SCHOOL OF ENGINEERING

SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES

Outcome based Curriculum for

Undergraduate Degree Courses in Engineering & Technology

Department of Electrical Engineering

(1) Vision: Developing Center of Excellence in Electrical Engineering by creating Innovative, Professionally Competent and Research Oriented Engineers for the betterment of Society.

(2) Mission:

- Bring-up professionally competent Engineers in Generation, Transmission and Distribution system.
- To mould ethically sound and socially responsible Electrical Engineers with leadership qualities.
- To inculcate research attitude among students for pursuing higher studies.

(3) Program Educational Preambles (PEO's):

PEO 1: Having successful technical and professional careers in power system, including supportive and leadership roles on multidisciplinary teams.

PEO 2: To acquire, use and develop skills as required for effective professional practices.

PEO 3: Exhibit demonstrable attributes for life-long learning to remain alongside in their profession and be leaders in technologically vibrant society.

(4) Programme Outcomes (PO's) :

PO-01: Engineering Knowledge: An ability to apply knowledge of mathematics, science, engineering fundamentals and electrical engineering concepts to the solution of complex electrical engineering problems.

PO-02: Problem Analysis: An ability to identify, formulate, research literature and analyze complex electrical engineering and related problems to design electrical and electronics system to meet specific social needs using principles of mathematics, natural sciences and engineering sciences.

PO-03: Design/Development of Solution: Design circuits, electrical drive systems, processes and optimal electrical components and solutions for complex electrical engineering problems using their core technical skills with appropriate consideration for public health, safety, cultural, societal, and environmental considerations.

PO-04: Investigation: To investigate complexity in electrical engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data and synthesis of information to derive valid conclusions.

PO-05: Modern Tool Usage: To analyze, identify, formulate and solve hardware and software based computing problems using modern engineering and software tools such as Matlab simulation, C++, Ansys, CAD design of electrical machines and soft computing techniques including resources such as national laboratories and standard data's with an understanding of the limitations.

PO06: The Engineer and Society: An ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PO-07: Environment and Sustainability: Analyze the impact of industrial activities on global warming and finding the sustainable technical solution through independent and reflective learning.

PO-08: Ethics: Apply ethical principles and commit to professional ethics, social responsibilities and norms of electrical and power engineering practice such as IEEE, IE.

PO-09: Individual and Team Work: An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

PO-10: Communication: An ability to communicate effectively, orally as well as in writing, with society at large, and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project Management: Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team, to manage projects in a multidisciplinary environment.

PO-12: Life-Long Learning: An ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

(5) Program Specific Outcomes (PSOs)

PSO-1 Make use of the basic concepts in Electrical Engineering and its specialization to solve the complex problems in power systems, power electronics, control systems, electrical drives and embedded systems and machine learning.

PSO- 2 Analyze suitable controllers and Power converters for the electrical system and drives considering the impact on the society and health**.**

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Department of Electrical Engineering

(6) Programme PO's and PSO's Mapping

			PO 1	PO2	PO3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO10	PO11	PO1 2		
S. No	**Prog ram**	**Courses Category**	Engin eering Know ledge	Prob lem Ana lysis	Design/De velopment of Solution	Investi gation	Mo der n Too l Usa ge	The Engi neer and Soci ety	Enviro nment and Sustain ability	Et hic s	Indiv idual and Tea m Wor k	Commu nication	Projec t Manag ement	Life - Lon g Lear ning	**P S O 1**	**P S O 2**
1	BE(EE)	Humanities and Social Sciences including Management courses	*	*			*	*		*		*		*		
2		Basic Science courses	*	*	*	*	*		*							
3		Engineering Science courses including workshop, drawing, basics of electrical/mecha nical/computer etc.	*	*	*		*							*		
4		Professional core courses	*	*	*	*										
5		Professional Elective courses relevant to chosen specialization/br anch	*	*	*	*	*	*		*	*					
6		Open subjects – Electives from other technical and /or emerging *subjects	*	*	*	*	*	*	*	*	*			*	*	*
7		Project work, seminar and internship in industry or elsewhere		*	*	*		*	*	*	*	*	*	*		*
8		Specific core subject		*	*	*										
9		Mandatory Course (Non credit)						*	*	*	*	*	*	*		

(7) Semester wise PO's and PSO's Mapping

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1 Engineering Knowledge	PO2 Problem Analysis	PO3 Design/Development of Solution	PO4 Investigation	PO5 Modern Tool Usage	PO6 The Engineer and Society	PO7 Environment and Sustainability	PO 8 Ethics	PO9 Individual and Team Work	PO10 Communication	PO11 Project Management	PO12 Life-Long Learning	PSO1	PSO2
Ist - Semester	Mathematics-I	*	*	*	*								*		
	Engineering Physics	*	*		*								*		
	Basic Computer Engineering	*	*	*	*	*			*		*		*		
	Basic Mechanical Engineering	*	*	*	*	*									
	Basic Civil Engineering & Mechanics	*	*	*				*						*	
	Language Lab					*			*	*	*		*		
	Self Study / GD Seminar	*	*	*	*	*			*	*		*	*		
IInd-Semester	Mathematics-II	*	*	*	*								*		
	Engineering Chemistry	*	*	*	*										
	English for Communication	*									*			*	
	Basic Electrical & Electronics Engineering	*	*	*	*										
	Engineering Graphics	*	*	*	*										*
	Manufacturing Practices					*			*	*	*	*	*		
	Industrial Training	*	*	*	*		*	*	*	*		*	*	*	
IIIrd - Semester	Mathematics -III	*	*	*	*										
	Electromagnetic Fields		*	*											
	Electrical Machines – I	*	*	*											
	Analog Electronics	*	*	*											

	Electrical Circuit Analysis	*	*	*	*								*		
	Java Programming	*	*	*	*	*									
	Self study /GD Seminar		*	*		*	*	*	*		*	*	*		
IVth - Semester	Energy, Ecology, Environment & Society						*	*		*				*	
	Digital Electronics	*	*											*	
	Electrical Machines – II	*	*	*											
	Power System-I	*	*	*	*										
	Power Electronics	*	*	*											
	Software Lab I (Circuit Simulator)			*	*	*							*		
Vth - Semester	Control Systems		*	*	*	*									
	Microprocessors		*	*	*			*							
	Electrical Machine Design					*									
	Signal and System		*	*											
	Line Commutated and Active Rectifiers	*	*		*					*				*	
	Electrical Materials	*	*	*	*										*
	Embedded Systems	*	*	*	*										
	Industrial Training-I	*	*	*	*	*	*	*	*	*		*	*		
VIth - Semester	Power Systems – II	*	*	*	*										
	Measurements and Instrumentation	*	*	*	*										
	Electrical and Hybrid Vehicles	*	*	*	*		*	*	*						
	Digital signal procesing	*	*	*	*										
	Industrial Electrical Systems	*	*	*	*			*					*		
	Computer Architecture	*	*	*	*	*				*		*	*		
	Wind and Solar Energy Systems	*	*	*	*	*	*	*							

	Computational Electromagnetics	*	*	*	*	*			*						
	Internet of Things	*		*	*	*		*							
	Power Plant Engineering	*	*	*	*			*		*		*			
	Modern Manufacturing Process		*	*	*	*	*	*					*		
	Minor Project		*	*	*	*	*	*	*	*		*	*		
VIIth - Semester	Power System Protection	*	*	*	*	*	*	*							
	Electrical Drives	*	*	*	*										
	High Voltage Engineering	*	*	*	*			*							
	Power Quality and FACTS	*	*	*	*										
	Image Processing	*	*	*	*	*									
	VLSI Circuits	*	*												
	Evolutionary Techniques	*	*	*	*									*	*
	Data Structures and Algorithms	*	*	*	*	*							*		
	Project Stage -I	*	*	*	*	*	*	*	*		*	*			
	Self Study/GD/ Seminar		*	*	*	*	*	*	*	*	*	*	*		
VIIIth - Semester	Power System Dynamics and Control	*	*	*	*	*									
	Generalised Theory of Electrical Machines														
	HVDC Transmission Systems	*	*	*	*			*		*		*	*		
	Advanced Electric Drives	*	*	*	*									*	*
	Cyber Law and Ethics				*	*				*					*
	Project Management				*		*		*	*	*	*			
	Big data Analysis	*	*		*	*				*					
	Project Stage -II	*	*	*	*	*	*	*	*		*	*			*

I/III/ IV (preferred Semester)	Induction Program						*	*	*	*	*		*		
	NSS/NCC						*	*	*	*	*	*	*		

(8) <u>Structure of Programme</u>: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

<u>[L= Lecture, T = Tutorials, P = Practical's & C = Credits]</u>

Total Credits*= 160

Structure of Undergraduate Engineering program:

S. No.	Course Category	Credits of the EE Curriculum
1.	Humanities and Social Sciences including Management	08
2.	Basic Sciences	17
3.	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.	19
4.	Professional Core Subjects	65
5.	Professional Subjects: Subjects relevant to chosen specialization/branch	17
6.	Open Subjects: Electives from other technical and/or emerging subjects	13
7.	Project work, seminar and internship in industry or elsewhere	21
8.	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	Non-credit
	Total	**160**

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

(9) Scheme of Exanimation (Electrical Engineering) Academic Year 2019-20

I Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-101	Mathematics-I	60	30	10	-	-	100	3		-	3
2	BEBSC- 202	Engineering Physics	60	30	10	30	20	150	2	1	2	4
3	BEESC-203	Basic Computer Engineering	60	30	10	30	20	150	3	-	2	4
4	BEESC-204	Basic Mechanical Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-205	Basic Civil Engineering & Mechanics	60	30	10	30	20	150	3	-	2	4
6	BEHSMC-206	Language Lab	-	-	-	30	10	40	-	-	2	1
7	BELC-107	Self Study / GD Seminar					10	10			2	1
		Total	**300**	**150**	**50**	**150**	**100**	**750**	**13**	**1**	**12**	**20**

II Semester

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEBSC-201	Mathematics-II	60	30	10	-	-	100	3		-	3
2	BEBSC-102	Engineering Chemistry	60	30	10	30	20	150	3		2	4
3	BEHSMC-103	English for Communication	60	30	10	30	20	150	3	-	2	4
4	BEESC-104	Basic Electrical and Electronics Engineering	60	30	10	30	20	150	2	-	2	3
5	BEESC-105	Engineering Graphics	60	30	10	30	20	150	2	1	2	4
6	BEESC-106	Manufacturing Practices	-	-	-	30	10	40	-	-	2	1
7	BELC-207	Industrial Training					10	**10**	**-**	**-**	**2**	**1**
		Total	**300**	**150**	**50**	**130**	**100**	**750**	**13**	**1**	**12**	**20**

III SEMESTER

S. No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/ Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-301	Mathematics -III	60	30	10	-	-	100	3		-	3
2	EEA-302	Electromagnetic Fields	60	30	10	-	-	100	3		-	3
3	EEA-303	Electrical Machines – I	60	30	10	30	20	150	2	1	2	4
4	EEA-304	Analog Electronics	60	30	10	30	20	150	3	-	2	4
5	EEA-305	Electrical Circuit Analysis	60	30	10	30	20	150	2	1	2	4
6	EEA-306	Java Programming	-	-	-	30	20	50	-	-	2	1
7	EEA-307	Self study /GD Seminar	-	-	-	-	50	50	-	-	2	1
TOTAL			**300**	**150**	**50**	**120**	**130**	**750**	**13**	**2**	**10**	**20**

IV SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	BEA-401	Energy, Ecology, Environment & Society	60	30	10	-	-	100	3	-	-	3
2	EEA-402	Digital Electronics	60	30	10	30	20	150	2	1	2	4
3	EEA-403	Electrical Machines – II	60	30	10	30	20	150	3		2	4
4	EEA-404	Power System-I	60	30	10	30	20	150	3	-	2	4
5	EEA-405	Power Electronics	60	30	10	30	20	150	2	1	2	4
6	EEA-406	Software Lab I (Circuit Simulator)	-	-	-	30	20	50	-	-	2	1

7	EEA-407	Industrial Training-I	To be completed during fourth semester break. Its evaluation/credit to be added in fifth semester									
	TOTAL		**300**	**150**	**50**	**150**	**100**	**750**	**13**	**2**	**10**	**20**

V SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	EEA-501	Control Systems	60	30	10	30	20	150	2	1	2	4
2	EEA-502	Microprocessors	60	30	10	30	20	150	2	1	2	4
3	EEA-503	Electrical Machine Design	60	30	10	30	20	150	2	1	2	4
4	EEA-504	Program Elective-I	60	30	10	-	-	100	3	1	0	4
5	EEA-505	Open Elective - I	60	30	10	-	-	100	3	1	0	4
6	EEA-506	Industrial Training-I	-	-	-	150	100	250	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**12**	**5**	**10**	**22**

Program Elective - I	
EEA-504	EEA-504 (A) Signals and Systems
	EEA-504(B) Line Commutated and Active Rectifiers
Open Elective-I	
EEA-505	EEA-505 (A) Electrical Materials
	EEA-504 (B)Embedded Systems

VI SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	EEA-601	Power Systems – II	60	30	10	30	20	150	2	1	2	4
2	EEA-602	Measurements and Instrumentation	60	30	10	30	20	150	2	1	2	4
3	EEA-603	Program Elective-II	60	30	10			100	3	1	0	4
4	EEA-604	Program Elective-III	60	30	10	-		100	3	0	0	3
5	EEA-605	Open Elective - II	60	30	10	-		100	3	0	0	3
6	EEA-606	Minor Project	-	-	-	180	120	300	-	-	4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**13**	**3**	**8**	**20**

Program Elective - II	
EEA-603	EEA-603(A) Electrical and Hybrid Vehicles
	EEA-603 (B)Digital Signal Processing
	EEA-603 (C)Industrial Electrical Systems

Program Elective - III	
EEA-604	EEA-604 (A)Computer Architecture
	EEA-604 (B) Wind and Solar Energy Systems
	EEA-604 (C) Computational Electromagnetics
Open Elective-II	
EEA-605	EEA-605 (A) Internet of Things
	EEA-605 (B)Power Plant Engineering
	EEA-605 (C)Modern Manufacturing Processes

VII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	EEA-701	Power System Protection	60	30	10	30	20	150	3	0	2	4
2	EEA-702	Electrical Drives	60	30	10	30	20	150	3	0	2	4
3	EEA-703	Program Elective-IV	60	30	10	-	-	100	3	0	0	3
4	EEA-704	Open Elective - III	60	30	10	-	-	100	3	0	0	3
6	EEA-705	Project Stage-I	-	-	-	120	80	200	-	-	10	5
7	EEA-706	Self Study/GD/Seminar					200	200	-	-	2	1
	TOTAL		**240**	**120**	**40**	**180**	**320**	**900**	**12**	**0**	**16**	**20**

Program Elective - IV	
EEA-703	EEA-703 (A)High Voltage Engineering
	EEA-703 (B)Power Quality and FACTS
	EEA-703(C) Image Processing

Open Elective-III	
EEA-704	EEA-704 (A)VLSI circuits
	EEA-704 (B) Evolutionary Techniques
	EEA-704(C) Data Structures and Algorithms

VIII SEMESTER

S.No.	Subject Code	Subject Name	Maximum Marks Theory Slot			Maximum Marks (Practical Slot)		Total Marks	Periods/ hour/ week			Credits
			End Sem. Exam.	Mid Tests	Assign-ments/Quiz	End Sem. Practical & Viva	Practical Record /Assignment/ Quiz / Presentation		L	T	P	
1	EEA-801	Power System Dynamics and Control	60	30	10	30	20	150	3	0	2	4
3	EEA-802	Program Elective-V	60	30	10	-	-	100	3	0	0	3
4	EEA-803	Open Elective - IV	60	30	10	-	-	100	3	0	0	3
6	EEA-804	Project Stage-II	-	-	-	240	160	400	-	-	16	8
	TOTAL		**180**	**90**	**30**	**270**	**180**	**750**	**9**	**0**	**18**	**18**

Program Elective - V	
EEA-802	EEA-802 (A)Generalised Theory of Electrical Machines
	EEA-802 (B)HVDC Transmission Systems
	EEA-802(C)Advanced Electric Drives

Open Elective-IV	
EEA-803	EEA-803 (A) Cyber Law and Ethics
	EEA-803 (B) Project Management
	EEA-803 (C) Big data Analysis

(10) Course Content

Semester I
BEBSC-201 Mathematics-II

BEBSC-201	Mathematics-II	3L:0T:0P	3 credits	3Hrs/Week

Preambles

1. To introduce the basic concepts required to understand, construct, solve and interpret differential equations.
2. To teach methods to solve differential equations of various types.
3. To give an ability to apply knowledge of mathematics on engineering problems

Outcomes

The students will be able to:

1. Classify differential equations according to certain features.
2. Solve first order linear equations and nonlinear equations of certain types and interpret the solutions.
3. Understand the conditions for the existence and uniqueness of solutions for linear differential
4. Solve second and higher order linear differential equations with constant coefficients and construct all solutions from the linearly independent solutions
5. Find series solutions about ordinary and regular singular points for second order linear differential equations.
6. Solve initial value problems using the Laplace transform.
7. Solve systems of linear differential equations with methods from linear algebra

Unit - I Ordinary Differential Equations I (6 Hrs):

Differential Equations of First Order and First Degree (Leibnitz linear, Bernoulli's, Exact), Differential Equations of First Order and Higher Degree, Higher order differential equations with constants coefficients, Homogeneous Linear Differential equations, Simultaneous Differential Equations.

