO3	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO4	3	3	1	1	-	-	-	-	-	-	-	1	2	2
CO5	3	3	1	1	-	-	-	-	-	-	-	1	2	2
AV	3	3	1	1	-	-	-	-	-	-	-	1	2	2

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: SIXTH</td><td colspan="3">Subject Category: PEC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA207</td><td>Electric and Hybrid Vehicles</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">Basic Electrical and Electronics Engineering</td></tr>
</table>

Course Outcome	Course Outcome Statement	Level
CO1	Outline the basics of vehicle dynamics.	Understand
CO2	Choose proper energy storage systems for vehicle applications.	Apply
CO3	Identify suitable drive scheme for electric and hybrid vehicles.	Apply
CO4	Design and develop basic schemes of electric vehicles.	Apply
CO5	Design and develop basic schemes of hybrid electric vehicles.	Apply

<table>
<tr><td>UNIT-I</td><td>Introduction</td><td>Periods: 09</td></tr>
<tr><td colspan="2">History of hybrid and electric vehicles - social and environmental importance of hybrid and electric vehicles - impact of modern drive-trains on energy supplies - Fundamentals of vehicle propulsion and Braking: Dynamic Equation-Vehicle Power Plant and Transmission Characteristics-Vehicle Performance- Braking Performance.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td>Battery and Alternative energy sources for EV/HEV</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Battery Types- Parameters-Technical characteristics - modeling - Fuel cells -Types-Fuel cell electric vehicle-super capacitors- ultra capacitors.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td>Electric propulsion system</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Electric drives used in EV/HEV: Induction motor drives-DC motor drives- Permanent magnet motor drives - their Configuration-Control and Applications in EV/HEV</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td>Electric Vehicles (EV)</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Components of EV - advantages - EV transmission configuration: Transmission components-gear ratio-EV motor sizing- EV market.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td>Hybrid Electric Vehicles (HEV)</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Classification- Series and Parallel HEVs-Advantages & disadvantages - Series-Parallel Combination-Internal Combustion Engines: Reciprocating Engines- Gas Turbine Engine- Design of an HEV: Hybrid Drive train- Sizing of Components.</td><td>CO5</td></tr>
</table>

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. Liu, Wei. “Introduction to hybrid vehicle system modeling and control”. John Wiley & Sons, 2015.
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.
4. Mi, Chris, and M. AbulMasrur. Hybrid electric vehicles: principles and applications with practical perspectives. John Wiley & Sons, 2017.
5. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
6. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, Elsevier Publications 2001.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	3	2.8	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SIXTH**		Subject Category: **PEC**				Semester Exam Type: **TY**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA208	**Optimization Techniques**	3	-	-	3	25	75	100

Prerequisite	Differential equations, Integral calculus, Vector algebra and Matrix analysis	
Course Outcome	**Course Outcome Statement**	**Level**
CO1	Describe the classical optimization techniques	Understand
CO2	Explain basic concepts of linear programming	Understand
CO3	Explain the unconstrained nonlinear programming	Understand
CO4	Explain the constrained nonlinear programming	Understand
CO5	Describe the dynamic programming method	Understand

UNIT-I	**Classical optimization Techniques**	**Periods: 09**
Statement of optimization problem – classification of optimization problem - Single variable optimization – multivariable optimization without constraints – multivariable optimization with equlity constraints – solution by Lagrange multipliers – multivariable optimization with inequality constraints – Kuhn-Tucker conditions.		**CO1**
UNIT-II	**Linear Programming**	**Periods: 09**
Introduction – formulation of linear programming problem-graphical method for two variable optimization problems–Motivation of the Simplex method-solving LPP using simplex algorithm – two phase simplex method- Dual Simplex Method.		**CO2**
UNIT-III	**Unconstrained nonlinear programming**	**Periods: 09**
One dimensional minimization - Elimination methods: Fibonacci and Golden section search - Gradient methods - Steepest descent method – Newton's method.		**CO3**
UNIT-IV	**Constrained Non Linear Programming**	**Periods: 09**
Characteristics of a constrained problem – classification – basic approach of penalty function method-basic approaches of interior and exterior penalty function method – Lagrange multipliers – Convergence of constrained optimization problems.		**CO4**
UNIT-V	**Dynamic Programming**	**Periods: 09**
Multi stage decision processes–Concept of sub-optimization and the principle of optimality–computational procedure in dynamic programming–Conversion of final value problem in to Initial value problem-continuous dynamic programming.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. S.S. Rao, "Engineering Optimization; Theory and Practice", Revised 3rd Edition, New Age International Publishers, New Delhi, 2013
2. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
3. R. Panneerselvam, "Operations Research", PHI, 2006
4. Hamdy A Taha, "Operations Research –An Introduction", Prentice Hall India, 2003.
5. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
6. Ronald L. Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	3	2.6	1	-	-	-	-	-	-	-	-	1	1	-

PROFESSIONAL ELECTIVE
(VII SEMESTER)

Department: **Electrical and Electronics Engineering**				Programme: **B.Tech., (EE)**					
Semester: **SEVENTH**		Subject Category: **PEC**				Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EEA209	**Smart Grid**	3	-	-	3	25	75	100	
Prerequisite									

Course Outcome	Course Outcome Statement	Level
CO1	Describe the benefits of smart grid in power systems.	Understand
CO2	Explain rationale for smart grid technology and its characteristics.	Understand
CO3	Identify and discuss smart metering devices and associated technologies.	Apply
CO4	Explain about communication and control capabilities that will optimize the operation of the entire electrical grid.	Understand
CO5	Discus the application of Smart grid in the field of power systems.	Understand

UNIT-I	**Introduction to Smart Grid**	**Periods: 09**
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.		**CO1**
UNIT-II	**Wide Area Monitoring System**	**Periods: 09**
Fundamentals of synchro phasor technology – concept and benefits of wide area monitoring system–Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC)–Road Map for synchro phasor applications (NAPSI)–Operational experience and Blackout analysis using PMU.		**CO2**
UNIT-III	**Smart Meters**	**Periods: 09**
Features and functions of smart meters– Functional specification–category of smart meters– AMR and AMI drivers and benefits– AMI protocol– Demand Side Integration-Peak load, Outage and Power Quality management.		**CO3**
UNIT-IV	**Information and Communication Technology**	**Periods: 09**
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.		**CO4**
UNIT-V	**Smart Grid Applications**	**Periods: 09**
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.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, Smart Grid Technology and Applications, John Wiley & Sons Publication, 2012.
2. James Momoh, Smart Grid Fundamentals of Design and Analysis, Wiley India Pvt. Ltd., 2018.
3. Krzysztof Iniewski, Smart Grid Infrastructure and Networking, McGraw Hill Education (India) Pvt. Ltd., 2014.
4. Fereidoon. P. Sioshansi, Smart grid – integrating renewable, distributed and efficient energy Academic Press, 2011.
5. Stuart Borlase, Smart Grids: Infrastructure, Technology and Solutions, CRC Press Publication, 2013.
6. Smart Grid Primer, Published by Power Grid Corporation of India Limited, September 2013.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	2	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA210	**Renewable Energy**	3	-	-	3	25	75	100
Prerequisite	Basics of power generation and energy resources							
Objective	Renewable energy would provide the knowledge for the deployment of renewable energy sources which are the prime factor for sustainable development.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Examine various conventional and renewable energy sources.	Apply
CO2	Develop solar PV system for different applications.	Apply
CO3	Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system	Analyse
CO4	Discus Geothermal and ocean energy power plants.	Understand
CO5	Explain Bio energy system and related issues.	Understand

