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 and Electronics Engineering

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

(2) Mission:

- To provide high quality programs in education, scientific and technical research in the field of Electrical Engineering.
- To formulate higher quality human capital development agenda for contribution to the competitiveness of national and international industries in the field of Electrical and Electronics Engineering.
- To conduct strong basic and applied research, to disseminate knowledge, and to contribute to advancement of science and technology. Contribute to the socio-economic development of the Society through scientific and technological solutions.

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

PEO 1: fundamental knowledge in Mathematics, Physical Sciences, electrical sciences and engineering

PEO 2: intensive training in problem solving, real life and complex, laboratory skills, and design skills. Specialization in specific areas of interest and excel as a professional at national level

PEO 3: development of an analytical and research mind, adapt and innovate in a world of constantly evolving technology through lifelong learning. a well balanced education that includes communication skills, the ability to function well on a team, leadership quality, an appreciation for social commitments and ethical attitude and the ability to engage in lifelong learning.

(4) Programme Outcomes (PO's) :

PO-01: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems**.**

PO-02: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-03: Design/Development of Solution: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-04: Investigation: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-05: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-07: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-09: Individual and Team Work: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project Management: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-Long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

(5) Program Specific Outcomes (PSOs)

PSO-1 apply principles of engineering, electronics and computer science; physics, chemistry, environmental science, mathematics (including differential equations, discrete mathematics, linear algebra and complex variables) and laboratory skills for building, testing, operation and maintenance of high currents electrical systems, such as, electrical machines, power and energy systems.

PSO-2 model, analyse, design, and realize physical systems, components or processes related to high current electrical engineering systems.

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(06) 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(EX)	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)						*	*	*	*	*		*		

(07) Semester wise PO's and SPO's Mapping

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO 1	PSO 2
		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		
Semester-Ist	Mathematics-I	*	*	*	*								*		
	Engineering Physics	*	*		*								*		
	Basic Computer Engineering	*	*	*	*	*			*		*		*		
	Basic Mechanical Engineering	*	*	*	*	*									
	Basic Civil Engineering & Mechanics	*	*	*				*						*	
	Language Lab					*			*	*	*		*		
	Self Study / GD Seminar	*	*	*	*	*			*	*		*	*		
Semester-IInd	Mathematics-II	*	*	*	*								*		
	Engineering Chemistry	*	*	*	*										
	English for Communication	*									*			*	
	Basic Electrical & Electronics Engineering	*	*	*	*										
	Engineering Graphics	*	*	*	*										*
	Manufacturing Practices					*			*	*	*	*	*		
	Industrial Training			*	*		*	*	*	*		*	*	*	
Semester-IIIrd	Mathematics - III	*	*	*	*										
	Signals & Systems		*	*											
	Electrical Measurement & Measuring Instruments	*	*	*	*										
	Network Analysis	*	*	*	*										
	Analog Electronics	*	*	*									*		

	Java Programming	*	*	*	*	*									
	Self study /GD Seminar		*	*		*	*	*	*		*	*	*		
Semester-IVth	Energy, Ecology, Environment & Society						*	*		*				*	
	Digital Electronics	*	*											*	
	Electrical Machine-I	*	*	*											
	Power System-I	*	*	*	*										
	Control System	*	*	*											
	Software Lab I (Circuit Simulator)			*	*	*							*		
	Industrial Training-I		*	*		*	*	*	*	*		*	*		
Semester-Vth	Electrical Machines – II		*	*	*	*									
	Microprocessors		*	*	*			*							
	Power Electronics		*	*											
	Electrical Machine Design					*									
	Computer Networks	*													
	Analog and Digital Communication		*	*											
	Electromagnetic Field	*	*	*	*										*
	Project Management						*		*	*	*	*	*		
	Industrial Training-I		*	*	*	*	*	*	*	*		*	*		
Semester VIth	Power Systems – II	*	*	*	*										
	Electrical Drives	*	*	*	*										
	Computer Architecture	*	*	*	*	*				*		*	*		
	Digital signal processing	*	*	*	*										
	Electrical Energy Conservation and Auditing	*				*	*	*	*				*		
	Industrial Electrical Systems	*	*	*	*			*					*		
	Digital Control System	*													
	VLSI Circuits	*	*												
	Image Processing	*	*	*	*	*									
	Power Plant Engineering	*	*	*	*			*		*		*			
	Project - I(Minor)		*	*	*	*	*	*	*	*		*	*		
Sem	Power System	*	*	*	*	*	*	*							

ester VIIth	Protection														
	Power System Dynamics and Control	*	*	*	*	*									
	HVDC Transmission Systems	*	*	*	*			*		*		*	*		
	Special Machines	*	*	*	*										
	High Voltage Engineering	*	*	*	*			*							
	Control system design			*	*										
	Wind and Solar Energy Systems	*	*	*	*	*	*	*							
	Project Training-II(Major)		*	*	*	*	*	*	*	*		*	*		
	Self Study/GD/Seminar		*	*	*	*	*	*	*	*		*	*		
Semester VIIIth	Advanced Electric Drives	*												*	*
	EHVAC & DC		*	*				*							
	machine learning	*	*		*									*	
	modern manufacturing process		*	*	*	*	*	*					*		
	Economic Policies in India						*	*	*				*		
	cyber law and ethics				*	*				*					*
	internet of things	*		*	*	*		*							
	Entrepreneurship Development		*	*			*		*	*	*	*	*		
	Project-II (Major)														
I/III/IV (prefered Semester)	Mandatory Courses							*	*	*	*	*	*		