Unit-II Ordinary differential Equations II (6 Hrs):

Second order linear differential equations with variable coefficients, Method of variation of parameters, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Unit III Partial Differential Equations (10 Hrs)

Formulation of Partial Differential equations, Linear and Non-Linear Partial Differential Equations, Homogeneous Linear Partial Differential Equations with Constants Coefficients.

Unit IV Functions of Complex Variable (10 Hrs)

Functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, theorem ,Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral

Unit V Vector Calculus (10 Hrs)

Differentiation of Vectors, Scalar and vector point function, Gradient, Geometrical meaning of gradient, Directional Derivative, Divergence and Curl, Line Integral, Surface Integral and Volume Integral, Gauss Divergence, Stokes and Green theorems.

References : -

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig , Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. W. E. Boyce and R. C. Dip Rima, Elementary Differential Equations and Boundary Value Problems, 9th End., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
6. E. L. Inca, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

BEBSC- 202 Engineering Physics

BEBSC- 202	Engineering Physics	2L:1T:0P	3 credits	3Hrs/Week

Preambles:

- A comprehensive, high-quality education in the physical sciences
- A flexible curriculum with multiple concentrations that allows students to tailor their education according to their specific interests
- The opportunity to experience the excitement of scientific discovery through direct participation in faculty research
- An increased awareness of the physical processes in the surrounding world
- The essential knowledge and analytical, mathematical and computational tools with which to pursue post-graduate education in a variety of physics-related and other fields
- The foundation and practical skillsets for eventual success in any of a broad array of careers
- The motivation for a lifelong love of learning

Outcomes

The students will be able to

- Analyze the intensity variation of light due to Polarization, interference and diffraction
- Demonstrate the working principle of lasers
- Explain fundamentals of quantum mechanics and apply to one dimensional motion of particles
- Calculate Q-value of nuclear reactions and describe particle detectors and accelerators
- To solve the classical and wave mechanics problems
- To develop the understanding of laws of thermodynamics and their application in various processes
- To formulate and solve the engineering problems on Electromagnetism

Unit I Relativistic Mechanics: (6 Hrs):

Frame of reference, Inertial & non-inertial frames, Galilean transformations, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Length contraction, Time dilation, Velocity addition theorem, Variation of mass with velocity, Einstein's mass energy relation, Relativistic relation between energy and momentum, Massless particle.

Unit II Solid state & Nuclear physics (10 Hrs):

Free electron theory of metals, Qualitative discussion of Kronig-penny model and origin of energy bands. Intrinsic and Extrinsic Semiconductors. V-I Characteristics of PN junction diode, Zener diode, Hall-effect.

Introduction to Nuclear Physics , Static properties of Nucleus,Nuclear liquid drop model, Nuclear Shell Model, Linear particle accelelerator, Cyclotron, Betatron, Bainbridge mass sprectrograph.

Unit III Quantum Mechanics: (6Hrs):

Introduction to Quantum mechanics, Wave particle duality, Matter waves, Particle velocity, Phase velocity , Group velocity and their relation. Heisenberg's Uncertainty Principle. Time-dependent and time-independent Schrodinger wave equation, Solution to stationary state Schrodinger wave equation for one-Dimensional particle in a box, Compton effect.

Unit IV Wave Optics: (10 Hrs):

Interference :Coherent sources, Interference in uniform and wedge shaped thin films, Newton's Rings and its applications. Fraunhoffer diffraction at single slit and at double slit, Absent spectra, Diffraction grating, Spectra with grating, Dispersive power of grating, Rayleigh's criterion of resolution. Resolving power of grating and Prism.

Unit V Fibre Optics & Lasers: Fibre Optics(10 Hrs):

Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalized frequency, Classification of fibre, Attenuation and Dispersion in optical fibres.

Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's coefficients, Population inversion, Various levels of Laser, Ruby Laser, He-Ne Laser, Laser applications.

Reference Books: -

1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)

3. Optics - Brijlal& Subramanian (S. Chand)
4. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)
5. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)
6. Engineering Physics-Malik HK and Singh AK (McGrawHill)

BEBSC- 202	**Engineering Physics**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments: -

1. To determine the wavelength of sodium light by Newton's ring experiment.
2. To determine the wavelength of different spectral lines of mercury light using plane transmission grating.
3. To determine the energy band gap of a given semiconductor material.
4. To determine the plank's constant with help of photocell.
5 To determine Resolving Power of Telescope.
6 To Study the V-I Charecteristics of P-N Junction diode.
7. To Study the Zener diode characteristics.
8. To determine the dispersive power of prism.

BTEESC-203 Basic Computer Engineering

BTEESC-203	**Basic Computer Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

- Successfully practice computer engineering to serve state and regional industries, government agencies, or national and international industries.
- Work professionally in one or more of the following areas: computer hardware and software design, embedded systems, computer networks and security, system integration, and electronic design automation.
- Achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.
- Maintain and improve their technical competence through lifelong learning, including entering and succeeding in an advanced degree program in a field such as engineering, science, or business.

Outcomes:-

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- an ability to communicate effectively with a range of audiences
- an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Unit –I Computer: (6Hrs):

Definition, Classification, Organization i.e. CPU, register, Memory & Storage Systems, I/O Devices, and System & Application Software. Computer application E-Business, Bio-Informatics, health Care, Remote Sensing & GIS, Meteorology and, Computer Gaming, Multimedia and Animation etc.

Unit –II Introduction to Algorithms (6 Hrs):

Complexities and Flowchart, Introduction to Programming, Categories of Programming Languages, Program Design, Programming Paradigms, Characteristics or Concepts of OOP, Procedure Oriented Programming VS object oriented Programming. Introduction to C, Character Set, Tokens, Precedence and Associativity, Program Structure, Data Types, Variables, Operators, Expressions, Statements and control structures, I/O operations, Array, Functions,

Unit – III Computer System Overview (10 Hrs):

Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of

Operating System. - Computer System Organization- Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

Unit IV Computer Networking (10 Hrs):
Introduction, Goals, OSI Model, Functions of Different Layers. Internetworking Concepts, Devices, TCP/IP Model. Topology, Introduction to Internet, World Wide Web, E• commerce Computer Security Basics: Introduction to viruses, worms, malware, Trojans, Spyware and Anti-Spyware Software, Different types of attacks like Money Laundering, Information Theft, Cyber Pornography, Email spoofing, Denial of Service (DoS), Cyber Stalking, ,Logic bombs, Hacking Spamming, Cyber Defamation, Security measures Firewall,

Unit V Data base Management System (10 Hrs):
Introduction, File oriented approach and Database approach, Data Models, Architecture of Database System, Data independence, Data dictionary, DBA, Primary Key, Data definition language and Manipulation Languages. Cloud computing: definition, cloud infrastructure, cloud segments or service delivery models (IaaS, PaaS and SaaS), cloud deployment models/ types of cloud (public' private, community and hybrid clouds), Pros and Cons of cloud computing

References:

1. Introduction of computers: Peter Norton, TMH
2. Object oriented programming with c++ :E.Balaguruswamy,TMH
3. Object oriented programming in C++: Rajesh k.shukla ,Wiley India
4. Computer network: Andrew Tananbaum,PHI
5. Data base management system,Korth,TMH
6. Operating system-silberschatz and Galvin-Wiley India
7.

BTEESC-203	**Basic Computer Engineering**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiment:-
1. Study of input and output devices of computer systems .
2. Write a program of addition, subtract, multiplication and division by using C.
3. Write a program to check weather a number is prime or not.
4. Study of various types of Operating System.
5. Study and practice of basic Linux commands-ls, cp, mv, rm, chmod kill, ps etc.
6. Design color coding of straight & crossover cable.
7. Installation of oracle 10g. Also create an employee table.

BEESC-204 Basic Mechanical Engineering

BEESC-204	**Basic Mechanical Engineering**	**2L:0T:0P**	**2 credits**	**2Hrs/Week**

Preambles:
- To provide a comprehensive knowledge of basic mechanical systems.
- Basic concepts from mechanical engineering sciences,
- Basic concepts I.C Engine
- Modern engineering tools (machine-tools, laboratory instrumentation, Working principle of steam Engine), and related subjects to design mechanical engineering components

Outcome:
- After successful completion of this course students will able to
- To describe and use basic engineering concepts
- principles and components of mechanical equipment
- measuring & testing method of physical quantities
- Assessment of boiler component.

Unit I Materials (6 Hrs):
Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Alloy steels their applications. Mechanical properties like strength, hardness, toughness ductility, brittleness , malleability etc. of materials , Tensile test- Stress-strain diagram of ductile and brittle materials ,

Unit II Measurement (10 Hrs):
Concept of measurements, errors in measurement, Temperature, Pressure, Velocity, Flow strain, Force and torque measurement, Vernier caliper, Micrometer, Dial gauge, Slip gauge, Sine-bar and Combination set. Production Engineering: Elementary theoretical aspects of production processes like casting, carpentry, welding etc Introduction to Lathe and Drilling machines and their various operations.

Unit III Fluids (6Hrs):
Fluid properties pressure, density and viscosity etc. Types of fluids , Newton's law of viscosity , Pascal's law , Bernoulli's equation for incompressible fluids, Only working principle of Hydraulic machines, pumps, turbines, Reciprocating pumps .

Unit IV Thermodynamics (10Hrs):
Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy.
Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency and performance analysis, natural and artificial draught, steam properties, use of steam tables.

Unit V Reciprocating Machines (10 Hrs) :
Working principle of steam Engine, Carnot, Otto, Diesel and Dual cycles P-V & T-S diagrams and its efficiency, working of Two stroke & Four stroke Petrol & Diesel engines. Working principle of compressor.

References : -
1- Kothandaraman & Rudramoorthy, Fluid Mechanics & Machinery, New Age . 2- Nakra & Chaudhary , Instrumentation and Measurements, TMH.
3- Nag P.K, Engineering Thermodynamics , TMH .
4- Ganesan , Internal Combustion Engines, TMH .
5- Agrawal C M, Basic Mechanical Engineering ,Wiley Publication. 6- Achuthan M , , Engineering Thermodynamics ,PHI.

BEESC-204	**Basic Mechanical Engineering**	**0L:0T:1P**	**2 credits**	**2Hrs/Week**

List of Experiments:-
1- Study of Universal Testing machines.
2- Linear and Angular measurement using, Micrometer, Slip Gauges, Dial Gauge and
3- Study of Lathe Machine.
4- Study of Drilling Machines.
5- Verification of Bernoulli's Theorem.
6- Study of various types of Boilers.
7- Study of different IC Engines.
8- Study of different types of Boilers Mountings and accessories.

BEESC-205 Basic Civil Engineering & Mechanics

BEESC-205	**Basic Civil Engineering & Mechanics**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:
The goal of this Engineering Mechanics course is to expose students to problems in mechanics as applied to plausibly real-world scenarios. Problems of particular types are explored in detail in the hopes that students will gain an inductive understanding of the underlying principles at work; students should then be able to recognize problems of this sort in real-world situations and respond accordingly.

The civil engineering program will serve Connecticut and the nation by providing a quality engineering education that enables students to enter a profession that can improve the civil infrastructure, and economic welfare. Civil engineering program will maintain a strong emphasis on undergraduate education with the goal that our program will be recognized for quality instruction in civil engineering analysis and design

Outcomes:

- Demonstrate knowledge of various surveying methods.
- Conduct a chain survey.
- Conduct a compass survey.
- Conduct levelling survey and be able to do RL calculations.
- Demonstrate knowledge of properties of various building materials.
- Draw free body diagrams and determine the resultant of forces and/or moments.
- Determine the centroid and second moment of area of sections.
- Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.
- Analyse statically determinate planar frames.

Unit I Building Materials & Construction (10 Hrs)
Stones, bricks, cement, lime, timber-types, properties, test & uses, laboratory tests concrete and mortar Materials: Workability, Strength properties of Concrete, Nominal proportion of Concrete preparation of concrete, compaction, curing. Elements of Building Construction, Foundations conventional spread footings, RCC footings, brick masonry walls, plastering and pointing, floors, roofs, Doors, windows, lintels, staircases – types and their suitability

Unit II Surveying & Positioning (10 Hrs):
Introduction to surveying Instruments – levels, theodolites , plane tables and related devices. Electronic surveying instruments etc. Measurement of distances – conventional and EDM methods, measurement of directions by different methods, measurement of elevations by different methods. Reciprocal levelling .

Unit III Basics of Engineering Mechanics covering (10 Hrs):
Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces ,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy

Unit IV Centroid and Centre of Gravity covering (10 Hrs):
Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Unit V Friction covering (10 Hrs):
Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames

Reference Books:

1. S. Ramamrutam & R.Narayanan; Basic Civil Engineering, Dhanpat Rai Pub.
2. Prasad I.B., Applied Mechanics, Khanna Publication.
3. Punmia, B.C., Surveying, Standard book depot.
4. Shesha Prakash and Mogaveer; Elements of Civil Engg & Engg. Mechanics; PHI

BEESC-205	**Basic Civil Engineering & Mechanics**	**0L:0T:2P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. To perform traverse surveying with prismatic compass, check for local attraction and determine corrected bearings and to balance the traverse by Bowditch's rule.
2. To perform leveling exercise by height of instrument of Rise and fall method.
3. To measure horizontal and vertical angles in the field by using Theodolite.
4. To determine (a) normal consistency (b) Initial and Final Setting time of a cement Sample.
5. To determine the workability of fresh concrete of given proportions by slump test or compaction factor test.
6. To determine the Compressive Strength of brick .
7. To determine particle size distribution and fineness modulus of course and fine Aggregate.
8. To verify the law of Triangle of forces and Lami's theorem.
9. To verify the law of parallelogram of forces.
10. To verify law of polygon of forces
11. To find the support reactions of a given truss and verify analytically.
12. To determine support reaction and shear force at a given section of a simply Supported beam and verify in analytically using parallel beam apparatus.
13. To determine the moment of inertia of fly wheel by falling weight method.
14. To verify bending moment at a given section of a simply supported beam.

BEHSMC-206 Language Lab and Seminar

BEHSMC-206	**Language Lab and Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preambles:

This course intends to impart practical training in the use of English Language for Communicative purposes and aims to develop students' personality through language Laboratory.

Outcomes:

The students will be able to communicate effectively ,able to demonstrate ,debate and will be able to develop a impressive personality through learning.

Topics to be covered in the Language laboratory sessions:

1. Introducing oneself, family, social roles.
2. Public Speaking and oral skills with emphasis on conversational practice, extempore speech, JAM(Just a minute sessions), describing objects and situations, giving directions, debate, telephonic etiquette.
3. Reading Comprehension: Intensive reading skills, rapid reading, and reading aloud (Reading material to be selected by the teacher).
4. To write a book review. Standard text must be selected by the teacher.
5. Role plays: preparation and delivery topic to be selected by teacher/faculty.