UNIT-I	**General Aspects**	**Periods: 09**
Trends in energy scenario- Energy sources and their availability- Commercial energy production- Final energy consumption- Indian energy scenario- Energy conservation and its importance- Salient features of the energy conservation act, 2001- Concept of new and renewable energy.		**CO1**
UNIT-II	**Solar Energy**	**Periods: 09**
Fundamentals of solar energy- Solar radiation - Solar thermal systems- Principle and types of solar collector -Solar water heater- Solar Photovoltaic Systems: Solar cells and their characteristics - PV arrays - Solar PV System - Concentrated Solar PV systems.		**CO2**
UNIT-III	**Wind Energy**	**Periods: 09**
Nature and Power in the wind - Wind Energy Conversion System (WECS) - Components and Classification of a WECS - Yaw and Pitch Control - Wind Turbines - Types - Horizontal and vertical axis wind turbines - Generators for WECS.		**CO3**
UNIT-IV	**Miscellaneous Sources**	**Periods: 09**
Energy from tides and waves - working Principle of tidal plants - tidal power generation -Geothermal energy - principle of working geothermal power plants-Magneto Hydro Dynamic Systems.		**CO4**
UNIT-V	**Bio Energy**	**Periods: 09**
Bio-mass resources - Biofuels- Biochemical conversion- Biomass gasification – Biogas - Biogas plants - Energy recovery from urban waste- Power generation from liquid waste- Biomass Cogeneration.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. D.P. Kothari, K.C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, New Delhi, 2011
2. Khan B H, "Non-Conventional Energy Resources", Tata McGraw-Hill, New Delhi 2010
3. Mukund R Patel, "Wind and Solar Power Systems", CRC Press, New York, 2011.
4. Solanki, Chetan Singh, " Solar Photovoltaics - Fundamentals, Technologies and Applications", PHI, New Delhi, 2015.
5. Bhadra S N, Banerjee S, Kastha D, "Wind Electrical Systems", Oxford University Press, New Delhi, 2008
6. G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, 2003.
7. Roger A. Messenger, "Photovoltaic Systems Engineering", CRC Press, New York, 2010.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	3	2
CO2	3	2	1	-	-	1	3	-	-	-	-	2	3	2
CO3	3	2	1	-	-	1	3	-	-	-	-	2	3	2
CO4	3	2	1	-	-	1	3	-	-	-	-	2	3	2
CO5	3	2	1	-	-	1	3	-	-	-	-	2	3	2
AV	3	2	1	-	-	0.8	2.6	-	-	-	-	2	3	2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**							
Semester:**SEVENTH**		Subject Category: **PEC**				Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks			
		L	T	P	C	CA	SE	TM	
EEA211	**Embedded Systems**	3	-	-	3	25	75	100	
Prerequisite	Microprocessors and microcontrollers								

Course Outcome	Course Outcome Statement	Level
CO1	Explain the hardware functional and software strategies required to develop various Embedded systems.	Understand
CO2	Interpret the basic knowledge of embedded networking and bus Communication in processors	Understand
CO3	Utilize various Embedded system Development Strategies	Apply
CO4	Explain the basic concepts of real time operating system on various processor scheduling algorithms	Understand
CO5	Apply various embedded concepts for developing automation applications	Apply

UNIT-I	**Introduction to Embedded Systems**	**Periods: 09**
Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.		**CO1**
UNIT-II	**Embedded Networking**	**Periods: 09**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.		**CO2**
UNIT-III	**Embedded Firmware Development Environment**	**Periods: 09**
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent model, object oriented model.		**CO3**
UNIT-IV	**RTOS Based Embedded System Design**	**Periods: 09**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines, RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication –synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.		**CO4**
UNIT-V	**Embedded System Application and Development**	**Periods: 09**
Case Study of Washing Machine- Automotive Application- Smart Card System Application-ATM machine –Digital camera		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Peckol, "Embedded system Design", John Wiley & Sons, 2009
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
3. Shibu. K.V, "Introduction to Embedded Systems", McGraw Hill, 2017.
4. Raj Kamal, 'Embedded System-Architecture, Programming, Design', McGraw Hill, 2013.
5. C.R. Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
6. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2012.
7. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufmann Publishers, Third reprint, Harcourt India, 2012.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2	2	1	-	-	-	-	-	-	1	2	2
CO2	-	3	3	2	1	-	-	-	-	-	-	1	3	1
CO3	-	3	3	2	1	-	-	-	-	-	-	1	2	1
CO4	-	2	3	3	1	-	-	-	-	-	-	1	3	1
CO5	1	3	2	3	1	-	-	-	-	-	-	1	2	1
AV	0.4	2.6	2.6	2.4	1	-	-	-	-	-	-	1	2.4	1.2

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA212	**Power Quality**	3	-	-	3	25	75	100
Prerequisite	Fundamentals power system and power electronics							

Course Outcome	Course Outcome Statement	Level
CO1	Comprehend concept of Power Quality & it's issues for various electrical systems	Understand
CO2	Identify the power quality problems, causes and suggest suitable mitigating techniques.	Apply
CO3	Discus the effect of over voltages and suggests suitable mitigating techniques.	Understand
CO4	Illustrate sources of harmonics and understand their effects on power system components with reference to IEEE and IEC standards.	Analyse
CO5	Discuss different techniques for power quality monitoring.	Understand