(08) <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 EX 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

(09) 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 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	EXA-302	Signals & Systems	60	30	10	-	-	100	3		-	3
3	EXA-303	Electrical Measurement & Measuring Instruments	60	30	10	30	20	150	2	1	2	4
4	EXA-304	Network Analysis	60	30	10	30	20	150	3	-	2	4
5	EXA-305	Analog Electronics	60	30	10	30	20	150	2	1	2	4
6	EXA-306	Java Programming	-	-	-	30	20	50	-	-	2	1
7	EXA-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	EXA-402	Digital Electronics	60	30	10	30	20	150	2	1	2	4
3	EXA-403	Electrical Machine-I	60	30	10	30	20	150	3		2	4
4	EXA-404	Power System-I	60	30	10	30	20	150	3	-	2	4
5	EXA-405	Control System	60	30	10	30	20	150	2	1	2	4
6	EXA-406	Software Lab I (Circuit Simulator)	-	-	-	30	20	50	-	-	2	1
7	EXA-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	EXA-501	Electrical Machines – II	60	30	10	30	20	150	2	1	2	4
2	EXA-502	Microprocessors	60	30	10	30	20	150	2	1	2	4
3	EXA-503	Power Electronics	60	30	10	30	20	150	2	1	2	4
4	EXA-504	Program Elective - I	60	30	10	-	-	100	3	1	0	4
5	EXA-505	Open Core Elective - I	60	30	10	-	-	100	3	1	0	4
8	EXA-508	Industrial Training-I				150	100	250			4	2
	TOTAL		**300**	**150**	**50**	**240**	**160**	**900**	**12**	**5**	**10**	**22**

Program Elective - III	
EXA-504 (A) Electrical Machine Design	EXA-504 (B) Computer Networks
Open Core Elective-II	
EXA-505 (A) Analog and Digital Communication	EXA-505 (B) Electromagnetic Fields

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	EXA-601	Power Systems – II	60	30	10	30	20	150	2	1	2	4
2	EXA-602	Electrical Drives	60	30	10	30	20	150	2	1	2	4
3	EXA-603	Program Elective - II	60	30	10	-	-	100	3	1	0	4
4	EXA-604	Program Elective - III	60	30	10	-	-	100	3	0	0	3
5	EXA-605	Open Core Elective-II	60	30	10	-	-	100	3	0	0	3
6	EXA-606	Project -I(Minor)	-	-	-	180	120	300	-	-	4	2
	TOTAL		**300**	**150**	**50**	**260**	**140**	**900**	**13**	**3**	**08**	**20**

Program Elective - II		
EXA-603	EXA-603 (A) Computer Architecture	EXA-603 (B)Digital Signal Processing
	EXA-603Electrical and Hybrid Vehicles	
Program Elective - III		
EXA-604	EXA-604 (A)Electrical Energy Conservation and Auditing	EXA-604 (B)Industrial Electrical Systems
	EXA-604 (C) Digital Control Systems	
Open Core Elective-II		
EXA-605	EXA-605 (A)VLSI circuits	EXA-605 (B)Image Processing
	EXA-605 (C) Power Plant Engineering	

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	EXA-701	Power System Protection	60	30	10	30	20	150	3	0	2	3
2	EXA-702	Solar PV Application	60	30	10	30	20	150	3	0	2	3
3	EXA-703	Program Elective-IV	60	30	10	-	-	100	3	0	0	3
4	EXA-704	Open Core Elective - III	60	30	10	-	-	100	3	0	0	3
6	EXA-705	Project Stage-I	-	-	-	120	80	200	-	-	10	4
7	EXA-706	Self Study/GD/Seminar					200	200			2	1
	TOTAL		**240**	**120**	**40**	**160**	**340**	**900**	**12**	**0**	**16**	**20**

Program Elective - IV		
EXA-701	EXA-701 (A)HVDC Transmission Systems	EXA-701 (B)Power Quality and FACTS
	EXA-701(C) Power System Dynamics and Control	
Open Core Elective-III		
EXA-703	EXA-703 (A)Wind and Solar Energy Systems	EXA-703 (B) Strength of Materials
	EXA-703 Intelligent Systems	