BELC–207 Self Study / GD Seminar

BELC–207	**Self-Study / GD Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preambles:

To improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

Outcomes:

- Analytical thinking
- Lateral thinking
- constructive argument

- Communication skill
- Presentation of views

Students will discuss the course related and interdisciplinary topics for problem solving. They will improve the mass communication and convincing / understanding skills about subject and their related problem in a group of students.

Semester II

BEBSC-101 Mathematics-I

BEBSC-101	Mathematics-I	3L:0T:0P	3 credits	3Hrs/Week

Preambles:
The objective of this foundational course is to review mathematical concepts already learnt in higher secondary. This course will also introduce fundamentals of mathematical functions, derivatives and aspects of calculus to students. This course deep understanding of matrix, differential equations, Sequences and series, Vector Space as well as a strong sense of how useful the subject can be in other disciplines of learning.

Outcomes:-
Course work is designed to provide students the opportunity to learn key concepts of mathematical functions, key concepts of matrix , Vector Spaces as well as fundamentals and applications of integral calculus.

Unit-I Calculus (10Hrs):
Rolle's theorem, Mean Value theorems, Expansion of functions by Mc. Laurin's and Taylor's for one variable; Taylor's theorem for function of two variables, Partial Differentiation, Maxima & Minima (two variables), Method of Lagrange's Multipliers.

Unit-II Integral (6 Hrs):
Definite Integral as a limit of a sum and Its application in summation of series; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas, Multiple Integral, Change the order of the integration, Applications of multiple integral for calculating area and volumes of the curves.

Unit-III Sequences and series (6 Hrs):
Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Unit-IV Vector Spaces (6 Hrs):
Vector Space,Vector Sub Space, Linear Combination of Vectors, Linearly Dependent, Linearly Independent, Basis of a Vector Space,Linear Transformations.

Unit-V Matrices (10 Hrs):
Rank of a Matrix, Solution of Simultaneous Linear Equations by Elementary Transformation, Consistency of Equation, Eigen Values and Eigen Vectors, Diagonalization of Matrices, Cayley-Hamilton theorem and its applications to find inverse.

References:-

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition

BEBSC-102 Engineering Chemistry

BEBSC-102	Engineering Chemistry	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

1. To acquire knowledge about hardness of water and importance of water in industrial purpose.
2. To understand the concept of molecular spectroscopy.
3. To gain the knowledge of about polymeric material and biodegradable substances.
4. To understand the mechanism of lubricant and properties of lubricant.

Outcomes:

1. Develop innovative methods to produce soft water for industrial use.
2. Identify the structure of unknown / new compounds with the help of spectroscopy.
3. Substitute metal with conducting polymers and produce cheaper biodegradable polymers to reduce environmental pollution.
4. Apply their knowledge for use and protect to industrial and domestic equipment.

UNIT-I Atomic and molecular structure (6Hrs)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. water treatment- Introduction, hardness of water, Units of hardness, disadvantage of hard water, scale and sludge formation in boilers, boilers troubles.

UNIT-II Spectroscopic techniques and applications (10Hrs)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

UNIT-III Intermolecular forces and potential energy surfaces (6Hrs)

Ionic, dipolar and van Der Waals interactions. Lubricant-Introduction, mechanism of lubricant, classification of lubricant, properties of lubricating oils.

UNIT-IV Use of free energy in chemical equilibria (10Hrs)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. High Polymers-Introduction, nomenclature, types of polymerization, classification of polymers, plastics-important, thermo-plastic resins and thermo setting resin,

UNIT-V Periodic properties (10Hrs)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

References:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
   Fundamentals of Molecular Spectroscopy, by C. N. Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.
4. Physical Chemistry, by P. W. Atkins
5. Engineering Chemistry jain&jain
6. Engineering Chemistry shashi chawla.

BEBSC-102	Engineering Chemistry	0L:0T:1P	1 credits	2Hrs/Week

LIST OF EXPERIMENTS:

1. Determination of surface tension and viscosity

2. Determination of chloride content of water
3. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 1.
4. Determine the change of viscosity of given lubricating oil with change in temperature by Redwood Viscometer No. 2.
5. To determine the flash and fire point of given lubricating oil by Cleveland's open cup apparatus.
6. To determine the flash and fire point of given lubricating oil by Abel's closed cup apparatus.
7. To determine the flash and fire point of given lubricating oil by Pensky Marten's apparatus.
8. To determine the total hardness of given water sample by titrating it against EDTA solution using EBT as an indicator.

Laboratory Outcomes:

The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

BEHSMC-103 English for Communication

BEHSMC-103	English for Communication	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

1. To enhance Professional competence in reading, writing, listening and speaking.
2. To modify the tactic of providing information about the language by using several techniques.
3. To minimize the Grammar Translation Method of ELT by replacing it with Direct Learning Method.
4. To Introduce Communicative Method of ELT and focusing the teaching pedagogy to the student-centered learning rather than the teacher-centered learning.
5. To develop the skills to master three major forms of communications which are vital in academic and professional settings namely professional presentations, interviews and group communications respectively.
6. To provide a deep insight of techniques for delivering effective presentations, appealing job interviews, and actively participating in various forms of group communication.

Outcomes :

At the end of this course students will have:

- Ability to design a language component or process to meet desired need within
- Realistic, Constraints such as economic, environmental, social, political, ethical Scenario.
- Ability to analyze the usage of English words in different contexts.
- An understanding of technical and academic articles' comprehension.
- The ability to present oneself at multinational levels knowing the type of different

Standards of English

UNIT-I Identifying Common errors in writing (6 Hrs):

Articles, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Reported Speech: Direct and Indirect, Sentence Structure.

UNIT-II Vocabulary building and Comprehension (6 Hrs)

Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, synonyms, antonyms, Reading comprehension.

UNIT-III Communication: (10 Hrs)

Introduction, Meaning and Significance, Process of Communication, Oral and Written Communication, 7 c's of Communication, Barriers to Communication and Ways to overcome them, Importance of Communication for Technical students, nonverbal communication.

UNIT-IV Developing Writing Skills (10 Hrs)

Planning, Drafting and Editing, Precise Writing, Précis, Technical definition and Technical description. Report Writing: Features of writing a good Report, Structure of a Formal Report, Report of Trouble, Laboratory Report, Progress Report.

UNIT-V Business Correspondence (10 Hrs):
Importance of Business Letters, Parts and Layout; Application, Contents of good Resume, guidelines for writing Resume, Calling/ Sending Quotation, Order, Complaint, E-mail and Tender.

References:-

1. 'Technical Communication : Principles and practice', Meenakshi Raman and Sangeeta Sharma (Oxford)
2. 'Effective Business Communication', Krizan and merrier (Cengage learning)
3. 'Communication Skill, Sanjay Kumar and pushlata, OUP2011
4. "Practical English Usage Michael Swan OUP, 1995.
5. "Exercises in spoken English Parts I-III CIEFL, Hyderabad, Oxford University Press
6. On writing well, William Zinsser, Harper Resource Book 2001.
7. Remedial English Grammar, F.T. Wood,Macmillan2007.

BEHSMC-103	English for Communication	0L:0T:1P	1 credits	2Hrs/Week

List of Experiments:-

1. Listening Comprehension.
2. Pronunciation, Intonation, Rhythm
3. Practicing everyday dialogues in English
4. Interviews.
5. Formal Presentation

BEESC-104 Basic Electrical and Electronics Engineering

BEESC-104	Basic Electrical and Electronics Engineering	2L:0T:0P	2 credits	2Hrs/Week

Preambles:
Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context and to provide students the working knowledge for the analysis of basic DC and AC circuits used in electrical and electronic devices. To impart basic knowledge of electronic devices and digital conversion.

Outcomes

- To understand and analyze basic electric and magnetic circuits
- To study the working principles of electrical machines and power converters.
- To introduce the components of low voltage electrical installations and safety devices.
- To introduce with basic electronics devices and logic gates

Unit-I Electrical circuit elements (10 Hrs):
Electrical circuit elements (R, L and C), Concept of active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, Kirchhoff"s laws, Loop and-delta transformation, nodal methods, Superposition of a theorem, Thevenin theorem, Norton theorem.

Unit-II AC Circuits (10 Hrs):
Representation of Sinusoidal waveforms –Average and effective values, Form and peak factors, Concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of single phase AC Circuits consisting of R, L, C, RL, RC, RLC combinations (Series and Parallel), Apparent, active & reactive power, Power factor, power factor improvement. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit-III Magnetic circuit (6 Hrs)
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. **Components of LT Switchgear:** Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Importance of earthing. Types of Batteries, Important characteristics for Batteries.Elementary calculations for energy consumption and savings, battery backup.

Unit-IV (10 Hrs): Digital Electronics (10 Hrs): Number systems used in digital electronics, decimal, binary, octal, hexadecimal, their complements, operation and conversion, floating point and signed numbers, Demorgan's theorem, AND, OR, NOT, NOR, NAND, EX-NOR, EX-OR gates and their representation, truth table, half and full adder circuits, R -S flip flop, J-K flip flop.
Unit-V Electronic Components And Circuits- (6Hrs)
Introduction to Semiconductors, Diodes, V -I
characteristics, amplifiers,transistors,Bipolar junction transistors (BJT) and their working, introduction to CC, CB & CE transistor configurations, different configurations and modes of operation of BJT, DC biasing of BJT

References: -

1. "Basic Electrical Engineering", Ritu Sahdev,
2. "Electrical Engineering S. Singh, P.V. Prasad,
3. E. Hughes, "Electrical Technology," Pearson Education, 2010.
4. I. J. Nagrath & D. P. Kothari, „Basic Electrical Engineering" TATA McGraw Hill Edu.
5. V. Del Toro, "Electrical Engg Fundamentals," PHI Learning.
6. B. Dwivedi & A. Tripathi "Fundamentals of Electrical Engineering" Wiley India.
7. D. A. Bell, "Electric Circuits," 7th Ed., Oxford Higher Education.
8. Graham Bell: Electronic Devices and Circuits, PHI

BEESC-104	**Basic Electrical and Electronics Engineering**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preambles:
1. Read and demonstrate the rating of basic equipments used in electrical engineering
2. Connections of different components as per the rules
3. Application different components in electrical field

Outcomes
1. Get an exposure to common electrical components and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the usage of common electrical measuring instruments.
4. Understand the basic characteristics of transformers and electrical machines.

List of Experiments: -
1. Verification of Kirchhoff's laws
2. Verification of Superposition and Thevenin Theorem.
3. Measurement of power and power factor in a single phase ac series inductive circuit and study improvement of power factor using capacitor
4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
5. Connection and measurement of power consumption of a fluorescent lamp (tube light).
6. Measurement of power in 3- phase circuit by two wattmeter method and determination of its power factor for star as well as delta connected load.
7. Determination of parameters of ac single phase series RLC circuit
8. To observe the B-H loop of a ferromagnetic material in CRO.
9. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a
10. single phase transformer
11. Determination of efficiency of a dc shunt motor by load test
12. To study running and speed reversal of a three phase induction motor and record speed

in both directions.

13. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.
14. To study the V-I Characteristics of Transistors.
15. To study V-I characteristics of various Diodes.

BEESC-105 Engineering Graphics and Design

BEESC-105	Engineering Graphics and Design	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

1. Increase ability to communicate with people.
2. Learn to sketch and take field dimensions.
3. Learn to take data and transform it into graphic drawings.
4. Learn basic Auto Cad skills.
5. Learn basic engineering drawing formats.
6. Prepare the student for future Engineering positions.

Outcomes:

Student's ability to hand letter will improve.

1. Student's ability to perform basic sketching techniques will improve.
2. Students will be able to draw orthographic projections and sections.
3. Student's ability to use architectural and engineering scales will increase.
4. Students ability to produce engineered drawings will improve
5. Student's ability to convert sketches to engineered drawings will increase.
6. Students will become familiar with office practice and standards.
7. Students will become familiar with Auto Cad two dimensional drawings.
8. Students will develop good communication skills and team work.

UNIT-I Introduction to Engineering Drawing(10 Hrs):

Principles of Engineering Graphics and their significance, usage of Drawing instruments, Lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT-II Orthographic Projections **(10 Hrs):**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of Regular Solids those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale

UNIT-III Sections and Sectional Views of Right Angular Solids (6 Hrs):

Prism, Cylinder, Pyramid, Cone –Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

UNIT-IV Isometric Projections: (6 Hrs):

Principles of Isometric projection –Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

UNIT-V Overview of Computer Graphics: (10 Hrs):

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Objects, Isometric Views of lines, Planes, Simple and compound Solids; Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of Units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance.

References:-

1.Bhatt N.D., Paschal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2.Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3.Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4.Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5.CAD Software Theory and User Manuals

BEESC-105	**Engineering Graphics and Design**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:-

1. Sketching and drawing of geometries and projections based on above syllabus
2. Term work: A min. of 30 hand drawn sketches (on size A4 graphic sketch Book) plus 5 CAD-printouts on size A4 sheets plus 10 sheets of size A2 or 6 sheets of size A1, (50% marks to be allotted for this record + 25% marks for attendance +25%marks for Teachers Assessment

BEESC-106 Manufacturing Practices

BEESC-106	**Manufacturing Practices**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preambles:

1. To understand process of cutting shaping.
2. To understand working principles for various machining processes.
3. To understand construction, working and applications of various machine tools.
4. To learn basic set up, working and applications of a few important non conventional machining processes to get hand on experience on various machine tools.

Outcomes:

1. The students will be able to understand the details about machines used in production.
2. The students will be able to understand the mechanics behind metal cutting.
3. The students will be able to understand the finishing and super finishing processes.
4. The students will be able to understand the Physics of material removal behind the various non-conventional machining processes.

Manufacturing is fundamental to the development of any engineering product. The course on Engineering Workshop Practice is intended to expose engineering students to different types of manufacturing / fabrication processes, dealing with different materials such as metals, ceramics, plastics, wood, glass etc. While the actual practice of fabrication techniques is given more weightage, some lectures and video clips available on different methods of manufacturing are also included.

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing

3. Fitting operations & power tools
4. Carpentry
5. Plastic molding, glass cutting
6. Metal casting
7. Welding (arc welding & gas welding), brazing

List of Experiments:-

1. Carpentry Shop Experiment To Make a T-LAP joint with wood Pieces
2. Machine Shop Experiment To Perform Knurling on Iron Rod
3. Welding Shop (LAP Joint) , Tools, Accessories, Diagram And Explanation
4. Sheet Metal Shop (Square Tray) , Parts, Accessories, Diagram And Explanation
5. Fitting Shop (Make a Joint) , Parts, Accessories, Diagram And Explanation
6. Carpentry Shop (T-Lap Joint) , Cutting Tools, Accessories, Diagram and Explanation
7. Machine Shop (the lathe machine) , Parts, Accessories, Diagram and Explanation

BELC 207 Industrial Training

BELC 207	**Industrial Training**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

- Industrial environment and work culture.
- Organizational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control

Semester III

BEA-301 Mathematics-III

BEA-301	**Mathematics-III**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

To enable the students to apply the knowledge of Mathematics in various engineering fields by making them

- to understand the method of solving algebraic, transcendental equations and to determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
- able to expand the given periodic function defined in the given range in terms of sine and cosine multiple of terms as a Fourier series and to extremise the functional using integration technique and to solve the partial differential equation using different analytical techniques.

Outcomes:

On completion of this course, students will be able to

- Solve field problems in Engineering involving PDEs.
- Use the root finding techniques to solve practical engineering problems.
- To apply the concept of numerical analysis to find the relative strengths and weaknesses of each computation method and know which are most applicable for given problem.
- To apply the analytical technique to express periodic function as a Fourier sine and cosine series.
- Estimate Laplace, Fourier and z transform

Unit I: Numerical Methods: (10 hours) Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Unit II: Numerical Methods: **(7 hours)** Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.,

Unit III: Numerical Methods: (10 hours) Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations, Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Unit IV: Transform Calculus: (10 hours) Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Unit V: Concept of Probability: (5 hours) Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

- Work with plane waves, derive Snell's laws from phase matching, and calculate the reflection and transmission coefficients at the interface of simple media.
- Justify the concepts of electromagnetic waves
- apply complex Poynting theorem to calculate average power

EEA-302 Electromagnetic Fields

EEA-302	**Electromagnetic Fields**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

- To introduce students with different coordinate systems.
- To familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.
- To expose the students to the ideas of electromagnetic waves and structure of transmission line.