UNIT-I	**Introduction to Power Quality**	**Periods: 09**	
Terms and Definitions: overloading – under voltage – over voltage. concepts of transients – short duration variations such as interruption – long duration variation such as sustained interruption. sags and swells – voltage sag – voltage swell – voltage imbalance – voltage fluctuation – power frequency variations. IEEE/IEC standards of power quality. Power Acceptability curve (CBEMA)			**CO1**
UNIT-II	**Voltage Sags and Interruptions**	**Periods: 09**	
Sources of sags and interruptions – estimating voltage sag performance – analysis and calculation of various faulted condition - voltage sag due to induction motor starting- estimation of the sag severity – mitigation of voltage sags, active series compensators. static transfer switches and fast transfer switches.			**CO2**
UNIT-III	**Overvoltages**	**Periods: 09**	
Sources of overvoltages – capacitor switching – lightning – ferro resonance. mitigation of voltage swells – surge arresters – low pass filters – power conditioners. lightning protection – shielding – line arresters – protection of transformers and cables. An introduction of recent tools for analysing transients.			**CO3**
UNIT-IV	**Harmonics**	**Periods: 09**	
Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics – harmonics vs transients. Effect of harmonics – harmonic distortion – voltage and current distortion – harmonic indices – inter harmonics – resonance. Harmonic distortion evaluation – devices for controlling harmonic distortion – passive and active filters. IEEE and IEC standards.			**CO4**
UNIT-V	**Power Quality Monitoring**	**Periods: 09**	
Monitoring considerations, historical perspective of power quality measuring instruments, power quality measurement equipment – monitoring and diagnostic techniques for various power quality problems– power line disturbance analyzer – harmonic / spectrum analyzer – flicker meters – disturbance analyser-Applications of expert systems for power quality monitoring.			**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. WayneBeaty, "Electrical Power Systems Quality", McGraw Hill, 2012.
2. Simmi P Burman, Bipin Singh, "Power Quality", Katson books, 2012.
3. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", Wiley, 2011.
4. C. Sankaran, "Power Quality", CRC Press, Taylor & Francis Group, 2017.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	1	1	-	-	-	-	1	1	-
CO2	2	2	1	-	-	1	1	-	-	-	-	1	1	-
CO3	2	2	1	-	-	1	1	-	-	-	-	1	1	-
CO4	2	2	1	-	-	1	1	-	-	-	-	1	1	-
CO5	2	2	1	-	-	1	1	-	-	-	-	1	1	-
AV	2	2	1	-	-	1	1	-	-	-	-	1	1	-

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: SEVENTH</td><td colspan="3">Subject Category: PEC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA213</td><td>High Voltage Direct Current Transmission</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
</table>

Course Outcome	Course Outcome Statement	Level
CO1	Describe the modern trends and planning of HVDC system.	Understand
CO2	Explain the multi terminal HVDC transmission systems.	Apply
CO3	Explicate various control strategy used in the HVDC system.	Analyse
CO4	Explain the HVDC faults and protection	Apply
CO5	Illustrate the reactive power management and harmonics elimination in HVDC systems.	Analyse

<table>
<tr><td>UNIT-I</td><td colspan="2">Introduction to High Voltage Transmission Systems</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="4">Introduction-Historical sketch- Comparison of AC and dc Transmission -Types of HVDC Systems - Components of a HVDC system - Application of DC Transmission- Planning & Modern trends in D.C. Transmission.</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td colspan="2">Multi Terminal HVDC Systems</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="4">Types of MTDC system–Comparison of series and parallel MTDC system–HVDC insulation–DC line insulators – DC breakers – Characteristics and types of DC breakers.</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td colspan="2">Analysis of HVDC Converters</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="4">Line commutated converter; Analysis of Graetz circuit with and without overlap –Pulse number– Choice of converter configuration – Converter bridge characteristics– Analysis of 12 pulse converters– Analysis of VSC topologies and firing schemes.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td colspan="2">HVDC Faults and Protection</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="4">Converter faults, commutation failure–Disturbance caused by over current and over Voltage –Protection against over current and over voltage–Surge arrestors smoothing reactors– Corona effects of DC line – Transient over voltages for DC line– Protection of DC links.</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td colspan="2">Reactive Power and Harmonics in HVDC</td><td colspan="2">Periods: 09</td></tr>
<tr><td colspan="4">Sources of reactive power-static VAR system–Reactive power control during transients– generation of harmonics–Types and design of various AC filters, DC filters–interference- telephone-RI noise.</td><td>CO5</td></tr>
<tr><td>Total Contact Hours: 45</td><td>Tutorial Hours:00</td><td>Practical Hours: 00</td><td colspan="2">Total Hours:45</td></tr>
</table>

Reference Book:

1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers; Fourth edition, 2023.
2. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
3. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.
4. Vijay K. Sood, HVDC and FACTS Controller: Application of Static Converters in Power Systems, IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, First edition January 2004.
5. S. Kamakshaiah and V. Kamaraju, "HVDC Transmission" , McGraw Hill publishers, Second edition, 2020.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	2	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA214	**Digital Control Systems**	3	-	-	3	25	75	100
Prerequisite	Linear Control Systems (IV Semester – core) and Modern Control Systems (V semester – elective); Vector algebra and Matrix analysis; Laplace transform and Fourier transform.							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Interpret the basic concepts of digital control system,z-transform and choice of sampling time plays which are critical in the reconstruction of continuous-time signal from sampled data.	Understand
CO2	Deduce pulse transfer function for a discrete-time system and to discuss how asymptotic stability of discrete-time system can be ascertained.	Analyse
CO3	Analyse the synthesis of controller for a discrete-time control system using classical approaches.	Apply
CO4	Analyse the discrete-time systems and their modelling in state-space approach. Knowledge of the properties of a discrete-time systems modelled in state-space.	Analyse
CO5	Analyse the synthesize state-feedback controllers (via pole-placement and optimal technique) for stabilization of unstable or poorly stable discrete-time system and stabilization of discrete-time systems in the presence of corrupted measurements.	Analyse

UNIT-I	**Introduction**	**Periods: 09**
Introduction to digital control system – sub-systems of a typical digital control system – discrete-time signal – quantizing and quantization error. Impulse sampling and data hold – zero-order hold and first-order hold circuits – A/D and D/A conversion circuits. Z-transform – z-transform of elementary signals – properties of z-transform – important theorems of z-transform – inverse z-transform. Mapping between the s plane and z plane. Reconstruction of continuous-time signals from sampled signals – Shannon's sampling theorem.		**CO1**
UNIT-II	**Analysis using Pulse Transfer Function**	**Periods: 09**
Convolution summation – starred Laplace transformation – pulse transfer function – closed-loop pulse transfer function. Stability analysis of closed-loop discrete-time system using Jury's test and Bilinear transformation (Routh's stability test). Transient and steady-state analysis of discrete-time control system.		**CO2**
UNIT-III	**Controller Synthesis: Classical Approach**	**Periods: 09**
Correlation between root locations in z-plane and time response - design of digital controller in z plane (root-locus approach) and w plane (frequency response approach). PID controllers – proportional, integral and derivative modes – continuous-time PID controller – classical tuning procedures – discretization of continuous-time PID controller - realization.		**CO3**
UNIT-IV	**State-space Approach**	**Periods: 09**
State-space model of discrete-time systems – discretization of continuous-time state-space equation - solution of state equation – state transition matrix and its properties – state space realization and state diagram – pulse transfer function matrix - characteristic equation - Eigen values -Eigen vectors - Similarity transformation. Controllability and observability of Linear Time Invariant (LTI) discrete data systems – tests for controllability and observability. Lyapunov stability analysis of discrete-time systems.		**CO4**