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	EXA-801	Advanced Electric Drives	60	30	10	30	20	150	3	0	0	4
3	EXA-802	Program Elective-V	60	30	10	-	-	150	3	0	0	3
4	EXA-803	Open Core Elective - IV	60	30	10	-	-	100	3	0	0	3
6	EXA-804	Project Stage-II	-	-	-	240	160	400	-	-	16	8
	TOTAL		**180**	**90**	**30**	**230**	**220**	**750**	**9**	**0**	**18**	**18**

Program Elective - V		
EXA-801	EXA-801 (A)Power Controller	EXA-801 (B)Optical Instrumentation & Measurement
	EXA-801 (C)Digital Image Processing	EXA-801 (D)Digital Image Processing
Open Core Elective-IV		
EXA-802	EXA-802 (A)EHVAC & DC	EXA-802 (B) Machine Learning
	EXA-802 (C) Modern Manufacturing Processes	\

* Additional open electives can be provided as per the availability of faculty in the University and student should produce prior permission from Dean with a batch of atleast 5 students.

(10) Course Content

Semester- I

BEBSC-101 Mathematics-I

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

OBJECTIVE:-

The Preamble 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.

Outcome:-

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, 2010.

BEBSC-102 Engineering Chemistry

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

OBJECTIVE:

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

REFRENCES:

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. engg. Chemistry jain.jain
6. engg. 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.

Course Outcomes (CO):

At the end of this course students will have:

CO1: Ability to design a language component or process to meet desired need within Realistic, Constraints such as economic, environmental, social, political, ethical Scenario.
CO2: Ability to analyze the usage of English words in different contexts.
CO3: An understanding of technical and academic articles' comprehension.
CO4: 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-VBusiness 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 Engineering

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

Course Objectives:

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.

Course 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

Reference's: -

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

Laboratory objectives:

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

Laboratory 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 single phase transformer
10. Determination of efficiency of a dc shunt motor by load test
11. To study running and speed reversal of a three phase induction motor and record speed in both directions.
12. Demonstration of cut-out sections of machines: dc machine, three phase induction machine, single-phase induction machine and synchronous machine.
13. To study the V-I Characteristics of Transistors.

14. 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

COURSE OBJECTIVE:s

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 Venire 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

COURSE OBJECTIVE:

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.

Course 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.

BEBSC-201 Mathematics-II

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

COURSE OBJECTIVE:s

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

Course 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 equations
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, 9^{th} 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

- an ability to apply knowledge of mathematics, science, and engineering.
- an ability to design and conduct experiments, as well as to analyze and interpret data.
- an ability to design a system, component, or process to meet desired needs within realistic constraints.
- an ability to function on multidisciplinary teams.
- an ability to identify, formulate, and solve engineering problems.
- an understanding of professional and ethical responsibility.
- an ability to communicate effectively.
- the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
- a recognition of the need for, and an ability to engage in life-long learning.
- a knowledge of contemporary issues.
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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 .Resolving Power of Telescope.

6 .V-I Charecteristics of P-N Junction diode.

7. 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

Preamble:-

- 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.

Outcome:-

- 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-Preambles 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

Reference books:

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

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 a employee table.

BEESC-204 Basic Mechanical Engineering

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

Preamble:

- 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

COURSE OBJECTIVE:: 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. Our 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

COURSE OBJECTIVE:: 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.

Topics to be covered in the Language laboratory sessions:

1. **1.** Introducing oneself, family, social roles.
2. 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

Preamble

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 -III

BEA-301 Mathematics-III

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

COURSE OBJECTIVE:
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.

Course 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 and Fourier transform 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.

References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
9. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. Statistics.

EXA-302 Signals and Systems

EXA-302	Signals and Systems	2L:1T:0P	3 Credits	2Hrs/Week

Unit I- Classification of signals and systems: (12 Hours)

Continuous time signals (CT signals), Discrete time signals (DT signals) - Step, ramp, pulse, impulse, sinusoidal and exponential signals, basic operations on signals, classifications of CT and DT signals- Periodic and aperiodic signals, energy and power signals, random signals, CT systems and DT systems, basic properties of systems, basic properties of systems, linear time invariant systems and properties.

Unit II- Analysis of continuous time signals: (08 Hours)

Time and frequency domain analysis, Fourier series analysis, spectrum of CT signals, Fourier transform and Laplace transform, region of convergence, wavelet transform.

Unit III- Linear time invariant continuous time systems: (08 Hours)

Differential equations representation, block diagram representation, state variable representation and matrix representation of systems, impulse response, step response, frequency response, relizability of systems, analog filters.

Unit IV- Analysis of discrete time signals: (10Hours)

Convolution sum and properties, sampling of CT signals and aliasing, DTFT and properties, Z transform and properties, inverse Z transform..

Unit V- State Space Analysis: (12 Hours)

Linear time invariant discrete time systems: Difference equations, block diagram representation, impulse response, analysis of DT LTI systems using DTFT and Z transform, state variable equations and matrix representation of systems, Digital filters.

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.