Outcomes:

At the end of the course, a student will be able to:

- Recognize different co-ordinate systems
- Interpret phasor Maxwell's equations in differential and integral forms, both in time and frequency domains.
- Work with plane waves, derive Snell's laws from phase matching, and calculate the reflection and transmission coefficients at the interface of simple media.
- Justify the concepts of electromagnetic waves
- apply complex Poynting theorem to calculate average power

Unit I: **Review of Vector Calculus (6 hours):** Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical), vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence a nd curl;integraltheorems of vectors. conversion of a vector from one coordinate system to another.

Unit I: Static Electric Field (6 Hours): Coulomb's law, electric field intensity, electrical field due to point charges. line, surface and volume charge distributions, gauss law and its applications. absolute electric potential, potential difference, calculation of potential differences for different configurations. electric dipole, electrostatic energy and energy density.

Unit III: Conductors, Dielectrics and Capacitance (6 Hours): Current and current density, ohms law in point form, continuity of current, boundary conditions of perfect dielectric materials. permittivity of dielectric materials, capacitance, capacitance of a two wire line, poisson's equation, laplace's equation, solution of laplace and poisson's equation, application of laplace's and poisson's equations.

Unit IV Static Magnetic Fields (12 Hours): Biot-Savart law, ampere law, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, steady magnetic fields produced by current carrying conductors.
Magnetic Forces, Materials and Inductance: Force on a moving charge, force on a differential current element, force between differential current
elements, nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, magnetic circuits, inductances and mutual inductances.

Unit V : Time Varying Fields and Maxwell's Equations (12 Hours): Faraday's law for electromagnetic induction, displacement current, point form of maxwell's equation, integral form of maxwell's equations, motional electromotive forces, boundary conditions.
Electromagnetic Waves: Derivation of wave equation, uniform plane waves, maxwell's equation in phasor form, wave equation in phasor form, plane waves in free space and in a homogenous material, wave equation for a conducting medium, plane waves in lossy dielectrics, propagation in good conductors, skin effect, poynting theorem.

References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik,"Electromagnetism-Theory & applications",PHI Learning Pvt. Ltd, New Delhi,2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G.W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W.J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W.J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E.G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012

EEA-303 Electrical Machines – I

EEA-303	**Electrical Machines – I**	**2L:1T:0P**	**3 credits**	**2Hrs/Week**

Preambles:
The course objectives are:

- Impart a basic knowledge of electrical quantities to understand the impact of technology in a global and societal context and understand the working principle, construction, applications of DC machines, AC machines and transformers.
- Provide working knowledge for the analysis, selection and control of basic DC and AC machines used in electrical devices and application of transformers in transmission and distribution of electric power.

Outcomes:

On completion of the course students will be able to

- Can analyze electric machine performance.
- Operate electric machines, such as motors and generators.
- Predict the behavior of any electrical and magnetic circuits.
- Formulate and solve complex AC, Dc circuits using laws and equations
- Identify the type of electrical machine used for that particular application.
- Realize the requirement of transformers in transmission and distribution of electric power and other applications.

Unit I: Magnetic Fields And Magnetic Circuits (5 Hours): Review of magnetic circuits - mmf, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.
Unit II: Electromagnetic Force And Torque (6 Hours): B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

Unit III: DC Machines (5 Hours): Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit IV: DC Machine - Motoring and Generation (5 Hours): Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed, V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Unit V: Transformers (9 Hours): Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of 1-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers, Cooling of transformers.

References

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
6. Electric Machinery, Ashfaque Hussain,2010

EEA-303 Electrical Machines – I

EEA-303	**Electrical Machines – I**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Suggested List of Experiments (Extendable):

1. To Perform turn ratio and polarity test on 1-phase transformer
2. To perform load test on a 1-phase transformer and plot its load characteristic
3. To perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit and its efficiency and regulation at different load and power factor.
4. To perform Sumpner's test on two 1-phase transformer and determine its efficiency at various load.
5. To analyse open ckt. Characteristics of self excited DC generator

6. To analyse load characteristics of DC compound generator.
7. To perform load test on DC shunt motor.
8. To perform load test on DC series motor.
9. To perform speed control of DC shunt motor.
10. To conduct Swinburne's test on DC machine to determine efficiency when working as generator and motor without actually loading the machine.

EEA-304 Analog Electronics

EEA-304	Analog Electronics	3L:0T:0P	3 credits	2Hrs/Week

Preambles:
1. To give the idea about fundamental properties of semiconductors.
2. Analysis, design, and applications of modern analog circuits using integrated field effect transistor technologies.
3. To empower students to understand the design and working of BJT / FET amplifiers, oscillators and Operational Amplifier.
4. To prepare the students for advanced courses in Communication system Circuit Design.

Outcomes: At the end of this course, Students will
- Demonstrate the use of analog circuit analysis techniques to analyze the operation and behavior of various analog integrated circuits.
- Design, simulate, and demonstrate the layout of Analog circuits.
- Draw the characteristics of transistors.
- Design and analyses of various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Analyse the functioning of OP-AMP and design OP-AMP based circuits.

Unit I: Diode (4 Hours): P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit II: BJT (8 Hours): Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

Unit III: MOSFET circuits (8 Hours): MOSFET structure and I-V characteristics, MOSFET as a switch, MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Unit IV: Differential, Multi-Stage And Operational Amplifiers (8 Hours): Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit V: Linear Applications Of Op-Amp (12 Hours) : Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift), Analog to Digital Conversion.
Nonlinear Applications Of Op-Amp (6 Hours): Hysteretic comparator, zero crossing detector, square-wave and triangular-wave generators, precision rectifier, peak detector.

References:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and
3. applications", McGraw Hill U. S., 1992.
4. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
5. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
6. P.R. Gray, R.G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EEA-304 Analog Electronics

EEA-304	Analog Electronics	0L:0T:1P	1 credits	2Hrs/Week

Suggested List of Experiments (Extendable):

1. V-I characteristics of various Diodes (P-N , Zener, Varactor, Schottky, Tunnel, Photodiode.
2. Characteristics of Transistors (BJT and FET)
3. Design of various clipping and clamping circuits
4. Design of half & full wave rectifier
5. Design & analysis of transistor amplifier in CE, CB & CC configuration.
6. Design & analysis of JFET Amplifier.
7. Design & analysis of MOSFET Amplifier

EEA-305 Electrical Circuit Analysis

EEA-305	Electrical Circuit Analysis	2L:1T:0P	3 credits	2Hrs/Week

Preambles:

To develop problem solving skills and understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior
- Relate pole and zero locations to characteristics of time-domain functions
- Design linear circuits to implement a desired transfer function

Unit I:Network Theorems (10 Hours): Superposition theorem, thevenin theorem, norton theorem, maximum power transfer theorem, reciprocity theorem, compensation theorem, analysis with dependent current & voltage sources, node & mesh analysis, duality & dual networks.

Unit II: Solution of First and Second Order Networks (8 Hours): Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-Ccircuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit III: Sinusoidal Steady State Analysis (8 Hours): Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, ac circuit analysis, effective or rms values, average power and complex power, three-phase circuits, mutual coupled circuits, dot convention in coupled circuits, ideal transformer.

Unit IV: Electrical Circuit Analysis Using Laplace Transforms (8 Hours): Review of laplace transform, analysis of electrical circuits using laplace transform for standard inputs, convolution integral, inverse laplace transform, transformed network with initial conditions, transfer function representation, poles and zeros, frequency response (magnitude and phase plots), series and parallel resonances

Unit V: Two Port Network and Network Functions (6 Hours): Two port networks, terminal pairs, relationship of two port variables, impedance & admittance parameters, transmission and hybrid parameters, interconnections of two port networks.

References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

EEA-305	Electrical Circuit Analysis	0L:0T:1P	1 credits	2Hrs/Week

Suggested List of Experiments (Extendable):

1. To determine node voltages and branch currents in a resistive network.
2. To obtain Thevenin's equivalent circuit of a resistive network.
3. To obtain transient response of a series R-L-C circuit for step voltage input.
4. To Verify Thevenin Theorem.
5. To Verify Superposition Theorem.
6. To Verify Reciprocity Theorem.
7. To Verify Maximum Power Transfer Theorem.
8. To Verify Millman's Theorem.
9. To Determine Open Circuit parameters of a Two Port Network.

EEA-306 Java Programming

EEA-306	Java Programming	0L:0T:1P	1 credits	2Hrs/Week

Preambles:

- programming in the Java programming language,
- knowledge of object-oriented paradigm in the Java programming language,
- the use of Java in a variety of technologies and on different platforms.

Outcomes:

On successful completion of this course, student should be able to:

- to do coding of Java programming language for various programming technologies
- knowledge of the structure and model of the Java programming language,
- use the Java programming language for various programming technologies
- develop software in the Java programming language
- evaluate user requirements for software functionality for analysis, synthesis and evaluation

Suggested List of Experiments (Extendable):

1. Study of circuit simulation software (any one- TINA-PRO/ PSPICE/ CIRCUIT MAKER/ GPSIM/SAPWIN,MATLAB etc).
2. Designing and Simulation of Different Electronics Circuit.
3. Designing and Simulation of Different Network Circuit.
4. Designing and Simulation of Digital Logic Circuit.
5. Designing and fabrication of PCB with circuit simulator
6. Write a Program to show Inheritance and Polymorphism
7. Write a program to show Interfacing between two classes
8. Write a program to Add a Class to a Package
9. Write a program to demonstrate AWT.
10. Write a program to Hide a Class
11. Write a Program to show Data Base Connectivity Using JAVA

12. Write a Program to show “HELLO JAVA ” in Explorer using Applet
13. Write a Program to show Connectivity using JDBC
14. Write a program to demonstrate multithreading using Java.
15. Write a program to demonstrate applet life cycle.

EEA-307 Self study /GD Seminar (Internal Assessment)

EEA-307	Self study /GD Seminar (Internal Assessment)	0L:0T:1P	1 credits	2Hrs/Week

Preambles:

The main objective is to improve the mass communication and convincing/understanding skills of students .And to give the students an opportunity to exercise their rights to express themselves.The evaluation will be done based on their presentation work and group discussion.

Outcomes:

In terms of **content**, students will be able to

Presentation Skills

They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

Discussion Skills

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion

Listening Skills

Students will demonstrate that they have paid close attention to what others say and can respond constructively. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants. They will be able to follow academic discussions, infer meanings that are not overt, and take notes from a discussion or presentation.

Argumentative Skills and Critical Thinking

Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Interdisciplinary Inquiry

Students will be able to reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem.

Engaging with Big Questions

Students will engage with important questions that stimulate discussion and debate.

Studying Major Works

Students will engage with works that are widely held to be significant in the field of study, while recognizing cultural diversity and the ever-changing nature of what is regarded as important.

Semester IV

BEA-401 Energy , Ecology, Environment & Society

BEA-401	**Energy, Ecology, Environment & Society**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:
To enhance the understanding of conventional and non-conventional energy sources and its relationship with the ecology and environment.

Outcomes:

1. To demonstrate knowledge of new and renewable energy and their relationship with ecology & environment.
2. To describe conventional and non-conventional energy scenario with respect to environment.
3. To analyze Synergy between energy and environment, global environment issues.
4. To explain the Environmental Pollution and their effects on environment To apply awareness regarding environmental protection and application of renewable energy.

Unit I Sources of Energy (6 Hrs):
Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydro, nuclear sources.

UNIT-II Segments of Environment: (6 Hrs):
Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation

UNIT-III Air Pollution: (10 Hrs):
Air pollutants, classification, (Primary & secondary Pollutants) Adverse effects of pollutants. Causes of Air pollution chemical, photochemical, Green house effect, ozone layer depletion, acid Rain. Sound Pollution: Causes, controlling measures, measurement of sound pollution (deciblage), Industrial and non – industrial.

UNIT-IV Water Pollution– (10 Hrs):
Water Pollution: Pollutants in water, adverse effects. Treatment of Domestic & Industrial water effluent. Soil Pollution – Soil Profile, Pollutants in soil, their adverse effects, controlling measures.

UNIT-V Society, Ethics & Human values– (10 Hrs):
Impact of waste on society. Solid waste management Nuclear, Thermal, Plastic, medical, Agriculture, domestic and e-waste). Ethics and moral values, ethical situations, objectives of ethics and its study . Preliminary studies regarding Environmental Protection Acts , introduction to value education, self exploration, sanyam & swasthya.

References:-

1. Harris, CE, Prichard MS, Rabin's MJ, "Engineering Ethics"; Cengage Pub.
2. Rana SVS ; "Essentials of Ecology and Environment"; PHI Pub.
3. Raynold, GW "Ethics in information Technology"; Cengage.
4. Svakumar; Energy Environment & Ethics in society; TMH
5. AK De "Environmental Chemistry"; New Age Int. Publ.
6. BK Sharma, "Environmental Chemistry" ; Goel Publ. House.
7. Bala Krishnamoorthy; "Environmental management"; PHI
8. Gerard Kiely, "Environmental Engineering" ; TMH 9. Miller GT JR; living in the Environment Thomson/cengage
9. Cunninghan WP and MA; principles of Environment Sc; TMH
10. Gandhiji M.K.- My experiments with truth

EEA-402 Digital Electronics

EEA-402	**Digital Electronics**	**2L:1T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
- To impart design of Digital Circuits.

Outcomes:

At the end of the course, a student will be able to:

- Convert different type of codes and number systems which are used in digital communication and computer systems.
- Employ the codes and number systems converting circuits and Compare different types of logic families
- Analyze different types of digital electronic circuit using various mapping and logical tools
- Design different types of with and without memory element digital electronic circuits for particular operation,

Unit-1: Fundamentals of Digital Systems And Logic Families (10Hours): Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit-II: Combinational Digital Circuits (10Hours): Standard representation for logic functions, K-map representation, and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator ,parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit-III: Sequential Circuits And Systems (8Hours): A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flip flops, Applications of flip flops, shift registers, applications of shift registers, series to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit-I: A/D and D/A Converters (7Hours): Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D Converter ICs

Unit-V: Semiconductor memories and Programmable logic devices. (7Hours): Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex**,** Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

EEA-402	Digital Electronics	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments (Extendable):

1. To test and study of operation of all logic Gates for various IC's.
2. Implementation of AND, OR, NOT, NOR, X-OR and X-NOR Gates by NAND and NOR Universal gates.
3. Binary Addition by Half Adder and Full Adder circuit.
4. Binary Subtraction by Half Subtractor and Full Subtractor circuit.
5. Design a BCD to Excess-3 code converter.
6. Verification of the Demorgan's Theorem.
7. Multiplexer/Demultiplexer based Boolean function realization.

EEA-403 Electrical Machines – II

EEA-403	Electrical Machines – II	3L:0T:0P	3 Credits	3Hrs/Week

Preambles:
To impart the fundamental knowledge of AC machines. Students will be able to develop their ability to apply the specific procedures for comprehensive treatment of rotating machines. To provide foundation in the field of manufacturing, testing, operation and control.

Outcomes:
At the end of the Course, the student will be able to:

- Demonstrate the basics of synchronous and induction machines and will analyze regulation and speed control of synchronous machines by different methods
- analyze, select, and control electric machines that are important in today's industry
- Analyze the performance characteristics of the different types of Induction and synchronous machines using different methods and tests
- Learn to draw equivalent circuit & circle diagram and phasor diagram
- to formulate, analyze and demonstrate of induction machines
- Demonstrate the necessity of starters ,speed control & braking for 3 phase IM

Unit-I: Fundamentals of AC Machine Windings (8 Hours): Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3d visualization of the above winding types, air-gap mmf distribution with fixed current through winding-concentrated and distributed, sinusoidally distributed winding, winding distribution factor

Unit-II: Pulsating and Revolving Magnetic Fields (4 Hours): Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, magnetic field produced by a single winding - fixed current and alternating current pulsating fields produced by spatially displaced windings, windings spatially shifted by 90 degrees, addition of pulsating magnetic fields, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit-III: Induction Machines (12 Hours): Construction, types (squirrel cage and slip-ring), torque slip characteristics, starting and maximum torque, equivalent circuit. phasor diagram, losses and efficiency, effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency), methods of starting, braking and speed control for induction motors, generator operation, self-excitation, doubly-fed induction machines.