UNIT-V	Controller Synthesis: State-space Approach	Periods: 09
State feedback controller design via pole placement – necessary and sufficient condition for arbitrary pole placement in z plane – State feedback controller synthesis – direct substitution method – similarity transformation approach and Ackermaan formula – deadbeat control technique. Controller design via optimization of a quadratic cost function (DLQR). Observer design and synthesis of observer based state feedback controller.		**CO5**

Total Contact Hours: 45	Tutorial Hours:00	Practical Hours: 00	Total Hours:45

Reference Book:

1. Katsuhiko Ogata, "Discrete-Time Control Systems", Second Edition, Prentice Hall India Learning Private Limited, 2005.
2. Gene F. Franklin, J. David Powell and Michael Workman, "Digital Control of Dynamic Systems", Third Edition, Pearson Education, 2003.
3. M. Sami Fidali and Antonio Visioli, "Digital Control Engineering: Analysis and Design", Elsevier Inc., 2009.
4. Charles L. Phillips and H. Troy Nagle, "Digital Control System: Analysis and Design", Pearson Education International, 1998.
5. Kannan Moudgalya, "Digital Control", Wiley, 2008. 6. Allen R. Stubberud, Gene H. Hostetter Mohammed S. Santina, "Digital Control System Design", Oxford University Press, 1994.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO4	3	3	2	1	-	-	-	-	-	-	-	1	2	1
CO5	3	3	2	1	-	-	-	-	-	-	-	1	2	1
AV	3	3	2	1	-	-	-	-	-	-	-	1	2	1

Department: **Electrical and Electronics Engineering**			Programme: **B.Tech., (EE)**						
Semester: **SEVENTH**			Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course		Period / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EEA215	**Power System Restructuring and Deregulation**		3	-	-	3	25	75	100
Prerequisite	-								

Course Outcome	Course Outcome Statement	Level
CO1	Solve the issues available in restructured power system and can address the problems in deregulated power market.	Understand
CO2	Exposed to the architecture of power markets and the technical challenges such as TTC in the restructured power market	Analyse
CO3	Explore the impact of depreciation on the power components and congestion management in the restructured power market	Apply
CO4	Explain the fundamentals of minimizing the cost of generation sources to meet the power system load	Analyse
CO5	Discuss the structure of electrical tariff and study on the current scenario of the Indian power market.	Analyse

UNIT-I	**Fundamentals of Power Markets**	**Periods: 09**
Fundamental sand structure of Restructured Power Market–Wheeling–Market Power- Power exchange and pool markets-Independent System Operator (ISO)–components- role of ISO- Operating Experiences of Restructured Electricity Markets in various Countries (UK, Australia, Europe, US, Asia).		**CO1**
UNIT-II	**Transmission Challenges**	**Periods: 09**
Transmission expansion in the New Environment–Introduction–Role of transmission planning–Transmission Capacity–Total Transfer Capability (TTC) – Computational procedure - Margins–Available transfer capability (ATC)–Principles–Constraints-Methods to compute ATC.		**CO2**
UNIT-III	**Congestion Management and Ancillary Services**	**Periods: 09**
Concept of Congestion Management–Method store lieve the congestion-Inter and Intra zonal Congestion Management–Generation Rescheduling – Locational Marginal Pricing–Financial Transmission Right-Ancillary Services.		**CO3**
UNIT-IV	**Transmission Pricing**	**Periods: 09**
Transmission pricing methods -Postage Stamp-Contract path-MW-mile– MVA mile– Distribution Factor method–Tracing method- Short run marginal cost (SRMC)–Generator Ramping and Opportunity Costs.		**CO4**
UNIT-V	**Indian Power Market**	**Periods: 09**
Current Scenario – Regions–Salient features of Indian Electricity Act 2003 – Regulatory and Policy development in Indian power Sector – Availability based tariff – Necessity–Working Mechanism – Unscheduled Interchange Rate – Operation of Indian Power Exchange.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. M. Shahidehpour and M. Alomoush, Restructuring Electrical Power Systems, Marcel Decker Inc., 2001.
2. M. Shahidehpour, H. Yamin and Z. Li, Market Operations in Electric Power Systems, John Wiley &Sons, Inc., 2002.
3. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, Operation of Restructured Power Systems, Kluwer Academic Publishers, 2001.
4. L. L. Lai, Power system Restructuring and Regulation, John Wiley sons, 2001.
5. Scholarly Transaction Papers, Utility and Power Exchange web sites.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	2	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA216	**High Voltage Engineering**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explicate the various breakdown mechanisms in Gas, Liquid, and Solid Dielectrics.	Understand
CO2	Explain the methods of generating and measuring High DC, AC, Impulse voltage and currents.	Analyse
CO3	Measure various forms of voltage and current using different methods.	Apply
CO4	Illustrate how over-voltages arise in a power system, and protection against these over-voltages.	Analyse
CO5	Suggest suitable HV testing of Electrical power apparatus as per Standards.	Analyse

UNIT-I	**Electrical Breakdown in Gases, Solids and Liquids**	**Periods: 09**
Ionization processes - Townsend & Streamer theory - the sparking voltage - Paschen's law - Time lag for breakdown - Breakdown in non-uniform fields and corona discharges-Conduction and breakdown in pure and commercial liquids and solids dielectrics and composite dielectrics- Vacuum breakdown-Partial discharge-applications of insulating materials.		**CO1**
UNIT-II	**Generation of High Voltages and High Currents**	**Periods: 09**
Generation of high AC voltages: cascaded transformers. Generation of high DC voltages: Rectifier and Voltage doubler circuits -Cockroft Walton voltage multiplier circuit and its qualitative analysis. Generation of impulse and switching surges: Marx circuit - generation of high impulse current - Tripping and control of impulse generators.		**CO2**
UNIT-III	**Measurement of High Voltages and High Currents**	**Periods: 09**
Measurement of AC, DC impulse and switching surges using sphere gaps - peak voltmeters - potential dividers and high speed CRO - Dielectric loss measurement at power frequency using Schering bridge - Partial discharge measurement: straight detection and balanced detection method.		**CO3**
UNIT-IV	**Over Voltages and Insulation Co Ordinations**	**Periods: 09**
Charge formation in clouds - stepped leader - Lightning surges - causes of over voltages - lightning and switching over voltages - protection against over voltages.		**CO4**
UNIT-V	**High Voltage Testing Practice**	**Periods: 09**
Indian Standards/IEC specification for testing - correction factor - testing of isolators and circuit breakers - testing of cables - power transformers and cables - High voltage laboratory layout - indoor and outdoor laboratories, testing facility requirements - safety precautions in H. V. Labs.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. M.S. Naidu and N. Kamaraju, "High voltage Engineering", Third edition, Tata McGraw Hill publishing company, New Delhi, 2003.
2. E. Kuffel and W.S. Zaengel, "High voltage Engineering Fundamentals", Pergamon Press, Oxford, London, 2004.
3. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers,2007.
4. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers, 1993.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons, 2011.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	1
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	1
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	1
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	1
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	1
AV	2	2	1	-	-	-	-	-	-	-	-	1	1	1