EXA-303 Electrical Measurements and Instruments

EXA-303	Electrical Measurements and Instruments	2L:1T:0P	3 credits	2Hrs/Week

COURSE OBJECTIVE

The primary objective of the course is to introduce operation principles of instruments, terminology related to measurements and to have an adequate knowledge in measurement techniques for voltage, current, power and energy.

COURSE OUTCOME:

After successful completion of course, Students are expected to possess an in-depth understanding and Knowledge of the concepts and principles of measurement of electrical and non electrical viz. physical quantities and instruments.

UNIT-1

Galvanometers –(10 hours): Theory, principle of operation and construction of ballistic galvanometer, D'arsonal galvanometer, Definition of analog & digital instruments, Classification of analog instruments, their operating principle, Operating force, Types of supports, Damping, Controlling.

UNIT-2

Different types of Ammeter & Voltmeter –(8 hours): PMMC, MI, Electrodynamometer, Induction, Expression for control & deflection torque, their advantages, disadvantages & error, Extension of range of instruments using shunt & multiplier**.** Digital Voltmeter, Ammeter, Multimeter and Wattmeter.

UNIT-3

Instrument transformers: (7 hours): Potential and current transformers, ratio and phase angle errors, testing of instrument transformers, Difference between CT and PT, errors and reduction of errors.

UNIT-4

Measurement of power: (8 hours): Power in AC and DC Circuit, Electrodynamometer type of wattmeter, Construction, theory, operation & error, Low power factor & UPF wattmeter, Double element and three element dynamometer wattmeter, Measurement of power in three phase circuit, one, two & three wattmeter method, Measurement of reactive power by single wattmeter, Measurement of power using CTs & PTs.

UNIT-5

Measurement of Energy: (9 hours): Single phase and three phasedigital / Electronic energy meter – construction & operation – Energy flow and power calculations, errors – Testing by phantom loading, Tri-vector meter, Maximum demand meter, Ampere hour meter.Power factor meter– Single phase and three phase Electro-dynamometer type & moving iron type. Frequency meter – Vibrating reed, Resonance type & Weston type, Synchronoscope, Ohmmeter –series & stunt type, Megger & Ratio meter. Resistance Measurement – Classification of low, medium & high resistance – Voltmeter-Ammeter method, Wheatstone Bridge, Kelvin's double bridge & loss of charge methods for resistance measurement, Earth resistancemeasurement. Magnetic Measurement – B-H Curve, Hysteresis Loop determination, Power loss in sheet metal – Lloyd Fischer square for measurement of power loss.

Topics for the laboratory (Expandable):

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 earth resistance by fall of potential method and verification by using earth tester
6. Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method
7. Calibration of a dynamometer type of wattmeter with respect to a standard/Sub Standard wattmeter
8. Calibration of single phase digital/ Electronic type energy meter.
9. Calibration of a dynamometer type of wattmeter by Phantom Loading method.
10. Measurements using Instrument Transformers.
11. Study of various types of Indicating Instruments.
12. Measurement of Power in three phase circuit by one, two & three wattmeters.

Text book:-

1. A.K. Sawhney; 'A course in Electrical & Electronic Measurements & Instrumentation'; Dhanpat Rai & co(p) Ltd ,New Delhi

Reference books:-

2. G. K. Banerjee,' Electrical and Electronic Measurements'. PHI Learning Pvt.Ltd.
3. R. B. Northrop,' Introduction to Instrumentation and Measurement'; CRC press Taylor & Francis
4. Vijay Singh;' Fundamentals of Electrical & Electronic Measurements', New Age International Publishers.

EXA-304 Network Analysis

EXA-304	**Network Analysis**	**3L:0T:0P**	**3 credits**	**2Hrs/Week**

COURSE OBJECTIVE

This Course introduces examination of electrical & electronic circuit analysis & synthesis tools &techniques such as the Laplace transform, nodal analysis & two port network theory.

COURSE OUTCOME

Student after successful completion of course must be able to apply the Thévenin, Norton, nodal and mesh analysis to express complex circuits in their simpler equivalent forms and to apply linearity and superposition concepts to analyze RL, RC, and RLC circuits in time and frequency domains and also to analyze resonant circuits both in time and frequency domains.

UNIT-1(12 hours):

Introduction to circuit elements R,L,C and their characteristics in terms of linearity & time dependent nature, voltage & current sources controlled & uncontrolled sources KCL and KVL analysis, Nodal & mesh analysis, analysis of magnetically coupled circuits, Transient analysis :-Transients in RL, RC&RLC Circuits, initial conditions, time constants. Steady state analysis-Concept of phasor & vector, impedance & admittance, Network topology, concept of Network graph, Tree, Tree branch & link, Incidence matrix, cut set and tie set matrices, dual networks, Dot convention, coupling co- efficient, tuned circuits, Series & parallel resonance.

UNIT-2(8 hours):

Network Theorems for AC & DC circuits- Thevenins & Norton's, Superpositions, Reciprocity, Compensation, Substitution, Maximum power transfer, and Millman's theorem, Tellegen's theorem, problems with dependent & independent sources.