Unit-IV: Single-Phase Induction Motors (6 Hours): Constructional features double revolving field theory, equivalent circuit, and determination of parameters, split-phase starting methods and applications

Unit-V: Synchronous Machines (12 Hours): Constructional features, cylindrical rotor synchronous machine - generated emf, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation, operating characteristics of synchronous machines, v-curves, salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics, parallel operation of alternators - synchronization and load division.

References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

EEA-403 Electrical Machines – II

EEA-403	**Electrical Machines – II**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments (Extendable):

11. To perform No-load and block rotor test on a 3- phase IM and determine its equivalent circuit.
12. To Perform load test on a 3- phase IM and plot its performance characteristics.
13. Study of various types of starters used for 3- IMs.
14. To determine regulation of alternator using mmf and zpf methods.
15. To synchronise alternator with infinite bus bar.
16. To plot V and inverted V curves for a synchronous motor.
17. To find Xd and Xq of salient pole synchronous machine by slip test.

EEA-404 Power System – I

EEA-404	**Power System – I**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

To introduce the students about the general structure of the network for transferring power from generating stations to the consumers. The different electrical & mechanical aspects of the power network along with its environmental and safety constraint and the price structure of Indian power market.

Outcomes:

At the end of the course, a student will be able to:

- to design and analyze the real time electrical transmission system with respect to various electrical parameters considering environmental and economic obligations
- to implement the appropriate safety equipments for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.
- implement the basic mathematical ,physical and electrical principles to formulate significant electrical hazards
- Judge the suitability of installing overhead and underground power transmission strategies considering electrical, mechanical, environmental, performance, safety and economic constraints

Unit I: Introduction (10 Hrs): Typical layout of an electrical power system–present power scenario in india. generation of electric power: conventional sources (qualitative):hydro station, steam power plant, nuclear power plant and gas turbine plant, non-conventional sources (qualitative): ocean energy, tidal energy, wave energy, wind energy, fuel cells, and solar energy, cogeneration and energy conservation and storage.

Unit II: Economics of Generation (10 Hrs):: Introduction, connected load, maximum demand, demand factor, load factor, diversity factor, load duration curve, number and size of generator units, base load and peak load plants, cost of electrical energy-fixed cost, running cost, tariff on charge to customer.

Unit III: Transmission Systems(10 Hrs):: Various Systems of transmission & their comparison, HVDC transmission converter, inverter, filters & substation layout, voltage and reactive power control.
Cables: Classification, Construction and characteristic of different types, insulation resistance
and capacitance, grading (capacitance and inter sheath), laying, jointing and splicing of cables.
phenomenon of dielectric losses, dielectric stress and sheath loss in cables.

Unit IV : Distribution Systems (6 Hrs):: Primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub mains and tapered mains, voltage drop and power loss calculations, voltage regulators, feeders kelvin's law and modified kelvin's law for feeder conductor size .

Unit V : Overhead Transmission Lines(6 Hrs):: Types of Conductors, line parameters: calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants

and equivalent circuits of short ,medium & long lines, line performance: circle diagram, regulation and efficiency of short, medium and long lines.

References:-

1. Ashfaque hussain , CBS Publication,2014
2. C.L. Wadhwa –Generation, Distribution and Utilization of Electrical Energy, Second Edition, New Age International, 2009
3. C.L. Wadhwa –Electrical Power Systems, Fifth Edition, New Age International, 2009
4. M.V. Deshpande –Elements of Electrical Power Station Design, Third Edition, WheelerPub. 1998
5. V.K. Mehta principal of electrical power system, S Chand Publication
6. J.B. Gupta electrical power system,kataria and sons publication

EEA-404	**Power System – I**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment:

1. To study and draw the typical Layout of an Electrical Power System
2. To draw the Electrical design of transmission line.
3. 3 To draw the Mechanical design of transmission line.
4. To study AC distribution- Single phase, 3-phase& 3 phase 4 wire system.
5. 5. Study of different type of insulator.
6. To study and draw the typical Layout of substation
7. To study and draw different types of towers
8. Study of different type of cables.

EEA-405 Power Electronics

EEA-405	**Power Electronics**	**2L:1T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

To introduce students to the basics of power semiconductor devices and passive components, their practical applications in power electronics.

- Principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.

Outcomes:

At the end of the course, a student will be able to:

- Relate basic semiconductor physics to properties of power devices, and combine circuit mathematics and characteristics of linear and non-linear devices.
- Describe basic operation and compare performance of various power semiconductor devices
- Design and Analyze power converter and rectifier circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
- Identify the critical areas in application levels and derive typical alternative solutions, select suitable power converters to control Electrical Motors and other industry grade apparatus.
- Recognize the role power electronics play in the improvement of energy usage efficiency and the applications of power electronics in emerging areas.

Unit I: Power Switching Devices (6 Hours): Diode, thyristor, MOSFET, IGBT: their characteristics; firing circuit for thyristor; voltage and current commutation of a thyristor; gate drive circuits for MOSFET and IGBT.

Unit II: Thyristor Rectifiers (10 Hours): Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Unit III: DC-DC Buck Converter (5 Hours): Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Unit IV: DC-DC Boost Converter (5 Hours): Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Unit V: Single-Phase Voltage Source Inverter (10 Hours)
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage
Three-Phase Voltage Source Inverter (6 Hours)
Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

References:

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009

EEA-405	**Power Electronics**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiments (Extendable):

1. To study V-I characteristics of SCR.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectified with R load (ii) L load with and without freewheeling diode.
4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study single-phase ac voltage regulator with resistive and inductive loads.
6. To study single phase cyclo-converter.
7. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor.
8. To study three-phase fully/half controlled bridge rectifier with resistive and inductive load

EEA-406 Software Lab-I (Circuit Simulator)

EEA-406	**Software Lab-I**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Preambles:

To introduce students

- Basics of software used in electrical field
- Designing and Simulation of electrical and electronics circuits

Outcomes:

At the end of the lab the students will be able to

- Design and simulate different electrical and electronics circuits
- fabrication of PCB
- Familiarisation with various softwares like Tina-Pro/ Pspice/ Circuit Maker ,Matlab etc..

List of Experiments (Extendable):

1. Study of circuit simulation software (any one- TINA-PRO/ PSPICE/ CIRCUIT MAKER/ GPSIM/SAPWIN etc).
2. Designing and Simulation of Different Electronics Circuit .
3. Designing and Simulation of Different Network Circuit.
4. Designing and Simulation of Digital Logic Circuit.
5. Designing and fabrication of PCB with circuit simulator

EEA- 407- Industrial Training – I

EEA- 407	**Industrial Training – I**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

Preambles:

Industrial Training is imparted with the following in mind-

- To provide comprehensive learning platform to students where they can enhance their employ ability skills and become job ready along with real corporate exposure.
- To enhance students' knowledge in electrical technology.
- To Increase self-confidence of students and helps in finding their own proficiency
- To cultivate student's leadership ability and responsibility to perform or execute the given task.
- To provide learners hands on practice within a real job situation

Outcomes

At the end of the training, a student will be able to:

- acquire and apply fundamental of engineering aspects learned during training.
- Become updated with all the latest changes in technological world.
- Ability to communicate efficiently.
- Ability to identify, formulate and model problems in real practical field and find engineering solution based on a systems approach.
- Awareness of the social, cultural, global and environmental responsibility as an engineer.

The Industrial Training– I should be the outcome of the training done/performed during semester break of $4^{th\ sem}$ .It should be submitted in hardware form (proto type)or simulation form along with proper data and certificates issued during project training. It should cover the electrical engineering aspects learned during training. A Power point presentation should also be submitted at the time of submission.

To be completed during fourth semester semester break. Its evaluation/credit to be added in fifth semester

Semester V

EEA-501 Control Systems

EEA-501	Control Systems	2L:1T:0P	3 credits	3 Hrs/Week

Preamble

To make students understand the concept of state –space analysis, stability and to design the compensator in time and frequency domain.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the modeling of linear-time-invariant systems using transfer function and state- space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Unit 1: Introduction to control problem (5 hours)

Industrial Control examples, Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit 2: Time Response Analysis (9 hours)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency-response analysis (8 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design.

Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit 5: State variable Analysis (10 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Pole-placement by state feedback.

Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems, Introduction to Optimal Control and NonlinearControl

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

References:

1. M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
2. B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
3. K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009

Control Systems Laboratory

EEA-501	**Control Systems**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

List of Experiments:

1. To determine speed torque characteristics of armature controlled D.C. servomotor.
2. To determine the speed torque characteristics and relationship between torque speed and control windings voltage by AC servomotor.
3. To obtain the step response transient characteristics of first order electric system and to measure system parameters.
4. To plot the nyquist plot of a given transformer function using matlab.
5. To plot the bode plot of a given transformer function using matlab.

EEA-502 Microprocessors

EEA-502	**Microprocessors**	**2L:1T:0P**	**3 Credits**	**3 Hrs/Week**

Preamble:

To introduce students with the architecture and operation of typical microprocessors, programming and interfacing of microprocessors and to provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Do assembly language programming.
- Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers.

Unit I: Fundamentals of Microprocessors: (10 Hours)

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Unit II: The 8051 Architecture (10 Hours)

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit III: Instruction Set and Programming (10 Hours)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Unit IV: Memory and I/O Interfacing (6 Hours):

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such

as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

Unit V: External Communication Interface (6Hours)
Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.
2. K. J. Ayala, "8051 Microcontroller", Delmar Cengage Learning,2004.
3. R. Kamal, "Embedded System", McGraw Hill Education,2009.
4. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Morgan Kaufman Publishers, 2013.
6. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.

EEA-502	Microprocessors	0L:0T:1P	1 Credits	2 Hrs/week

Hands-on experiments related to the course contents

1. To study 8085 based microprocessor system.
2. To study 8086 based microprocessor system.
3. Write an Assembly Language Program to add two 16 bit numbers.
4. Write an Assembly Language Program to subtract two 16 bit numbers.
5. To perform multiplication/division of given numbers.
6. To perform computation of square root of a given number.
7. To obtain interfacing of RAM chip to 8085/8086 based system
8. To develop and run a program for finding out the largest/smallest number from a given set of numbers.

EEA-503 Electrical Machine Design

EEA-503	Electrical Machine Design	2L:1T:0P	3 Credits	3Hrs/Week

Preamble
To familiarize students with the design concepts and various factors which influence the design
Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

Unit I: Introduction (10 Hours)
Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific

electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit II: Transformers (10 Hours)

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit III: Induction Motors (10 Hours)

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, SC current circle diagram, leakage reactance of polyphase machines, magnetizing current

Unit IV: Synchronous Machines (11 Hours)

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit V: Computer aided Design (CAD): (9 Hours)

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

EEA-503 Electrical Machine Design

EEA-503	Electrical Machine Design	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiment (Extendable):

1. Computer Program in "C" in MATLAB for Complete Design of 500KW, 600v lab wound dc machine
2. Computer Program in "C" in MATLAB for Optimal Design of dc machine
3. Computer Program in "C" in MATLAB for Complete Design of core type power Transformer
4. Computer Program in "C" in MATLAB for Complete Design of salient pole Alternator
5. Computer Program in "C" in MATLAB for Complete Design of Synchronous Machines
6. Computer Program in "C" in MATLAB for Optimal Design of cage rotor
7. Computer Program in "C" in MATLAB for Complete Design Of single ph IM

8. Computer Program in "c" in MATLAB for Optimal Design of slip ring IM

Program Elective-I

EEA-504 (A) Signals and Systems

EEA-504(A)	Signals and Systems	3L:1T:0P	4 Credits	4Hrs/Week

Preamble:

1. To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. 2 To understand Sampling theorem, with time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transform.
3. 3 To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems and lay down the foundation for advanced courses.

Outcomes:

On completion of the course, student will be able to

1) Analyze the discrete time signals and system using different transform domain techniques.
2) Design and implement LTI filters for filtering different real world signals.
3) Develop different signal processing applications using DSP processor.

Unit I- Introduction to Signal & Systems: (10 Hours)

Signals, classification of signals, basic continuous time and discrete time signals, continuous LTI, discrete LTI systems , impulse and step functions, impulse response stability, linearity, stability, time invariance, eigen values, eigen functions, discrete convolution, properties of discrete and continuous LTI system, systems described by difference and differential equations.

Unit II- Fourier Analysis of Continuous Time Signals and Systems: (10 Hours)

Fourier series, fourier series representation of continuous periodic signal & its properties, fourier transform and its properties, parseval's theorem, frequency response of LTI systems.

Unit III- Fourier Analysis of Discrete Time Signals & Systems: (10 Hours)

Discrete-time fourier series, discrete-time fourier transform (including DFT) and properties, frequency response of discrete time LTI systems, continuous time fourier transform for periodic and non-periodic signals, properties of CTFT.

Unit IV- Laplace & Z-Transform Transform: (8Hours)

Laplace transform and its inverse, existence conditions, region of convergence and properties, application of laplace transform for the analysis of continuous time LTI system, Z-Transform, properties of Z-transform, inversion of Z-transform, two dimensional Z-transform, convergence of Z-transform, region of convergence and properties, application of Z-transform for the analysis of discrete time LTI systems, Z transform problems.

Unit V- State Space Analysis: (12 Hours)

Concept of state, state space representation, discrete time LTI systems, state space representation of continuous time LTI systems, solutions of state equation for discrete time LTI systems, solutions of state equation for continuous time LTI systems.

Sampling: Sampling theorem, ideal & real sampling, reconstruction of signal from its samples, aliasing sampling in frequency domain, sampling of discrete-time signals.

References:

1. Alan V. Oppenheim, Alan S. Willsky and H. Nawab, Signals and Systems, Prentice Hall, 1997
2. Simon Haykin, Communication Systems, 3rd Edition, John Wiley, 1995.
3. Signals & Systems, 2nd Edition, by Alan Oppenheim, Alan Wilsky, S. Nawab. Prentice Hall, 1997.
4. Signals and Systems, by Simon Haykin and Barry Van Veen. Wiley, 1999.

EEA-504 (B) Line Commutated and Active Rectifiers

EEA-504 (B)	**Line Commutated and Active Rectifiers**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble:

Analyse controlled rectifier circuits. Understand the operation of line-commutated rectifiers
6 pulse and multi-pulseconfigurations. nderstand the operation of PWM rectifiers operation in rectification and regenerationmodes and lagging, leading and unity power factor mode

Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyse controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

Unit 1: Diode rectifiers with passive filtering (6 Hours)

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuousconduction, input current waveshape, effect of source inductance; commutation overlap.

Unit 2: Thyristor rectifiers with passive filtering (6 Hours)

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3- phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape

Unit 3: Multi-Pulse converter (6 Lectures)

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Unit 4: Single-phase ac-dc single-switch boost converter (6 Hours)

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

Unit 5: Ac-dc bidirectional boost converter (6 Hours)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Isolated single-phase ac-dc flyback converter (10 Hours) Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

Text / References:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison- Wesley, 1991.
3. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007. 5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001

Open Elective-I

EEA-505 (A) Electrical Materials

EEA-505 (A)	**Electrical Materials**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble: To make students understands the insulating, conducting and magnetic materials used in electrical machines and their properties and application .

Outcomes: At the end of the course the students will be able to evaluate and classify insulating, conducting and magnetic materials used in electrical machines. Understand the properties of liquid, gaseous and solid insulating materials.