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: **SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA217	**Power System Economics**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Discuss the structure of electrical tariff and the impact of depreciation on the power components	Understand
CO2	Illustrate the concepts and principles of economic dispatch.	Analyse
CO3	Describe the basic concepts of economic operation with non-smooth functions.	Apply
CO4	Explain the fundamentals of minimizing the cost of generation sources to meet the power system load with the aid of computational methods.	Analyse
CO5	Identify economic dispatch and optimal power flow for practical power system test data.	Analyse

UNIT-I	**Economic Considerations**	**Periods: 09**
Cost of electrical energy – Expressions for cost of electrical energy–Capital-interest– Depreciation-Different methods- Factors affecting cost of operation- Number and size of generating units- Importance of high load factor- Importance of power factor improvement- Most economical power factor- Meeting the KW demand on power stations- Power system tariffs – Regions and structure of Indian Power System.		**CO1**
UNIT-II	**Economic Dispatch**	**Periods: 09**
Modelling of Cost Rate Curves – Economic Dispatch Calculation - Losses neglected, with generator Real and Reactive power limits; Losses included- Losses of economy in incremental cost data - Problems - Generator Capability Curve – Effect of Ramping rates – Prohibited Operating Zones- Automatic Load dispatch in Power Systems.		**CO2**
UNIT-III	**Economic Operation**	**Periods: 09**
General loss formula- Evolution of incremental transmission loss rate- Method of calculation of loss coefficients– Systematic development of transmission loss formula- Transmission loss as a function of plant generation– Participation Factor- Non – Smooth Fuel Functions (Quadratic, Valve point loading, CCCP, Multiple Fuel) – Problems-Introduction to Artificial Intelligence Techniques for solving ELD problems		**CO3**
UNIT-IV	**Economic Control**	**Periods: 09**
Inter connected operation - Economic operation of hydro thermal power plants - Gradient approach– Newton's Method-Modelling and solution approach to short term and long-term Hydro-Thermal scheduling problem using Dynamic Programming.		**CO4**
UNIT-V	**Optimal Power Flow and Fundamentals of Markets**	**Periods: 09**
Problem formulation - Cost minimization - Loss minimization - Solution using NLP and successive LP methods– Constraints-DC and AC OPF (Real and Reactive Power Dispatch)–Fundamentals of Markets– Efficiency and Equilibrium-Modelling of consumers and producers bids– Global welfare–Dead Loss.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Allen J Wood and BF Wollen berg, Power Generation, Operation and Control, John Wiley & Sons, New York, 2010
2. Hadi Saadat, Power System Analysis, Second Edition, Tata McGraw Hill Publishers, 2007.
3. Steven Stoft, Power System Economics, John Wiley & Sons, 2000.
4. Daniel S. Kirschen and Goran Strbac, Power System Economics, John Wiley &Sons, Ltd, 2004.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	1	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	2	2	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:**SEVENTH**		Subject Category: **PEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA218	**Utilization of Electrical Energy**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Elucidate the working of various electric lamps and design a good lighting scheme	Understand
CO2	Summarize the various types of electric heating, electric welding and design a heating element	Apply
CO3	Explain the different types of drives and control Schemes using electric motors.	Apply
CO4	Analyse the different electric traction systems and address the recent trends.	Analyse
CO5	Explain the different types of batteries and energy conservation	Apply

UNIT-I	**Illumination**	**Periods: 09**
Introduction - definition and meaning of terms used in illumination engineering –Laws of illumination - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.		**CO1**
UNIT-II	**Heating and Welding**	**Periods: 09**
Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.		**CO2**
UNIT-III	**Electric Drives and Control**	**Periods: 09**
Group drive – Individual drive – selection of motors – starting and running characteristics – Running characteristics - Mechanical features of electric motors – Drives for different industrial applications - Choice of drives – power requirement calculation – power factor improvement.		**CO3**
UNIT-IV	**Electric Traction**	**Periods: 09**
Traction system – Speed time characteristics – Series and parallel control of D.C motors - Open circuited, shunt and bridge transitions – Tractive effort calculation – Electric braking – Tramways and trolley bus – A.C traction and recent trend.		**CO4**
UNIT-V	**Electrolytic Processes**	**Periods: 09**
Electrolysis – polarization factor – preparation work for Electro plating – Tanks and other equipment – Calculation of energy requirements – Methods of charging and maintenance – Ni-iron and Ni- cadmium batteries -Components and materials. Energy Auditing – Energy Conservation techniques for domestic and industrial applications.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited, 1993
2. J.B. Gupta, "Utilisation Electric power and Electric Traction", S.K. Kataria and sons, 2000.
3. R.K. Rajput, "Utilisation of Electric Power", Laxmi publications private Limited., 2007.
4. H. Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.
5. C.L. Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age international Pvt. Ltd., 2003

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	-	-	-	-	-	2	2	2
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	2
CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	2
CO4	2	2	1	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	1	-	-	-	-	-	-	-	-	2	2	2
AV	2	2	1	-	-	-	-	-	-	-	-	2	2	2

OPEN ELECTIVEELECTIVE (OEC)

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:-		Subject Category: **OEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA301	**Power Generation Systems**	3	-	-	3	25	75	100
Prerequisite								
Course Outcome	**Course Outcome Statement**						**Level**	
CO1	Explain the concepts of power generation from various conventional and non-conventional power generation methods.						Understand	
CO2	Explain the process of power generation from thermal and hydro electric plant.						Understand	
CO3	Explain the economic operation of thermal and hydro electric plant.						Understand	
CO4	Explain the process of power generation from Nuclear electric plant.						Understand	
CO5	Explain the concept of non-conventional power plants						Understand	
UNIT-I	**Economics of Generation**						**Periods: 09**	
Load and load duration curve – load, demand and diversity factors – plant capacity and plant use factors – choice of type of generation – choice of size and number of units – cost of energy generated – tariffs.								**CO1**
UNIT-II	**Thermal And Hydro Power Systems**						**Periods: 09**	
Comparison of power systems – classification, typical layout and working of steam, diesel low and high head hydro power plants–pumped storage plants								**CO2**
UNIT-III	**Economic Operation of Steam – Hydro Plants**						**Periods: 09**	
Interconnected operation – division of load in interconnected systems – loss formula coefficients – economic loading of steam power plants and steam hydro power plants.								**CO3**
UNIT-IV	**Nuclear Power Plants**						**Periods: 09**	
Principle of nuclear power generation – location – advantages and disadvantages of nuclear power plants – types of nuclear reactors and their comparison –Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR)– layout of reactors – reactor control – reactor safety – waste disposal-Safety measures for Nuclear Power plants.								**CO4**
UNIT-V	**Non-Conventional Power Plants**						**Periods: 09**	
Basic concepts – principle of working and layout of MHD, solar, wind, tidal, biomass, geothermal power Generation and Fuel Cell power systems.								**CO5**
Total Contact Hours: 45		**Tutorial Hours:00**			**Practical Hours: 00**		**Total Hours:45**	
Reference Book:								