UNIT-3(8 hours):

Frequency domain analysis – Laplace transform solution of Integro-differential equations, transform of waveform synthesized with step ramp, Gate and sinusoidal functions, Initial & final value theorem, Network Theorems in transform domain

UNIT-4(10 hours):

Concept of signal spectra, Fourier series co-efficient of a periodic waveform, symmetries as related to Fourier coefficients, Trigonometric & Exponential form of Fourier series.

UNIT-5(8 hours):

Network function & Two port networks – concept of complex frequency, Network & Transfer functions for one port & two ports, poles and zeros, Necessary condition for driving point & transfer function. Two port parameters – Z, Y, ABCD, Hybrid parameters, their inverse & image parameters, relationship between parameters, Interconnection of two ports networks, terminated two port networks.

Topics for the laboratory (Expandable):

EXA-304	**Network Analysis**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

1. To Verify Thevenin Theorem.
2. To Verify Superposition Theorem.
3. To Verify Reciprocity Theorem.
4. To Verify Maximum Power Transfer Theorem.
5. To Verify Millman's Theorem.
6. To Determine Open Circuit parameters of a Two Port Network and to Determine Short Circuit parameters of a Two Port Network.

   To Determine A,B, C, D parameters of a Two Port Network
7. To Determine h parameters of a Two Port Network
8. To Find Frequency Response of RLC Series Circuit.
9. To Find Frequency Response of RLC parallel Circuit.

REFERENCES

1. M.E. Van Valkenburg, Network Analysis,Pearson
2. William H Hayt. & Jack E. Kemmerly, Steven M Durbin; Engineering Circuit Analysis;McGrawHill
3. Richard C Dorf, James A Svoboda, Introduction to Electric Circuits, Wiley India, 2015
4. Charles K. Alexander & Matthew N.O. Sadiku: Electrical Circuits; McGrawHill
5. J David Irwin, Robert M Nelms, Engineering Circuit Analysis, Wiley India,2015
6. Robert L Boylestad, introductory circuit analysis, Pearson,2016
7. M S Sukhija, T K Nagsarkar; Circuits and Networks, Oxford University Press, 2015
8. Samarajit Ghosh, Network Theory Analysis and Synthesis

EXA-305 Analog Electronics

EXA-305	Analog Electronics	2L:1T:0P	3 credits	2Hrs/Week

COURSE OBJECTIVE:

The Preambles are to study

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.

Course 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 C(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 C(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.

EXA-305	**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

EXA-306 Java Programming

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

COURSE OBJECTIVE:

- 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.

Course 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.

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

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

The main Preamble 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.

EXA-308-NSS/NCC

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

COURSE OBJECTIVE:

- 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.

Course 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

SEMESTER –IV

BEA-401 Energy ,Ecology, Environment & Society

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

Unit 1 Sources of Energy (6 Hrs):
Renewable & Non Renewable, Fossil fuel, Biomass Geothermal, Hydrogen, Solar, Wind, hydro, nuclear sources.

UNIT-2 Segments of Environment: (6 Hrs):
Atmosphere, hydrosphere, Lithosphere, biosphere. Cycles in Ecosystem – Water, Carbon, Nitrogen. Biodiversity: Threats and conservation

UNIT-3 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-4 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-5 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, Preambles 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

EXA-402 Digital Electronics

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

COURSE OBJECTIVE
This course covers the basics of digital logic circuits and design. It provides Boolean algebra concepts and their application in digital circuitryand elaborates on both combinational and sequential circuits.Memory circuits are also covered.

COURSE OUTCOME:
Student after successful completion of course must possess an understanding of numerical values in various number systems and perform number conversions between different number systems and Understand the importance and need for verification, testing of digital logic and design for testability. The student will be able to design, simulate, built and debug complex combinational and sequential circuits based on an abstract functional specification.

UNIT 1:

Number Systems and Codes: (10 Hrs): Digital number systems, base conversion, Binary, Decimal, octal, Hexadecimal, number system with radix r, Gray codes. Alpha numeric codes – ASCII code and BCD codes, concept of parity, complement's& (r-1)'s, subtraction with complements, signed Binary numbers, Error Detecting & Correcting codes. Basic Theorems & Properties of Boolean algebra: AND, OR, NOT operators, laws of Boolean algebra, Demorgon's theorem, Boolean expression & logic diagram. Negative logic, Alternate logic gate representation (concept of bubbled gates) canonical and standard Forms (Minterms & Maxterms), sum of minters& product of maxterms, conversion between canonical forms. Truth table & maps, 2,3,4,5 and 6 variable maps, solving digital problems using Maps, Don't care conditions, Tabular minimization. Sum of product & product of sum reduction, Exclusive OR & Exclusive NOR circuits, Parity generator &checkers.