Unit I Conducting Material and Their Properties (10 Hrs)

Classification, properties, highresistivity alloy: constant mangann,nichrome, electrochemical, properties of copper,aluminum, steel tungsten, molybdenum, platinum, tantalum, niobium, mercurry, nickel,titanum, carbon, lead, thermal, bitmetals, thermocouple, materials, specific resistance,conductance, super conductors, variation of resistance with temperature.

Unit II Semi Conductor Materials: **(10 Hrs)**

Electrical conductivity, elements having semiconductor properties, general application, hall effect, energy levels, conduction in semiconductors, intrinsic conduction, impurity conduction, p and n type impurities, electrical change, neutrality, drift, mobility current flow in semi conductors p-n junction formation by alloying, elasing (forward and reverse) of p-n junction, reverse separation current, zener effect, junction, capacitance, hall defects and hall coeffiecient.

Unit III Magnetic Materials: (10 Hrs)

B.H. curve, soft and hard magnetic materials, di-magnetic, para magnetic and ferromagnetic materials, electrical sheet steel, cast iron, permanent magnetic materials, dynamic and static hysteresis loop, hysterisis loss, eddy current loss, magnetisation, magnetic susceptibility, coercive force, rectangular hysteresia loop, magnet rest square loop core materials, iron silicon, iron alloys.

Unit IV Insulating Materials: **(6 Hrs)**

Electrical, mechanical and chemical properties of insulating material, electrical characteristics, volume and surface resistivity, permitivity loss, and dielectric loss, polarisability**,** classification of dielectric.

Unit V Mechanical Properties: (6 Hrs)

Classification of insulating materials on the basis of temperature rise, general properties of transformer oil, varnishes, solidifying insulating materials, resins, bituminous waxes, drying oils, fibrous insulating materials, wood, paper and cardboard, insulating

textiles, varnished adhesive tapes, inorganic fibrous material and other insulating materials, such as mica, ceramic, bakelite, ebonite, glass, PVC, rubber, other
plastic molded materials.

References:

1. TTTI Madras; Electrical Engineering Materials; TMH.
2. Electrical Engineering Material s & Devices; John Allison ;TMH
3. Electrical Engineering Materials: Indulkar and S. Thruvengadem;
4. Electrical Engineering Materials; S. Chand
5. Dekkor AK; Electrical Engineering Materials; PHI

EEA-504 (B) Embedded Systems

EEA-504 (B)	Embedded Systems	3L:1T:0P	4 Credits	4Hrs/Week

Preamble: Discuss the major components that constitute an embedded system.2. Implement small programs to solve well-defined problems on an embedded platform.3. Develop familiarity with tools used to develop in an embedded environment.

Outcomes: At the end of content students will be able to

1. Understand microcontroller, microcomputer,embedded system.
2. Understand different components of a micro-controller andtheir interactions.
3. Become familiar with programming environment used todevelop embedded systems
4. Understand key concepts of embedded systems like IO,timers, interrupts, interaction with peripheral devices
5. Learn debugging techniques for an embedded system

Unit1. Introduction: (10- Hours):

Different types of Micro-controllers, embedded micro-controller, external memory micro-controller, Processor architectures: Harvard vs Princeton, CISC vs. RISC, Micro-controller memory types. Development tools/environment, Intel Hex Format object files, debugging.

Unit2 Architecture of 8051: (10- Hours):

Block diagram, pin Configuration, Functional descriptions of internal Units-- registers, PSW, internal RAM, ROM, Stack, Oscillator and Clock. Other features--I/O Pins, Ports and Circuits, Counters and timers, Serial data transmission /reception. Interrupts--Timer flag interrupt, serial communication interrupt, External interrupt, software generated interrupts.

Unit3. Programming of 8051: (10- Hours):

Instruction format, addressing modes, Data transfer instructions, logical instructions, arithmetic instructions, Jump and Call instructions. Interrupts and interrupt handler subroutines. Development of assembly Language programs

Unit4. Architecture Of Pic: (6- Hours):

Block diagram, pin Configuration, Functional descriptions of internal blocks—program memory considerations, register file structure. registers, oscillators and clock. Other features--I/O Pins, Counters and timers, Watchdog timer, SPI port USART. Interrupts—Interrupt structure.

Unit5. Application Design & Hardware Interfacing With 8051 & Pic: (6- Hours):

Hardware Interfacing with LED, Seven segment LED, LCD, Switches and stepper motor.

References:

1. Design with PIC Micro-controller by John B. Peatman, Pearson.
2. The 8051 microcontroller and embedded system by M.A.Mazidi, PHI
3. Programming and customizing the 8051 micro-controller- Predko, TMH.
4. Designing Embedded Hardware: John Catsoulis: Shroff Pub and Dist.
5. Programming embedded systems in C and C++: Michael Barr: Shroff Pub and distr

EEA-506 Industrial Training-I

EEA-506	**Industrial Training-I**	**0L:0T:2P**	**2 credits**	**4Hrs/Week**

Preamble

1. To expose the students to actual working environment of electrical engineering and enhance their knowledge and skill from what they have learned in the classes.
2. Another purpose of this program is to instill the good qualities of integrity, responsibility and self-confidence.
3. To persue students with the electrical field ethics and rules in terms of the society.

Outcomes:

Ability to communicate efficiently. Acquired to be a multi-skilled engineer with good technical knowledge of electrical and electronics components and their processing, management, leadership and entrepreneurship skills. Ability to identify, formulate and model problems and find engineering solution based on a systems approach.

Students must observe following points to enrich their learning in electrical engineering during industrial training:

- Industrial environment and work culture.
- Organisational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.
- Quality control and assurance.
- Maintenance system.
- Costing system.
- Stores and purchase systems.
- Roles and responsibilities of different categories of personnel.
- Customer services.
-Problems related to various areas of Work etc.
- Layout if any

To be submitted : The students has to submit the power point presentation of minimum15 slides of the training performed(comprising of points stated above) along with the original certificate of training performed with proper seal and signature of the authorized person.

Semester VI

EEA-601 Power Systems – II

EEA-601	**Power Systems – II**	**2L:1T:0P**	**3 credits**	**3 Hrs/Week**

Preamble:

- To introduce the students to the general structure of the network for transferring power from generating stations to the consumers.
- To expose the students to the different electrical & mechanical aspects of trhe power network along with its environmental and safety constraints.
- To familiarize the students with the price structure of Indian power market

Outcomes:

At the end of this course, students will demonstrate the ability to

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

Unit 1: Power Flow Analysis (7 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Unit 2: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th} order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Unit 3: Control of Frequency and Voltage (9 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.Power flow control using embedded dc links, phase shifters

Unit 4: Monitoring and Control (8 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Unit 5: Power System Economics and Management (10 hours)

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education, 1994.

2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

EEA-601	**Power Systems-II Laboratory**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of experiments (Extendable):

1. To develop a program in Matlab for information of Y-bus matrix for N bus system.
2. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3 iteration.
3. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
4. Assessment of transient stability of a single machine system.
5. Effect of compensation on voltage profile of IEEE 6-bus system.
6. Study of any software tools (PSCAD,EDSA, Mi POWER, ETAP etc)

EEA-602 Measurements and Instrumentation

EEA-602	**Measurements and Instrumentation**	**2L:1T:0P**	**3 credits**	**2Hrs/Week**

Preamble:

The objective of the course is to provide a brief knowledge of measurements and measuring instruments related to engineering. To give the sufficient information of measurements and error related to instruments and their minimization in any kind of industry viz. electrical, electronics, mechanical etc.and basic knowledge of AC bridges.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Design and validate DC and AC bridges.
- Analyze the dynamic response and the calibration of few instruments.
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis.
- Understand computerized data acquisition.

Unit I-Philosophy of Measurement(8 Hrs): Methods of measurement, measurement system, classification of instrument systems, characteristics of instruments & measurement systems, Accuracy and precision, sensitivity resolution, errors in measurement & its analysis, standards, operating force, types of supports, damping, controlling.

Unit II- Analog Measurement of Electrical Quantities(10Hrs):: PMMC, MI, electrodynamic, thermocouple, electrostatic & rectifier type ammeters & voltmeters, electrodynamic type wattmeter, three phase wattmeter, power in three phase systems, low power factor & UPF wattmeter, errors & remedies in wattmeter, energy meter, D’arsonal galvanometer.

Instrument TransformersCT and PT; their errors, applications of CT and PT in the extension of instrument range, measurement of speed, frequency and power factor.

**Unit III- Measurement of Parameters (6Hrs)::: ** Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q meter, Megger.

Unit IV- AC Potentiometers(10Hrs): Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement.
Magnetic Measurement- Ballistic galvanometer, flux meter, determination of hysteresis loop, measurement of iron losses, Lloyd Fischer square for measurement of power loss.

Unit V- Digital Measurement of Electrical Quantities(10Hrs):: Concept of digital measurement, block diagram, analog & digital instruments, digital voltmeter, frequency meter, spectrum analyzer, electronic multimeter.
Cathode Ray Oscilloscope: CRO block diagram, Cathode Ray Tube & its components, applications of CRO, lissajous pattern, dual trace & dual beam oscilloscopes.

References:

1. E. W. Golding & F. C. Widdis, "Electrical Measurement &Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India
2. A. K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India
3. Purkait, "Electrical & Electronics Measurement & Instrumentation", TMH
4. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India
5. M. B. Stout , "Basic Electrical Measurement", Prentice Hall of India
6. W. D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International
7. J. B. Gupta, "Electrical Measurement & Measuring Instrument", S. K. Kataria & Sons

EEA-602	Measurements and Instrumentation	0L:0T:0P	1 credits	2Hrs/Week

List of Experiments:

1. Measurement of low resistance using Kelvin's Double Bridge.
2. Measurement of medium resistance using Wheatstone's bridge.
3. Measurement of high resistance by loss of charge method.
4. Measurement of Insulation resistance using Megger.
5. Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method
6. Calibration of a induction type single phase energy meter
7. Calibration of a dynamometer type of wattmeter by Phantom Loading method.
8. Measurements using Instrument Transformers.
9. Study of various types of Indicating Instruments.
10. Measurement of Power in three phase circuit by one, two & three wattmeters.
11. Measurement of a batch of resistors and estimating statistical parameters.
12. Measurement of L using a bridge technique as well as LCR meter.
13. Measurement of C using a bridge technique as well as LCR meter.

Program Elective - II

EEA-603 (A) Electrical and Hybrid Vehicles

EEA-603 (A)	**Electrical and Hybrid Vehicles**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

The students will be able to, explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals. Analyse different energy storage technologies and Demonstrate different configurations of electric vehicles and its components

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage and strategies related to energy storage systems.
- Analyze various electric drives suitable for hybrid electric vehicles

Unit 1: Introduction (6 hours)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Unit 2 Hybrid Electric Drive-trains(6 hours):

Basic concept of hybrid traction, introduction to various hybrid drive- train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit 3: Electric Trains (10 hours)

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. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit 4: Energy Storage (10 hours)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its

analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit 5: Energy Management Strategies (10 hours)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV)

References:

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016

EEA-603 (B) Digital Signal Processing

EEA-603 (B)	**Digital Signal Processing**	**3L:1T:0P**	**4 credits**	**4Hrs/Week**

Preamble:

To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors. To make students aware about the meaning and implications of the properties of systems and signals.

Outcomes:

At the end of this course students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various application

Unit -1 Discrete time signals (10Hrs):

Sequences; representation of signals on orthogonal basis; Samplingand reconstruction of signals; Discrete systems attributes, Z-Transform,

Unit -2 Analysis of LSI systems (6Hrs):

Analysis of LSI systems, frequencyAnalysis, Inverse Systems, Discrete Fourier Transform (DFT),Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit -3 Designof FIR Digital filters(10Hrs):

: Windowmethod,Park-McClellan's method.Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Lowpass, Bandpass, Bandstop and High pass filters.

Unit -4(10Hrs) Analysis of FIR:

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit -4 Signal Processing (6Hrs):

Introduction to multirate signalprocessing. Application of DSP.

Text/Reference Books:

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall,1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

EEA-603 (C) Industrial Electrical Systems

EEA-603 (C)	Industrial Electrical Systems	3L:1T:0P	4 credits	4Hrs/Week

Preamble:

To equip learners with the skills and knowledge necessary to successfully carry out basic service and maintenance of Industrial Electrical Systems in a safe and environmentally sound manner.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and selectthe proper size of various electrical system components.

Unit 1: Electrical System Components (10 Hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit 2: Residential and Commercial Electrical Systems (12 Hours)

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit 3: Illumination Systems (6 Hours)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Unit 4: Industrial Electrical Systems I (8 Hours)

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit 5: Industrial Electrical Systems II (6 Hours)

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

2. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
3. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
4. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
5. Web site for IS Standards.
6. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

Program Elective - III

EEA-604 (A) Computer Architecture

EEA-604 (A)	Computer Architecture	3L:0T:0P	3 credits	3Hrs/Week

Preamble:

To study the basic organization and architecture of digital computers (CPU, memory, I/O, software). Discussions will include digital logic and microprogramming. Such knowledge leads to better understanding and utilization of digital

computers, and can be used in the design and application of computer systems or as foundation for more advanced computer-related studies

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the concepts of microprocessors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of microprocessors.
- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor

Unit 1: Introduction to computer organization (10 hours)

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

Unit 2: Memory organization (6 hours)

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit 3: Input – output Organization (6 hours)

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit 4: 16 and 32 microprocessors (10hours)

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Unit 5: Pipelining (10 hours)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set. VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, **"**Computer organization**"**, McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, **"**The Intel microprocessors**"**, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, **"**Computer Architecture A Quantitative Approach**"**, Morgan Kauffman, 2011.
4. W. Stallings, **"**Computer organization**"**, PHI, 1987.
5. P. Barry and P. Crowley, **"**Modern Embedded Computing**"**, Morgan Kaufmann, 2012.

6. N. Mathivanan, **"**Microprocessors, PC Hardware and Interfacing**"**, Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, **"**Microcomputer Systems: The 8086/8088 Family**"**, Prentice Hall India, 1986.
8. J. Uffenbeck, **"**The 8086/8088 Design, Programming, Interfacing**"**, Prentice Hall, 1987.
9. B. Govindarajalu, **"**IBM PC and Clones**"**, Tata McGraw Hill, 1991.
10. P. Able, **"**8086 Assembly Language Programming**"**, Prentice Hall IndiA

EEA-604 (B) Wind and Solar Energy Systems

EEA-604 (B)	Wind and Solar Energy Systems	3L:0T:0P	3 credits	3Hrs/Week

Preamble:

To study clean and renewable energy sources, i.e. wind energy turbines and systems, solar photovoltaic devices and systems and to practice system-level designs, analytical design and analysis and modeling and simulation.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Unit 1: Physics of Wind Power: (6 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit 2: Wind generator topologies: (10 Hours)

Review of modern wind turbine technologies,Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Unit 3: The Solar Resource: (6 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit 4: Solar photovoltaic: (10 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit , array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.Converter Control.

Unit 5: Network Integration Issues: (10 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power

regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Solar thermal power generation:

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

References:

1. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.
2. G. M. Masters, "Renewable and Efficient Electric Power Systems**",** John Wiley and Sons, 2004.
3. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons, 1991.

EEA-604 (C) Computational Electromagnetics

EEA-604 (C)	Computational Electromagnetics	3L:0T:0P	3 credits	3Hrs/Week

Preamble:

To provide the deep knowledge of Conventional and Analytical design methodology of solving field equations and Field plotting

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the advanced concepts of electromagnetics.
- Understand computational techniques for computing fields.
- Apply the techniques to simple real-life problems.

Unit 1: Introduction (6 hours)

Conventional design methodology, Computer aided design aspects – Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Unit 2: Analytical Methods (6 hours)

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Unit 3: Finite Difference Method (FDM) (10 hours)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Unit 4: Finite Element Method (FEM) (10 hours)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements,

vector elements, 2D and 3D finite elements, efficient finite element computations.

Unit 5: Special Topics(10 hours)

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's field Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

References

1. P. P. Silvester and R. L. Ferrari "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001

Open Elective-II

EEA 605 (A) Internet of Things

EEA 605 (A)	**Internet of Things**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:

1. To assess the vision and introduction of IoT.
2. To Understand IoT Market perspective.
3. To Implement Data and Knowledge Management and use of Devices in IoT Technology.
4. To Understand State of the Art - IoT Architecture.
5. To classify Real World IoT Design Constraints, Industrial Automation in IoT.