1. V.K Mehta, “Principles of Power Systems”, S. Chand & Company Ltd., New Delhi., 2012.
2. M. L. Soni, P. V. Gupta, U. S. Bhatnagar, “A Course in Electrical Power”, Edition9, Dhanpat Rai, 1987
3. Nag.P.K. K, “Power Plant Engineering”, Tata McGraw Hill, Second Edition, 12th Reprint, 2006.
4. Rai. G.D, “An introduction to Power Plant Technology”, Khanna Publishers, Delhi, Eleventh Reprint,2013

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO2	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	2	2	1	1	-	-	-	-	-	-	-	-	1	-
AV	2	2	1	1	-	-	-	-	-	-	-	-	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester:-		Subject Category: **OEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA302	**System Dynamics**	3	-	-	3	25	75	100
Prerequisite	Differential equations, Integral calculus, Vector algebra and Matrix analysis; Laplace transform.							
Objective	Renewable energy would provide the knowledge for the deployment of renewable energy sources which are the prime factor for sustainable development.							

Course Outcome	Course Outcome Statement	Level
CO1	Illustrate the basic concepts of system attributes, modelling in transfer function and state-space approaches.	Understand
CO2	Model complex mechanical, electrical and electromechanical systems in transfer function and state-space approach.	Understand
CO3	Modelling fluid and thermal systems from first principles and deduce analogies between mechanical, electrical, fluid, and thermal systems.	Understand
CO4	Explain the system variables with respect to time when subjected to standard test signals and sinusoidal steady state analysis.	Understand
CO5	Explain the concept of stability of dynamic systems and to study the tests for ascertaining system stability including Lyapunov approach.	Understand

UNIT-I	**Mathematical Modelling of Dynamic Systems**	**Periods: 09**
Classical Approach: Introduction to System; concept of linearity and time-invariance, causal and non-causal systems. Physics based (first principle) modelling of dynamic systems – simple mechanical systems (translational and rotational systems) – linearization of nonlinear systems. Transfer function approach – open loop and closed-loop systems – poles and zeros – classification of system based on type and order. State-variable Approach: Concept of state-space modelling of dynamic systems in time-domain – state equation and output equation – physical variable approach and phase variable approach for modelling dynamic systems. Derivation of transfer function from state-space model. Advantages of state-space approach over transfer function model.		**CO1**
UNIT-II	**Mechanical, Electrical and Electromechanical Systems**	**Periods: 09**
Modelling of complex mechanical systems (with multiple inputs and outputs (MIMO)) in transfer function and state-space approach. Mathematical modelling of R-L, R-C and R-L-C circuits – complex impedance – MIMO electrical circuits. Analogy between electrical and mechanical systems. Armature control and Field control of DC servo systems.		**CO2**
UNIT-III	**Fluid and Thermal Systems**	**Periods: 09**
Physics based approach for mathematical modelling of liquid level system (with and without sub-system interactions), pneumatic and hydraulic systems. Thermal systems – thermal resistance and thermal capacitances – modelling of temperature control system (first-order). Analogy between fluid and thermal systems.		**CO3**
UNIT-IV	**Time-domain Analysis of Dynamic Systems**	**Periods: 09**
Classical Approach: Standard test signals – transient response analysis of first-order dynamic system – transient response analysis of second order dynamic systems for different damping conditions. Steady state analysis – steady state errors. Steady-state response of an LTI system to sinusoidal input – frequency response phenomenon. State-space Approach: Solution to state equation (homogenous and forced systems) – properties of state transition matrix.		**CO4**

UNIT-V	Stability of Dynamic Systems	Periods: 09
Concept of bounded-input-bounded-output (BIBO) and internal stability – correlation between pole location in *s* plane and impulse response of a system – significance of dominant pole-pair. Routh-Hurwitz stability criterion – relative stability analysis. Eigen values of system matrix and stability. Introduction to Lyapunov stability analysis (energy function approach) – Lyapunov stability analysis of LTI systems (qualitative approach only).		CO5

Total Contact Hours: 45	Tutorial Hours:00	Practical Hours: 00	Total Hours:45

Reference Book:

1. Katsuhiko Ogata, "System Dynamics", Fourth Edition, Pearson Education, 2005
2. Katsuhiko Ogata, "Modern Control Engineering", Fifth Edition, Prentice Hall, 2010.
3. Norman S Nise, "Control Systems Engineering", 7th Edition, Wiley, 2015.
4. Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, "Feedback Control of Dynamic Systems", 8^{th} Edition, Pearson, 2018.
5. Joseph J. Distefano, III, Allen R. Stubberud and Ivan J. Williams, "Feedback and Control Systems", Schaum's Outlines, Second Edition, Tata-McGraw Hill Edition, 2003.
6. Nicolae Lobontiu, "System Dynamics for Engineering Students", Academic Press (Elsevier), 2010.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	2	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO5	3	3	1	-	-	-	-	-	-	-	-	1	2	-
AV	3	2.8	1	-	-	-	-	-	-	-	-	1	2	-

Department: **Electrical and Electronics Engineering**			Programme: **B.Tech., (EE)**						
Semester:-			Subject Category: **OEC**			Semester Exam Type: **TY**			
Course Code	Course		Period / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EEA303	**Fuzzy and Neural Systems**		3	-	-	3	25	75	100
Prerequisite	-								

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explain the fundamental concepts of Fuzzy set theory.	Understand
CO2	Illustrate the Fuzzy inference mechanisms and defuzzification concepts	Understand
CO3	Explain the fundamental concepts of Neural Networks	Understand
CO4	Outline the supervised and unsupervised learning algorithms used in Neural networks	Understand
CO5	Explain the associative memories and Neuro Fuzzy Systems and its applications to Engineering	Understand