UNIT 2:

Combinational Circuits: (10 Hrs): Design procedure, Adders (half and Full), subtracted (half and full) code convertors, Analysis of design, Universal building blocks, Implementation of any logic circuit with only NAND gates or with only NOR gates, Binary serial adder, parallel adder, serial/parallel adder, look ahead carry generator, BCD adder, Binary multiplier, Magnitude comparator, Decoder, DE multiplexer, Encoders, priority encoder, Multiplexers & implementation of combinational logic diagram.

UNIT-3:

Sequential Logic Circuit: (10 Hrs): Latches, SR latch with NAND & NOR gates, D latch, edge triggered flip flop, J-K flip flop, T flip flop, Master slave flip flop, Analysis of clocked sequential circuit, state table, state diagram, state reduction state equations, state assignments, flip flop excitation table & characteristic equations, Design procedure for sequential circuits, Design with state reduction, Applications of flip-flop.

UNIT 4:

Registers and Counters : (10 Hrs): Asynchronous and Synchronous counter, counters with MOD numbers, Down counter, UP/DOWN counter, propagation delay in ripple counter, programmable counter, Pre- settable counter, BCD counter, cascading, counter applications, Decoding in counter, Decoding glitches, Ring Counter, Johnson counter, Rotate left & Rotate right counter, Registers – Buffer, Shift left, shift right, shift left/Right registers, parallel in parallel out, serial in serial out, parallel in serial out, serial in parallel out registers.

UNIT 5:
(10 Hrs):
Random Access Memory, Timing waveform, Memory Decoding, Internal Construction, Coincident decoding, Address multiplexing, Read only memory – Combinational circuit

implementation, Type of ROMs, combinational PLDs, Programmable Logic Array (PLA), Programmable Array Logic (PAL), sequential programmable device. Analog to digital conversion – Ramp type, dual slope, integration, successive approximation,

parallel conversion, parallel/ serial conversion, convertor specifications, Digital to Analog convertors – Binary weighted & R/2R D to A convertors.

References:

1. Anand Kumar, Fundamentals of digital circuits, PHI
2. A K Maini, Digital Electronics, Wiley India
3. Thomas Blakeslee; Digital Design with standard MSI and LSI; Wiley Interscience
4. Jain RP; Modern digital electronics; TMH
5. M Mano; Digital Logic & Computer design; PHI
6. Tocci ; Digital Systems Principle & applications; Pearson EducationAsia
7. Gothmann; Digital Electronics;PHI
8. Malvino, Leech; Digital Principles and applications–(TMH)
9. Floyad; Digital Fundamentals(UBS)
10. Nripendra N. Biswas; Logic Design Theory(PHI)
11. D.C. Green; Digital Electronics (Pearson EducationAsia)
12. SubrataGhoshal; Digital Electronics, Cengage

EXA-402 Digital Electronics

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

List of Experiments (Expandable):

1. Verification of all the logicgates.
2. Design of BCD to Excess-3 codeconverter.
3. Implementation of NAND & NOR as Universalgate.
4. Design of RS, JK, T& D Flipflop.
5. Multiplexer /Demultipexer based boolean function
6. Design of combinational circuit for the
7. Halfadder
8. Fulladder
9. Half subtractor
10. Fullsubtractor
11. Design various A-D & D-Aconvertors.
12. Verify the truth table of SR flip flop
13. Verify BCD to seven segment decoder.

EXA-403 Electrical Machines – I

EXA-403	Electrical Machines – I	3L:0T:0P	3 Credits	2Hrs/Week

COURSE OBJECTIVE
The objective of this foundational course is to develop fundamentals, physical concepts and systematic development of circuit models analysis of transformers, induction motors and special machines

COURSE OUTCOME:
After the completion of course, students must learn the foundation to the theory of electromechanical devices with specific emphasis on transformers and induction motor.

UNIT 1
Transformer-I: (10 Hrs): Working principle, e.mf. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses, separation of hysteresis and eddy current losses, efficiency, tests: open circuit and short circuit, load, Sumpner's test, Condition for maximum efficiency and regulation, Power and distribution transformer, allday efficiency, Excitation phenomenon. Autotransformer: working, advantages, its equivalent circuit and phasor diagram.

UNIT 2

Transformer-II: (8 Hrs): Three phase transformer: its construction, groups and connections, their working and applications; Scott connection; Parallel operation of Transformers: application, advantages, requirement and load sharing; Tap changers, cooling, conservator and breather. Pulse and high frequency transformers.