Outcomes:

On successful completion of the course, the student will: • Understand the concepts of Internet of Things • Analyze basic protocols in wireless sensor network • Design IoT applications in different domain and be able to analyze their performance • Implement basic IoT applications on embedded platform

Unit 1 Introduction to IoT - (10 hHrs)

Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT,Functional blocks of IoT, Communication models & APIs

Unit 2 IoT & M2M - (10 hHrs)

Machine to Machine, Difference between IoT and M2M, Software define Network

Unit 3 Network & Communication (10 hHrs)

Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination
Challenges in IoT Design challenges, Development challenges, Security challenges, Other challenges

Unit 4 Domain specific applications(6 hHrs)

Domain specific applications of IoT Home automation, Industry applications, Surveillance applications,

Unit 5 Other IoT applications (6 hHrs)
Developing IoTs Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python

References:

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"

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

EEA-605 (B) Power Plant Engineering

EEA-605 (B)	**Power Plant Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:
To provide an overview of power plants and the associated energy conversion issues

Outcomes:
Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Unit 1 Coal based thermal power plants, (10 Hrs);
Basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Unit 2 Gas turbine and combined cycle power plants(10 Hrs):
Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Unit 3 Basics of nuclear energy conversion(10 Hrs):
, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Unit 4 Hydroelectric power plants(6 Hrs):

classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Unit 5 Energy, economic and environmental issues(6 Hrs):
, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Referencs:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

EEA-605 (C) Modern Manufacturing Processes

EEA-605 (C)	**Modern Manufacturing Processes**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods

Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Unit 1 Conventional Manufacturing processes: (6Hrs)

Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Unit 2 Introduction to bulk and sheet metal forming, (10Hrs)

plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Unit 3 Metal cutting: (10Hrs)

Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit 4 Additive manufacturing: (6Hrs)

Rapid prototyping and rapid tooling Joining/fastening processes: Physics of welding, brazing and soldering;design considerations in welding,Solid and liquid state joining processes;Adhesive bonding.

Unit 5 Unconventional Machining Processes: (10Hrs)

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014

2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems

3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing

EEA 606 Projects-I (Minor)

EEA 606	Project-I (Minor)	0L:0T:2P	2 credits	4 Hrs/Week

Preamble:

To prepare minor projects as per the need of real world and industries and validate their result using electrical, electronics and other computing technologies.

Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and validate DC and AC bridges
2. Analyze the dynamic response and the calibration of few instruments
3. Learn about various measurement devices, their characteristics, their operation and their limitations
4. understand statistical data analysis
5. Understand computerized data acquisition.
6. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
7. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
8. Able to write comprehensive report on Minor project work.

Guidelines:

The Minor-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The Minor project may be a complete hardware or a combination of hardware and software. The software part in Minor project should be less than 50% of the total work.
3. Minor Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of Minorproject.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due

considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

Semester VII

EEA-701 Power System Protection

EEA-701	Power System Protection	3L:0T:0P	3 credits	3Hrs/Week

Preamble:

Toprovide an overview of the principles and schemes for protecting **power** lines, transformers, buses, generators and introduces the fundamentals of wide-area monitoring and control

Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the different components of a protection system.
- Evaluate fault current due to different types of fault in a network.
- Understand the protection schemes for different power system components.
- Understand the basic principles of digital protection.
- Understand system protection schemes, and the use of wide-area measurements.

Unit 1: Introduction and Components of a Protection System (6 hours)
Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Unit 2: Faults and Over-Current Protection (6 hours)
Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

Unit 3: Equipment Protection Schemes(10 hours)
Directional, Distance, Differential protection. Transformer and Generator protection. Busbar Protection, Bus Bar arrangement schemes,
Digital Protection Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

Unit 4: Modeling and Simulation of Protection Schemes (10 hours)
CT/PT modeling and standards, Simulation of transients using Electro-Magnetic Transients (EMT) programs. Relay Testing.

Unit 5: System Protection (10hours)
Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under- voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

References:

1. J. L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, 1987.
2. Y. G.Paithankar and S. R. Bhide, "Fundamentals of power system protection", Prentice Hall, India, 2010.
3. A. G. Phadke and J. S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, 1988.
4. A. G. Phadke and J. S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer, 2008.
5. D. Reimert, "Protective Relaying for Power Generation Systems", Taylor and Francis, 2006.

EEA-701 Power System Protection

EEA-701	**Power System Protection**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments :(Extendable)

1. Determination of drop out factor of an instantaneous over current relay.
2. Determination of operating characteristic of IDMT relay.
3. Determination of operating characteristic of differential relay.
4. Study and operation of gas actuated protective relay.
5. Study and operation of static over current relay
6. Analysis of power system faults (Symmetrical & Asymmetrical) using MATLAB.
7. Study of SF6 circuit breaker
8. Protectional simulation study of generator, Transformer, Feeder & Motor protection.

EEA-702 Electrical Drives

EEA-702	**Electrical Drives**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble:

To provide fundamental knowledge in dynamics and control of Electric Drives. To justify the selection of Drives for various applications. To familiarize the various semiconductor controlled drives employing various motors.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the characteristics of dc motors and induction motors.
- Understand the principles of speed-control of dc motors and induction motors.
- Understand the power electronic converters used for dc motor and induction motor speed control.

Unit 1: DC motor characteristics (6 hours)

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high

speed operation.

Unit 2: Chopper fed DC drive (6 hours)

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.

Unit 3: Multi-quadrant DC drive (6 hours)

Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Unit 4: Closed-loop control of DC Drive (12 hours)

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Induction motor characteristics

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque- speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Unit 5: Scalar control or constant V/f control of induction motor (12 hours)

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Control of slip ring induction motor

Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

References:

1. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
2. R. Krishnan, “Electric Motor Drives: Modeling, Analysis and Control”, Prentice Hall, 2001.
3. G. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press, 2002.
4. W. Leonhard, “Control of Electric Drives”, Springer Science & Business Media, 2001.

EEA-702	**Electrical Drives**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of experiments:

1.To study the starting and running characteristics of converter fed DC traction motor.
2. To study the energy recovery systems and braking of a DC drive.
3. To study the braking methods of a three-phase induction motor.

4. To study the performance of VSI fed three-phase induction motor using PWM technique.
5. To control the speed of a three phase slip ring Induction motor using rotor impedance control.
6. To study the performance of Vector Controlled three phase Induction motor drive.
7. To Study frequency Controlled Synchronous motor drive.

Program Elective – IV

EEA-703(A) High Voltage Engineering

EEA-703(A)	**High Voltage Engineering**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To understand the principles of theory of high voltage generation and measurements. 2- To understand the operation of high voltage power supplies for ac, dc, and impulse voltages 3- To get familiar with various applications where high voltage field is used.

Outcomes:

At the end of the course, the student will demonstrate

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

Unit 1: Breakdown in Gases (6 Hours)

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Unit 2: Breakdown in liquid and solid Insulating materials (6 Hours)

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Unit 3: Generation of High Voltages (10 Hours)

Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Measurements of High Voltages and Currents

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Unit 4: Lightning and Switching Over-voltages (10 Hours)

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Unit 5: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (10 Hours)

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

References:

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.

EEA-703 (B) Power Quality and FACTS

EEA-703 (B)	**Power Quality and FACTS**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To give important operating principle, design and planning of power system operation and the effect of different FACTs devices to the operation and control of power system will be presented.

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- Understand the working principles of FACTS devices and their operating characteristics.
- Understand the basic concepts of power quality.
- Understand the working principles of devices to improve power quality

Unit 1: Transmission Lines and Series/Shunt Reactive Power Compensation (6 hours)

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

Unit 3: Voltage Source Converter based (FACTS) controllers (10 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation

and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

Unit 4: Application of FACTS (10 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

Unit 5: Power Quality Problems in Distribution Systems (10 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

DSTATCOM : Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM. **Dynamic Voltage Restorer and Unified Power Quality Conditioner** Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

References:

2. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
3. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
4. T. J. E. Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
5. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
6. G. T. Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991

EEA-703 (C) Image Processing

EEA-703 (C)	Image Processing	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

to give an introduction to basic concepts and methodologies for digital image processing , to develop a foundation that can be used as the basis for further study and research in this field.

Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

Unit 1 Digital Image Fundamentals(6 Hrs)-

Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Unit 2 Image Enhancements and Filtering(6 Hrs)

-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and

its inverse, frequency domain filters – low-pass and high-pass.

Unit 3 Color Image Processing-Color models (10 Hrs):
RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding, global and adaptive, region-based segmentation.
Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit 4 Image Compression-Redundancy (10 Hrs):

inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

Unit 5 Fundamentals of Video Coding(10 Hrs):
-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

References:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

Open Elective-III

EEA-704 (A) VLSI Circuits

EEA-704 (A)	VLSI Circuits	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

To provide students with a sound knowledge of **VLSI** system **design** verification and testability, and system reliability. The emphasis of the **course** is on techniques for system **design**, testing, system noise and performance analysis.

Outcomes:

UNIT –I: Review of Microelectronics and Introduction to MOS Technologies: (10Hrs)
MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT –II: Layout Design and Tools: (10Hrs)
Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools. Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT –III: Combinational Logic Networks: (6 Hrs)
Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT –IV: Sequential Systems: (10 Hrs)
Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

UNIT –V: Floor Planning: (6Hrs)
Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Reference:
1. Essentials of VLSI Circuits and Systems, K. Eshraghian Eshraghian. D, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.
3. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
4. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

EEA-704 (B) Evolutionary Techniques

EEA-704 (B)	**Evolutionary Techniques**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To be able to assess and understand the key commonalities and differences in various **evolutionary** and swarm-based models. To be able to apply **techniques** in **evolutionary** computation and swarm intelligence to problems such as optimization, automatic programming, control, and biological modeling.

Outcomes:

to provide students with a deeper insight into the evolutionary processes - both selective and random - which can explain the genetic composition of populations, form, behaviour and distribution of organisms, and to teach students the basic methods of analysing the evolutionary relationships between species.

Unit –I: Introduction: (8 Hrs)
Approaches to intelligent control, architecture for intelligent control, symbolic reasoning system, rule-based systems, the AI approach, knowledge representation - expert systems.

Unit –II: Artificial Neural Networks: (6 Hrs)
Basic concept mathematical model, mcculloch-pitts neuron model, simple perceptron, Adaline and Madaline, feed-forward multilayer perceptron, learning and training the neural network, data processing, scaling, fourier transformation, principal-component analysis, wavelet transformations, hopfield network, self-organizing network and recurrent network, neural network based controller.

Unit –III: Fuzzy Logic System: (12 Hrs)

Crisp sets, fuzzy sets, basic fuzzy set operation and approximate reasoning, fuzzy logic modeling and control, fuzzification, inferencing and defuzzification, fuzzy knowledge and rule bases, fuzzy modeling and control schemes for nonlinear systems, self organizing fuzzy logic control.

Unit –IV: Genetic Algorithm: (10 Hrs)
Basic concept of genetic algorithm and detail algorithmic steps, adjustment of free parameters, solution of typical control problems using genetic algorithm, concept on some other search techniques like Tabu search and Ant-colony search techniques for solving optimization problems.

Unit –V: Applications: (10 Hrs)
GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-neural network toolbox, stability analysis of neural-network interconnection systems, implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox, stability analysis of fuzzy control systems.

References:

1. Introduction to Artificial Neural Systems - Jacek.M.Zurada, Jaico Publishing House, 1999.
2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.
3. Fuzzy Sets, Uncertainty and Information - Klir G.J. & Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.
4. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994.. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
5. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
6. Elements of Artificial Neural Networks - Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka, Penram International.
7. Artificial Neural Network –Simon Haykin, 2nd Ed., Pearson Education.
8. Introduction Neural Networks Using MATLAB 6.0 - S.N. Shivanandam, S. Sumati, S. N. Deepa,1/e, TMH, New Delhi.

EEA-704 (C) Data Structures and Algorithms

EEA-704 (C)	**Data Structures and Algorithms**	**3L:0T:0P**	**3 Credits**	**3Hrs/Week**

Preambles:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists, trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

Outcomes:

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort,

Heap Sort and compare their performance in term of Space and Time complexity.

5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Unit 1 Introduction (6 Hours):

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. **Searching:** Linear Search and Binary Search Techniques and their complexity analysis.

Unit 2: Stacks and Queues: (6 Hours):

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Unit 3:Linked Lists: (10 Hours):

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Unit 4:Sorting and Hashing: (10- Hours):

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Unit 5:Graph: : *(*10- Hours):

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

References

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.
3. "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

EEA 705 Project Stage-I

EEA 705	Project Stage-I	0L:0T:5P	5 credits	10Hrs/Week

Preambles:

1. To be able to apply some of the techniques/principles as per the real life needs.
2. To carry out budget and time planning for the project.
3. To inculcate electronic hardware implementation skills by learning PCB artwork design using an appropriate tool

Outcomes:

At the end of this course students will demonstrate the ability to

- Design and validate electrical algorithms for optimum solution
- Analyze the dynamic response and the calibration of few instruments
- Build projects as per industry and society demands.

Guidelines:

1. To prepare the synopsys of the major project to be done in next semester.
2. The Project Stage-I is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
3. The Project Stage-I may be a complete hardware or a combination of hardware and software.
4. The software part in Minor project should be less than 50% of the total work.
5. Project should cater to a small system required in laboratory or real life.
6. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
7. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of Minorproject.
8. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
9. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
10. Art work and Layout should be made using CAD based PCB simulation software.
11. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.

EEA-706 Self Study/GD/Seminar

EEA-706	**Self Study/GD/Seminar**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

Preambles:

The main objective is to improve the mass communication and convincing/understanding skills of students .And to give the students an opportunity to exercise their rights to express themselves. The evaluation will be done based on their presentation work and group discussion

Outcomes:

In terms of **content**, students will be able to

Presentation Skills

They will be able to make use of visual, audio and audio-visual material to support their presentation, and will be able to speak cogently with or without notes. Students will present either in groups or as individuals.

Discussion Skills

Students will be able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject, ask appropriate questions, use evidence to support claims, respond to a range of questions, take part in meaningful discussion

Listening Skills

Students will demonstrate that they have paid close attention to what others say and can respond constructively. Through listening attentively, they will be able to build on discussion fruitfully, supporting and connecting with other discussants. They will be able to follow academic discussions, infer meanings that are not overt, and take notes from a discussion or presentation.

Argumentative Skills and Critical Thinking

Students will develop persuasive speech, present information in a compelling, well-structured, and logical sequence, respond respectfully to opposing ideas, show depth of knowledge of complex subjects, and develop their ability to synthesize, evaluate and reflect on information.

Questioning

Through asking appropriate questions, students will demonstrate their understanding of discussions and spark further discussion.

Interdisciplinary Inquiry

Students will be able to reach across diverse disciplines to apply theories, methods and knowledge bases from multiple fields to a single question or problem.

Engaging with Big Questions

Students will engage with important questions that stimulate discussion and debate.

Studying Major Works

Students will engage with works that are widely held to be significant in the field of study, while recognizing cultural diversity and the ever-changing nature of what is regarded as important.

Semester VII
EEA 801 Power System Dynamics and Control

EEA 801	**Power System Dynamics and Control**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To determine the dynamic characteristics of power system equipment, to recognize dynamic performance of power systems and to illustrate the system stability and controls. To analyse the model representation .

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the problem of power system stability and its impact on the system.
- Analyse linear dynamical systems and use of numerical integration methods.
- Model different power system components for the study of stability.
- Understand the methods to improve stability.

Unit 1: Introduction to Power System Operations (4 hours)

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Unit 2 : Analysis of Linear Dynamical System and Numerical Methods (6 hours)

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System, Analysis using Numerical Integration Techniques, Issues in Modeling: Slow and Fast Transients, Stiff System

Unit 3 : Modeling of Synchronous Machines and Associated Controllers (12 hours)

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime

Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Unit 4 : Modeling of other Power System Components (10 hours)

Modeling of Loads. Load Models - induction machine model. HVDC and FACTS controllers, Wind Energy Systems.