UNIT-I	**Fundamental Concepts of Fuzzy Set Theory**	**Periods: 09**
Conventional sets versus fuzzy sets – Basic concepts and definitions. Operation in fuzzy sets– NOT, AND and OR operators. Convexity of fuzzy sets-lamda cuts on fuzzy sets. Membership functions - type's choice and membership value assignment methods.		**CO1**
UNIT-II	**Fuzzy Inference Mechanisms**	**Periods: 09**
Fuzzy relationship –equivalence and tolerance. Fuzzy if then rules– types. Rule based models - Mamdani and TSK models. Defuzzification methods. Fuzzy control systems– Simple and general controllers– applications		**CO2**
UNIT-III	**Introduction to Neural Networks**	**Periods: 09**
Biological neuron- comparison between a biological neuron and a computer- Model of an Artificial Neuron –single and multi-input neurons. Transfer functions-types. Neural Network Architectures – Perceptron learning rule- limitations -linear seperability problem. Multilayer networks.		**CO3**
UNIT-IV	**Supervised and unsupervised learning algorithms**	**Periods: 09**
Optimization techniques. Back propagation algorithm for multi-layer networks– advantages, drawbacks and applications – Variants of Back Propagation Algorithms. RBF networks. Hebbs unsupervised learning rule. Kohonens self-organizing map algorithm		**CO4**
UNIT-V	**Associative memories and Neuro Fuzzy Systems**	**Periods: 09**
Types of Associative Memories –Bidirectional Associative Memories – Auto Associative Memory: Architecture, Algorithm and properties. Neuro-fuzzy systems– Application of neural and fuzzy systems to Engineering.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Timothy. J. Rose, Fuzzy logic with Engineering applications, McGraw Hill1999.
2. Hagen, Demuth and Beale, Neural Network design, Thompson Learning, 2002.
3. K. Vinoth Kumar, R. Saravana Kumar, Neural Networks and Fuzzy Logic, Katson, 2012.
4. Peter E. Sutherl, "Principles of Electrical Safety", IEEE Press, Wiley, 2015.
5. John Yen, Reza Langani, Fuzzy logic, Pearson Education, 1999.
6. S. Rajasekaran, G. A. VijayalakshmiPai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications, PHI, 2017.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	-	-	-	-	-	1	1	-
CO2	1	1	1	-	-	-	-	-	-	-	-	1	1	-
CO3	1	1	1	-	-	-	-	-	-	-	-	1	1	-
CO4	1	1	1	-	-	-	-	-	-	-	-	1	1	-
CO5	1	1	1	-	-	-	-	-	-	-	-	1	1	-
AV	1	1	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: -		Subject Category: **OEC**				Semester Exam Type: **TY**		
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA304	**PLC AND INDUSTRIAL AUTOMATION**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Explicate the Architecture of Industrial Automation and working of Programmable Logic Controllers	Understand
CO2	Choose the components of PLC and addressing the memory	Evaluate
CO3	Perform programs for simple applications using bit logic instructions and timers & counters	Apply
CO4	Use Functions and Function Blocks for Industrial Applications programming	Apply
CO5	Diagnose the Hardware faults, Programming Error, and developing simple application.	Analyse

UNIT-I	**PROGRAMMABLE LOGIC CONTROLLERS**	**Periods: 09**
Evolution of PLC – Sequential and Programmable controllers – Architecture of PLC-PLC Hardware components: I/O modules, CPU, Memory–PLC Programming devices-Memory allocation and Addressing, PLC Scan Cycle.		**CO1**
UNIT-II	**PROGRAMMING PART - I**	**Periods: 09**
Programming Methods: Ladder logic, Instruction list, Sequential function chart- NO/NC & RLO Concept – Bit Logic Instructions - Programming timers and counters using ladder logic – math instructions, Program control instructions.		**CO2**
UNIT-III	**PROGRAMMING PART - II**	**Periods: 09**
Symbolic Name - Local Variables – Function and Function Blocks, Instance Data block, Shared Data Block–Single Instance and Multiple Instance – Analog Signal Processing in PLC – Scaling & Normalising, Program Debugging – Cross references – Call structure – Assignment list – Dependency Structure and Resources, Error Handling OBs.		**CO3**
UNIT-IV	**INDUSTRIAL AUTOMATION**	**Periods: 09**
History of Automation – Architecture of Industrial Automation, Fixed Automation – Programmable Automation – Flexible Automation, Components of Industrial Automation – Sensors.		**CO4**
UNIT-V	**PLCS IN PROCESS AUTOMATION**	**Periods: 09**
Development of control logic for: Planner machine-Skip hoist control-Automatic control of water pump-Air compressor-Conveyor system-Battery operated truck-bottle filling system.		**CO5**

Total Contact Hours: 45	**Tutorial Hours: 00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Frank Petruzella, "Programmable Logic Controllers" McGraw-Hill Education – Fourth Edition, 2010.
2. W. Bolton, "Programmable Logic Controllers" Newnes, Sixth edition 2015.
3. BISWANATH PAUL, "Industrial Electronics and Control Including Programmable Logic Controller", Prentice-Hall of India Private Limited – Third Edition, 2014.
4. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications" PrenticeHall, 2003
5. Jon Stenerson, "Programmable Logic Controllers with ControlLogics", DELMAR Cengage Learning

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	1	-	-	2	-	2	2	2	1	2
CO2	3	3	3	-	2	-	-	1	-	2	3	2	1	3
CO3	3	3	3	-	2	-	-	1	-	2	3	2	1	3
CO4	2	3	1	-	1	-	-	1	-	1	3	1	1	3
CO5	2	3	1	-	2	-	-	1	-	1	3	1	1	3
AV	2.6	2.8	2	-	1.6	-	-	1.2	-	1.6	2.8	1.6	1	2.8

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: -		Subject Category: **OEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA305	**PROCESS CONTROL ENGINEERING**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	Course Outcome Statement	Level
CO1	Build the mathematical model of Simple systems	Apply
CO2	Select the suitable control methods for a particular process	Understand
CO3	Choose the Final control elements for process control	Analyse
CO4	Develop a simple tuning algorithm for PID controller	Apply
CO5	Relate the simple control methods with multi-loop control.	Analyse

UNIT-I	**PROCESS DYNAMICS**	**Periods: 09**
Need for process control – Mathematical model of Flow, Level, and Thermal processes – Interacting and non-interacting systems –Continuous and batch processes –Servo and regulatory operations – Heat exchanger.		**CO1**
UNIT-II	**CONTROL ACTIONS**	**Periods: 09**
Characteristic of on-off, proportional, single speed floating, integral and derivative controllers – PI, PD and PID Control modes –Electronic PID controller – Auto transfer - Reset windup. .		**CO2**
UNIT-III	**FINAL CONTROL ELEMENTS**	**Periods: 09**
PID Tuning – Process reaction curve method – Continuous-cycling method – Damped oscillation method, Introduction to Auto tuning of PID controllers.		**CO3**
UNIT-IV	**CONTROLLER TUNING**	**Periods: 09**
History of Automation – Architecture of Industrial Automation, Fixed Automation – Programmable Automation – Flexible Automation, Components of Industrial Automation – Sensors.		**CO4**
UNIT-V	**MULTILOOP CONTROL**	**Periods: 09**
Methods of process control – Feed-forward control – Ratio control – Cascade control – Inferential control, Introduction to multivariable control– Model Predictive Control		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Myke King, “Process Control: A Practical Approach”, John Wiley & Sons, 2016
2. D. Patranabis, “Principles of Process Control,” Tata McGraw Hill Education, 2012. .
3. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004
4.Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, “Process Dynamics and Control”, Technology & Engineering – 2010.