UNIT 3

Three phase Induction Motor- I: **(8 Hrs):**Working principle, construction, comparison of slip ring and squirrel cage motors, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque-speed and power-speed characteristics, Losses and efficiency, No load and block rotor test, circle diagram

UNIT 4

Three phase Induction Motor-II: (10 Hrs): Starting of squirrel cage and slip ring motors, power factor control, Cogging & Crawling, Double cage &Deep bar Indication Motor, impact of unbalanced supply and harmonics on performance, speed control, braking, Induction Generator. Applications

UNIT 5

Single Phase Motors: (10 Hrs): Single Phase Induction motor; double revolving field theory, equivalent circuit and its determination, performance calculation, starting methods and types of single phase Induction motors: their working principle and applications, comparison with three phases Induction Motor. Single phase A.C. series motor, Servo motors, Linear Induction Motor

TEXT BOOKS

Electrical Machines by Nagrath and Kothari, McGraw-Hill
P.S.Bimbhra, Electrical Machines,Khanna Publishers

REFERENCES

1. V.Del Toro, "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., EnglewoodCliffs

2. S K Bhattacharya, Electrical Machines, McGraw-Hill
3. Ashfaq Hussain, Electrical Machines, Dhanpat Rai & Co
4. Langsdorf, A.C. Machines, McGraw-Hill
   Samarajit Ghosh, Electrical Machines, Pearson

EXA-403	Electrical Machines – I	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments (expandable)

1. Perform turn ratio and polarity test on 1-phasetransformer
2. Perform load test on a 1-phase transformer and plot its load characteristic
3. Perform OC and SC tests on a 1-phase transformer and determine its equivalent circuit. Also find its efficiency and regulation at different load and power factor.
4. Perform OC and SC tests on a 3-phase transformer and determine its equivalent circuit. Also
5. find its efficiency and regulation at different load and power factor.
6. Perform Sumpner's test on two 1-phase transformer and determine its efficiency at various load.
7. Perform No-load and block rotor test on a 3- phase IM and determine its equivalent circuit.
8. Perform load test on a 3- phase IM and plot its performance characteristics.
9. Study various types of starters used for 3- IMs.
10. Perform No-load and block rotor test on a 1- phase IM and determine its equivalent circuit.

EXA-404 Power System – I

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

COURSE OBJECTIVE

The objective of this course is to get an overview of the power systems and its changing landscape. It covers the characteristics of various power system loads, analysis of transmission line along with its performance.

COURSE OUTCOME Student after successful completion of course must possess an understanding of Power generation, Transmission Line Components, Underground Cables, transmission lines and their representation, conductors and insulators.

UNIT 1: An overview of Electrical Energy Generation General background: (10 Hrs): structure and components of power network. Power generation – Introduction to conventional, non-conventional & distributed generation, Effect of transmission voltage on power system economy. Selection of size of feeder. Comparison of isolated versus interconnected power system. Problems associated with modern large interconnected power system. Power Plant Economics - Load curves, base load, peak load, load factor, demand factor, diversity factor, capacity factor, utilization factor, cost of electricity, capital cost, fuel and operation cost.

UNIT 2: Transmission Line Components & Under Ground Cabling: (12 Hrs): Inductance resistance and capacitance of transmission line, Calculation of inductance for 1-Φ and 3- Φ, Single and double circuit line, Concept of GMR and GMD, Symmetrical & asymmetrical conduction configuration, Calculation of capacitance for 2 wire and 3 wire systems, Effect of ground or capacitance, Capacitance calculation for symmetrical and asymmetrical 1-phase and three phase, Single and double circuit line, Charging current, Transposition of line, Composite conductor, Skin and proximity effect, bundle conductor. Underground Cable Comparison of cables and overhead transmission lines, Classification of cables, requirement of cable construction, capacitance of single and multi-core cable, economic core diameter, dielectric stress in cable, Grading of cables, ionization of Heating of cables, Phenomena of dielectric losses and sheath loss in cables, Thermal resistance of cables.

UNIT 3: Transmission systems & performance of transmission line: (10 Hrs): Various systems of transmission, effect of system voltage, comparison of conductor materials required for various overhead systems. Short, Medium & long transmission line and their representation, Nominal T, Nominal Л, Equivalent T and equivalent Л, network models, ABCD constants for symmetrical &asymmetrical network, Mathematical solution to estimate regulation efficiency of all types of lines. Surge Impedance, loading, Interpretation of long line equation and its equivalent equation. Tuned power lines. Power flow through transmission line, Circle diagram, Method of voltage control, Static & rotating VAR generator, transformer control.

UNIT 4:

Insulator & Mechanical design(10 Hrs): Types of conductors used in overhead transmission line, Types of line supports and towers, Distribution of conductors over transmission towers, Spacing between conductors, Length of span and sag tension calculation for transmission line, Wind & ice loading, support of line at two different levels, string chart, Sag template, Stringing of conductor, Vibration and Vibration dampers. Insulator Materials used for transmission line insulations, Types of insulator for overhead transmission line failure of insulator, Voltage distribution of suspension insulator, String efficiency, Shielding and grading.

UNIT 5:

Voltage control & Distribution system: (10 Hrs): AC single phase, 3 phase, 3wire & 4 wire distribution, Kelvin's law for most economical size of conductor Substation layout showing substation equipment, bus bar single bus bar and sectionalized bus bar, main and transfer for bus bar system, sectionalized double bus bar system, ring mains.

REFERENCES

1. John Grainger and William Stevenson, Power system Analysis, McGraw Hill.
2. C.L. Wadhwa, Electrical Power System Analysis, New Age International.
3. D.P. Kothari, I.J. Nagrath, Power System Engineering TMH II Ed. Reprint 2009.