Unit 5 : Stability Analysis (10 hours) Angular stability analysis in Single Machine Infinite Bus System.

Angular Stability in multi- machine systems – Intra- plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Introduction to Torsional Oscillations and the SSR phenomenon. Stability Analysis Tools: Transient Stability Programs, Small Signal Analysis Programs.

Enhancing System Stability Planning Measures. Stabilizing Controllers (Power System Stabilizers).Operational Measures-Preventive Control. Emergency Control.

References:

1. K.R. Padiyar, " Power System Dynamics, Stability and Control", B. S. Publications,2002.

2. P. Kundur, " Power System Stability and Control", McGraw Hill,1995.

3. P. Sauer and M. A. Pai, " Power System Dynamics and Stability" , Prentice Hall,1997.

EEA 801	**Power System Dynamics and Control**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

7. To develop a program in Matlab for information of Y-bus matrix for N bus system.
8. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3 iteration.
9. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
10. Assessment of transient stability of a single machine system.
11. Effect of compensation on voltage profile of IEEE 6-bus system.
12. Study of any software tools (PSCAD,EDSA, Mi POWER, ETAP etc)

Program Elective – V

EEA-802 (A) Generalized Theory of Electrical Machines

EEA-802 (A)	**Generalized Theory of Electrical Machines**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To introduce the concepts of ideal synchronous machines and poly-phase induction machines.

- Applications which will be utilized in the electrical machines with its performance and theory of operation.
- Study of special machines.

Outcomes:

After the completion of the course, the students will be able to:

- Express the revolving field and reference frame theory.

- Develop mathematical model of three-phase AC machines and parameters in different reference frame.
- Simulate the transient performance of three-phase ac machines in different reference frames.
- Investigate the transient performance of different DC machines.
- Select special purpose small machines for different applications.

Unit I Generalized Theory: Conversions, basic two pole machines, transformer with movable secondary, transformer voltage and speed voltage, Kron's primitive machine , analysis of electrical machines, voltage and torque equation.

Unit II Linear Transformations: Invariance of power, transformations from displaced brush axis, three phases to two phase, rotating axes to stationary axes, transformed impedance matrix, torque calculations.

Unit III DC Machines: Generalized representation, generator and motor operation, operation with displaced brushes, steady state and transient analysis, sudden short circuit, sudden application of inertia load ,electric braking of dc motors.

Unit IV Synchronous Machines: Generalized representation, equivalent circuit, steady state analysis, transient analysis , phasor diagrams, electromechanical transients.

Unit V Special Machines: Generalized representation, steady state analysis of reluctance motor, brushless dc motor, variable reluctance motor & single phase series motor.

References:

1. B.Adkins & R.G.Harley, The General theory of AC Machines.
2. P.S.Bhimbra, Generalised theory of Electrical m/c
3. White & Woodson, Electro Mechanical Energy Conversion.
4. D. P. Kothari,B. S. Umre, "Laboratory Manual for Electrical Machines", IK International New Delhi.

EEA-802 (B) HVDC Transmission Systems

EEA-802 (B)	**HVDC Transmission Systems**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To introduce students with the concept of HVDC Transmission system. To familiarize the students with the HVDC converters and their control system. To expose the students to the harmonics and faults occur in the system and their prevention

Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the advantages of dc transmission over ac transmission.
- Understand the operation of Line Commutated Converters and Voltage Source Converters.
- Understand the control strategies used in HVDC transmission system.
- Understand the improvement of power system stability using an HVdc system.

Unit 1:Dc Transmission Technology (6 hours)

Comparison of AC and dc Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVdc Systems. Components of a HVdc system. Line Commutated Converter and Voltage Source Converter based systems.

Unit 2: Analysis of Line Commutated and Voltage Source Converters (10 hours)
Line Commutated Converters (LCCs): Six pulse converter, Analysis neglecting commutation overlap, harmonics, Twelve Pulse Converters. Inverter Operation. Effect of Commutation Overlap Expressions for average dc voltage, AC current and reactive power absorbed by the converters. Effect of Commutation Failure, Misfire and Current Extinction in LCC links. Voltage Source Converters (VSCs): Two and Three-level VSCs. PWM schemes: Selective Harmonic Elimination, Sinusoidal Pulse Width Modulation. Analysis of a six pulse converter. Equations in the rotating frame. Real and Reactive power control using a VSC.

Unit 3: Control of HVdc Converters: (10 hours)
Principles of Link Control in a LCCHVdc system. Control Hierarchy, Firing Angle Controls – Phase-Locked Loop, Current and Extinction Angle Control, Starting and Stopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers. Reactive Power Control. Principles of Link Control in a VSC HVdc system: Power flow and dc Voltage Control. Reactive Power Control/AC voltage regulation.

Unit 4: Components of HVdc systems: (6 hours)
Smoothing Reactors, Reactive Power Sources and Filters in LCC HVdc systems DC line: Corona Effects. Insulators, Transient Over-voltages. dc line faults in LCC systems. dc line faults in VSC systems. dc breakers. Monopolar Operation. Ground Electrodes.

Unit 5 :Stability Enhancement using HVdc Control (10 hours)
Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems. MTdc Links Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTdc systems using LCCs. MTdc systems using VSCs. Modern Trends in HVdcTechnology. Introduction to Modular Multi-level Converters.

References:

2. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 2011.
3. J. Arrillaga, "High Voltage Direct Current Transmission", Peter Peregrinus Ltd., 1983.
4. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

EEA-802 (C) Advanced Electric Drives

EEA-802 (C)	Advanced Electric Drives	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

To give unified treatment of advance electrical drive systems with power electronic converters, including the mechanical parts, electrical machines, and power converters and control.

Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the operation of power electronic converters and their controlstrategies.
2. Understand the vector control strategies for ac motordrives 3. Understand the implementation of the control strategies using digitalsignal processors.

Unit 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Qdrive.

Unit 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).

Unit 3: Synchronous motor drives (6 hours)

Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Unit 4: Permanent magnet motor drives (6 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Unit 5: Switched reluctance motor drives (10 hours)

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM. DSP based motion control (6hours) Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motioncontrol.

References:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia,2003.

2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons,2013.
3. H. A. Taliyat and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press,2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press,2009.

Open Elective-IV

EEA 803(A) Cyber Law and Ethics

EEA 803(A)	Cyber Law and Ethics	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

Understanding the Real Approach, Cyber Ethics, Cyber Jurisdiction, Cyber Laws of other rules.

Outcomes:

Students identify and analyze statutory, regulatory, constitutional, and organizational *laws* that affect the information technology professional.Students locate and apply case *law* and common *law* to current *legal* dilemmas in the technology field.

UNIT I History of Information Systems and its Importance, (10 hHrs)

basics, Changing Nature of Information Systems, Need of Distributed Information Systems, Role of Internet and Web Services, Information System Threats and attacks, Classification of Threats and Assessing Damages Security in Mobile and Wireless Computing- Security Challenges in Mobile Devices, authentication Service Security, Security Implication for organizations, Laptops Security Basic Principles of Information Security, Confidentiality, Integrity Availability and other terms in Information Security, Information Classification and their Roles.

UNIT II Security Threats to E Commerce, (10 hHrs)

Virtual Organization, Business Transactions on Web, E Governance and EDI, Concepts in Electronics payment systems, E Cash, Credit/Debit Cards. Physical Security- Needs, Disaster and Controls, Basic Tenets of Physical Security and Physical Entry Controls, Access Control- Biometrics, Factors in Biometrics Systems, Benefits, Criteria for selection of biometrics, Design Issues in Biometric Systems, Interoperability Issues, Economic and Social Aspects, Legal Challenges

UNIT III Model of Cryptographic Systems, (6 hHrs)

Issues in Documents Security, System of Keys, Public Key Cryptography, Digital Signature, Requirement of Digital Signature System, Finger Prints, Firewalls, Design and Implementation Issues, Policies Network

Unit IV Security- (6 hHrs)

Basic Concepts, Dimensions, Perimeter for Network Protection, Network Attacks, Need of Intrusion Monitoring and Detection, Intrusion Detection Virtual Private Networks- Need, Use of Tunneling with VPN, Authentication Mechanisms, Types of VPNs and their Usage, Security Concerns in VPN

UNIT V Security metrics- (10 hHrs)

Classification and their benefits Information Security & Law, IPR, Patent Law, Copyright Law, Legal Issues in Data mIning Security, Building Security into Software Life Cycle Ethics- Ethical Issues, Issues in Data and Software Privacy Cyber Crime Types & overview of Cyber Crimes

References:
1. Godbole,— Information Systems Security‖, Wille
2. Merkov, Breithaupt, — Information Security‖, Pearson Education
3. Yadav, —Foundations of Information Technology‖, New Age, Delhi 4. Schou, Shoemaker, — Information Assurance for the Enterprise‖, Tata McGraw Hill
5. Sood,—Cyber Laws Simplified‖, Mc Graw Hill
6. Furnell, —Computer Insecurity‖, Springer 7. IT Act 2000

EEA-803 (B) Project Management

EEA-803 (B)	**Project Management**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

1. To make them understand the concepts of Project Management for planning to execution of projects.
2. To make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Outcomes:

On completion of this course, the students will be able to:

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control.
4. Apply the risk management plan and analyse the role of stakeholders.
5. Understand the contract management, Project Procurement, Service level Agreements and productivity.

Unit 1 Concepts of Project Management:(6Hrs) Meaning, definition and characteristics of a project, technical and socio-cultural dimensions, project life cycle phases, project planning, graphic presentation, work breakdown structure, manageable tasks, size of network, blow down NW, identity and logic dummy activity, Fulkerson rule for numbering NW, time-scaled NW

Unit-2 NW analysis (6Hrs): PERT network, mean time and variances, probability to complete PERT project in specified time, CPM network, Event Occurrence Time (EOT), activity start/ finish times, forward and reverse path calculations, concept and calculation of floats, resource allocation and critical-chain.

Unit-3 Project Duration And Control (10Hrs): Importance and options to accelerate project completion, timecost tradeoff, fixed variable and total costs, use of floats and cost optimization, project performance measures, project monitoring info and reports, project control process, Gant chart and control chart, cost-schedule S-graph, planned cost of work schedule (PV), budgeted/ earned cost of work completed (EV) and actual cost of work completed (AC), schedule and cost variances (SV, CV) forecasting final project costs.

Unit-4 Project Organization, Culture And Leadership(10Hrs): Projects within functional organization, dedicated project/ task-force teams, staff, matrix and network organization, choosing appropriate project organization, Organization culture, ten characteristics, cultural dimensions supportive to projects, social network and management by wandering around (MBWA), different traits of a manager and leader, managing project teams, five stage team development model, shared vision, conflicts, rewards, rejuvenating project teams, project stakeholders, concept of project partnering.

Unit-5 Strategic Planning and Project Appraisal(10Hrs): Capital allocation key criteria, Porters competitive strategy model, BCG matrix, Strategic Position Action Evaluation (SPACE), time value of money, cash flows, payback period, IRR, cost of capital, NPV, social cost benefit analysis, UNIDO approach, project risks and financing.

References:

1. Prasana Chandra: Projects: planning Implementation control, TMH.
2. Gray Clifford F And Larson EW, Project The managerial Process, TMH
3. Panneerselven and Serthil kumar, Project management, PHI
4. Burke , Project Management-Planning and control technics, Wiley India
5. Kamaraju R, Essentials of Project Management, PHI Learning
6. Jack R. Meredith, Project Management: a managerial approach, Wiley.
7. Choudhary ,Project Management, TMH
8. Srinath LS, PERT And CPM Principles and Appl, East West Press
9. Richman L, Project Management: Step By Step, PHI Learning

EEA-803 (C) Big data Analysis

EEA-803 (C)	Big data Analysis	3L:0T:0P	3 credits	3Hrs/Week

Preambles :

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System
- Apply analytics on Structured, Unstructured Data.
- Exposure to Data Analytics with R.

Outcomes:

The students will be able to:

- Identify Big Data and its Business Implications.
- List the components of Hadoop and Hadoop Eco-System
- Access and Process Data on Distributed File System
- Manage Job Execution in Hadoop Environment
- Develop Big Data Solutions using Hadoop Eco System
- Analyze Infosphere BigInsights Big Data Recommendations.

UNIT I : Introduction To Big Data And Hadoop (8 Hrs)

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II : HDFS (Hadoop Distributed File System) (4 Hrs)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III :Map Anatomy (10 Hrs)

Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Unit IV : Hadoop Eco System Pig (10 Hrs)

: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction

UNIT V : Data Analytics with R Machine Learning : (10 Hrs)

Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

References:

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
4. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
5. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.
6. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.
7. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & sons, 2012. • Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
8. Pete Warden, "Big Data Glossary", O'Reily, 2011.
9. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
10. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
11. Paul Zikopoulos ,Dirk DeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan , "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

EEA 804 Project Stage-II

EEA 804	Project Stage-II	0L:0T:8P	8 credits	16Hrs/Week

Preambles:

The object of Project Stage-II is to enable the student to extend further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work.

Outcomes:

At the end of this course students will demonstrate the ability to

- Design and validate real life industrial based projects
- Analyze the dynamic response and the calibration of few instruments
- Learn about various measurement devices, their characteristics, their operation and theirlimitations
- understand statistical data analysis
- Understand computerized data acquisition.
- Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
- Design, implement and test the prototype/algorithm in order to solve the conceived problem.
- Able to write comprehensive report on major project work.

Under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EEP1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

MANDATORY COURSES

Sr. No.	Course Code	Course Title	Credits	Preferred Semesters
1	MC	[Environmental Sciences, Induction Program, NSS/NCC]	Nil	I, III, IV,
		Total		0

Induction Program

MC	**Induction Program**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Induction program	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

A student has to undergo this induction program after joining the institute and before the commencement of classes. Normal classes of the engineering program shall begin after the students have undergone a three-weeks induction program. The Induction program for students comprises of Physical activities; Learning an art form; Literature & Cinema; Social Awareness; Lectures &Visits; Universal Human Values; Familiarization to Department/ Branch, College& Innovations.

EEA-308-NSS/NCC

EEA-308	**NSS/NCC**	**0L:0T:0P**	**Nil**	**2Hrs/Week**

Preamble:

- To develop qualities of Character, Courage, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure and the ideals of Selfless Service amongst the Youth of the Country.
- To Create a Human Resource of Organized, Trained and Motivated Youth, to Provide Leadership in all Walks of life and be always available for the Service of the Nation
- To Provide a Suitable Environment to Motivate the Youth to Take Up a Career in the Armed Forces.

Outcomes:

- To develop student's personality through community services
- Instilling discipline in the souls of the cadets,

- Imparting leadership, discipline, integration, adventure, military, physical and community development training

Course Content :

The National Cadet Corps (India)) was formed under NCC Act of 1948 and is open to school and college students on voluntary basis. The Cadets are given basic military training in small arms and parades. The motto of NCC is "Unity and Discipline". One week long NSS camp is organized every year where students undertake various social welfare activities like Blood Donation Camp, Tree Plantation and awareness programs on drug de-addiction, AIDS, Swine-flu and campaign for saving water and cleanliness.

(11) Assessment

PO/Course Assesment Tools Types	PO/Course Assesment Tools	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
		Engineering Knowledge	Problem Analysis	Design/Development of Solution	Investigation	Modern Tool Usage	The Engineer and Society	Environment and Sustainability	Ethics	Individual and Team Work	Communication	Project Management	Life-Long Learning
Direct Tools	Test	✓	✓	✓	✓				✓	✓	✓	✓	
	Assignments	✓	✓			✓				✓			
	lab /seminar/industrial training/projects(Rubrics)	✓	✓	✓		✓		✓	✓	✓	✓	✓	✓
Indirect Tools	Course end survey	✓				✓		✓					
	Exit survey	✓	✓										✓
	Faculty Survey		✓	✓	✓			✓					
	Alumni Survey	✓			✓		✓		✓	✓	✓		✓
	Program Statistics	✓			✓				✓			✓	