MAPPING OF CO’S WITH PO’S AND PSO’S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO2	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO3	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO4	3	3	1	-	-	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	-	-	-	-	-	-	1	1	-
AV	3	2.8	1	-	-	-	-	-	-	-	-	1	1	-

Department: **Electrical and Electronics Engineering**		Programme: **B.Tech., (EE)**						
Semester: -		Subject Category: **OEC**			Semester Exam Type: **TY**			
Course Code	Course	Period / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EEA306	**ELECTRIC AND HYBRID VEHICLES**	3	-	-	3	25	75	100
Prerequisite	-							

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Identify the importance of hybrid electric vehicle	Understand
CO2	Explicate the different train topologies and power flow control in electric vehicles	Understand
CO3	Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources	Understand
CO4	Analyse the different types of electric propulsion systems	Analyse
CO5	Choose proper energy storage systems for vehicle applications	Apply

UNIT-I	**INTRODUCTION TO HYBRID ELECTRIC VEHICLES**	**Periods: 09**
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. .		**CO1**
UNIT-II	**ELECTRIC DRIVE-TRAINS**	**Periods: 09**
Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis		**CO2**
UNIT-III	**HYBRID ELECTRIC DRIVE-TRAINS**	**Periods: 09**
Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.		**CO3**
UNIT-IV	**ELECTRIC PROPULSION UNIT**	**Periods: 09**
Introduction to electric components used in hybrid and electric vehicles, Configuration and control- DC Motor Drives, Induction Motor drives, Permanent Magnet Drives, Switched Reluctance Drives.		**CO4**
UNIT-V	**ENERGY STORAGE**	**Periods: 09**
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy Storage and Analysis- Battery, Fuel, Super Capacitor, Hybridization of different energy storage devices, Power Electronic Converter for Battery Charging.		**CO5**

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2 nd Edition, 2003
2. MehrdadEhsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons, 2003

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	-	-	2	-	-	-	-	2	2	2
CO2	2	2	1	-	-	-	2	-	-	-	-	2	2	2
CO3	2	2	1	-	-	-	2	-	-	-	-	2	2	2
CO4	2	2	1	-	-	-	2	-	-	-	-	2	2	2
CO5	2	2	1	-	-	-	2	-	-	-	-	2	2	2
AV	2	2	1	-	-	-	2	-	-	-	-	2	2	2

<table>
<tr><td colspan="2">Department: Electrical and Electronics Engineering</td><td colspan="7">Programme: B.Tech., (EE)</td></tr>
<tr><td colspan="2">Semester: -</td><td colspan="3">Subject Category: OEC</td><td colspan="4">Semester Exam Type: TY</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Course</td><td colspan="3">Period / Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td>L</td><td>T</td><td>P</td><td>C</td><td>CA</td><td>SE</td><td>TM</td></tr>
<tr><td>EEA307</td><td>WIRING, ESTIMATION AND COSTING</td><td>3</td><td>-</td><td>-</td><td>3</td><td>25</td><td>75</td><td>100</td></tr>
<tr><td>Prerequisite</td><td colspan="8">-</td></tr>
</table>

Course Outcome	**Course Outcome Statement**	**Level**
CO1	Discuss basic wiring system and lighting Acessories.	Understand
CO2	Explain the basic protective system used for various consumers.	Understand
CO3	Design a layout for internal wiring for various consumers	Apply
CO4	Attain basic knowledge on the equipments/cables used for external wiring.	Apply
CO5	Prepare an estimate based on market rate and Govt. schedule rate.	Apply

<table>
<tr><td>UNIT-I</td><td>INTRODUCTION</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Wires, Wire Splicing and Termination, Types and Installation of Wiring Systems, Lighting Accessories. Electrical Symbols .</td><td>CO1</td></tr>
<tr><td>UNIT-II</td><td>PROTECTIVE DEVICES</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Introduction, Protective devices used in Residential, Commercial and Industrial buildings for protection of wiring system, Fuse, MCB, MCCB, ELCB/RCCB, RCBO, SPD and other Circuit Breakers. .</td><td>CO2</td></tr>
<tr><td>UNIT-III</td><td>INTERNAL WIRING SYSTEM AND LAMP CIRCUITS</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Design and Drawing of Internal wiring system for various types of Residential, Commercial and Industrial buildings, Electrical layout, Different types of circuits, Light circuit, Power circuit, Sub-main wiring, Main wiring, Single Line diagram. Load Calculation.</td><td>CO3</td></tr>
<tr><td>UNIT-IV</td><td>EXTERNAL WIRING SYSTEM</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Introduction, Different types of Under Ground (UG) Cables, Cable Laying, Electrical Control Panels, Feeder Pillar, External Electrical Distribution System, Single Line Diagram, Load Calculations, General Specifications of Generating Set, Transformer, Circuit Breakers..</td><td>CO4</td></tr>
<tr><td>UNIT-V</td><td>ESTIMATING AND COSTING</td><td>Periods: 09</td></tr>
<tr><td colspan="2">Introduction, Estimating and Costing of Internal and External Wiring System (a) based upon actual measurement and prevailing market rate and rate analysis (b) based upon Government Schedule of rates.</td><td>CO5</td></tr>
</table>

Total Contact Hours: 45	**Tutorial Hours:00**	**Practical Hours: 00**	**Total Hours:45**

Reference Book:

1. Dr. S L Uppal and G C Garg, “Electrical Wiring, Estimating and costing”, Khanna publishers, 6th Edition, 2010.
2. J.B. Gupta, “A Course in Electrical Installation Estimating and Costing”, S K Kataria& Sons, 2013.
3. William E. Steward, T. A. Stubbs, Trevor E. Marks, Steve Clarke, Modern Wiring Practice: Design and Installation, Taylor and Francis, 22 nd Edition, 2012.
4. M. A. Laughton D.F. Warne, “Electrical Engineers Reference Book”, Elsevier, 2002.

MAPPING OF CO'S WITH PO'S AND PSO'S

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	-	-	-	2	-	-	-	-	1	2	-
CO2	1	1	1	-	-	-	2	-	-	-	-	1	2	-
CO3	1	1	1	-	-	-	2	-	-	-	-	1	2	-
CO4	1	1	1	-	-	-	2	-	-	-	-	1	2	-
CO5	1	1	1	-	-	-	2	-	-	-	-	1	2	-
AV	1	1	1	-	-	-	2	-	-	-	-	1	2	-