EXA-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.

EXA-405 Control System

EXA-405	Control System	2L:1T:0P	3 Credits	3Hrs/Week

COURSE OBJECTIVE

This course introduces students to foundation of frequency-domain design methods for analysis and design of continuous-time control systems, which form the essentials for industrial practice.

COURSE OUTCOME

After successful completion of course, Students are expected to possess an in-depth understanding andknowledge about the practical control system designs.

UNIT 1:

Modeling of dynamic systems: Electrical, Mechanical and hydraulic systems, Concept of transfer function, Laplace Transform, State space description of dynamic systems: Open and closed loop systems, Signal flow graph, Mason's formula, Components of control systems: Error detectors (Synchros& Potentiometer), Servomotors (AC & DC), tacho-generators, power amplifier, steeper motors.

UNIT 2:

Time – domain analysis of closed loop systems: Test signals, time response of first and second order systems, Time domain performance specifications, Steady state error & error constants Feedback control actions: Proportional, derivative and integral control. .

UNIT-3:

Stability: Routh-Hurwitz stability analysis Characteristics equation of closed loop system root loci, construction of loci, Effect of adding, poles and Zeros on the loci, Stability by root loci.

UNIT-4:

Frequency, Domain analysis, Bode plots, Effect of adding, poles and Zeros, Polar plot, Nyquist stability analysis, Relative stability: Gain and phase margins.

UNIT-5:

Design of control systems with PD/PI/PID Control in time domain and Frequency domain, lead-lag, Lag-lead compensation, Design of compensating networks. Solution of state equation: Eigen values & eigenvectors digitalization state transitive matrix

EXA-405	Control System	0L:0T:1P	1 Credits	2Hrs/Week

List of experiments (Expandable)

1. Time response of second order system.
2. Characteristics of Synchros.
3. Effect of feedback on servomotors.
4. Determination of transfer function of A-C servomotor
5. Determination of transfer function of D-C motor.
6. Formulation of PI & PD controller and study of closed loop responses of 1st and 2nd order dynamic systems. State space model for classical transfer function using MATLAB.
7. Simulation of transfer function using operational amplifier.
8. Design problem: Compensating Networks of lead and lag.
9. Temperature controller using PID.
10. Transfer function of a DC generator.

11. Characteristics of AC servomotor.
12. Use of MATLAB for root loci and Bode plots of type-1, type-2 systems.
13. Study of analog computer and simulation of 1st orderand 2nd order dynamic equations.
14. Formulation of proportional control on 1st order and 2nd order dynamic systems.
15. Feedback control of 3rd order dynamic Systems

REFERENCES

1. B.C. Kuo and FaridGolnaraghi, 'Automatic Control Systems', Wiley India.
2. M. Gopal, 'Control system engineering', McGraw Hill
3. K. Ogata, 'Modern Control Engineering', Pearson
4. D. Roy, Chaudhary,'Modern Control Systems', PHI.
5. S. Salivahanan, R. Rengaraj, G.R. Venkatakrishnan, 'Control System Engineering', Pearson.
6. Stefani ShahianSavant,Hostetter, 'Design of feedback control systems' Oxford
7. B.S.Manke, Control system Engineering, Khanna Publishers

EXA-406 Software Lab-I (Circuit Simulator)

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

Lab Preamble:

To introduce students

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

Lab 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

EXA- 407- Industrial Training – I

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

Preamble

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

EXA-501 Electrical Machines – II

EXA-501	Electrical Machines – II	2L:1T:0P	3 Credits	3Hrs/Week

COURSE OBJECTIVE:s:
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.

Course 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.

EXA-501	Electrical Machines – II	0L:0T:1P	1 Credits	2Hrs/Week

List of Experiments (Extendable):

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

EXA-502 Microprocessors

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

COURSE OBJECTIVE:

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.

Course 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 1: 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 2: 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 3: 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 4: 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 5: 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.

EXA-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.

EXA-503 Power Electronics

EXA-503	Power Electronics	2L:1T:0P	3 Credits	3Hrs/Week

Course Preamble:

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.

Course 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

EXA-503	**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

Program Elective - I

EXA-504 (A) Electrical Machine Design

EXA-504 (A)	Electrical Machine Design	3L:0T:0P	3 Credits	3Hrs/Week

COURSE OBJECTIVE:

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

Course 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 1: 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 2: 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 3: 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 curret circle diagram, leakage reactance of polyphase machines, magnetizingcurrent

Unit 4: 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 5: 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 Preamble 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.

EXA-504 (B) Computer Networks

EXA-504 (B)	Computer Networks	3L:0T:0P	3 Credits	3Hrs/Week

Preambles of the course

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.

Course Outcomes

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
3. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component
4. For a given problem related TCP/IP protocol developed the network programming.
5. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Unit 1: (9 Hours)

Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

Unit 2: (9 Hours)

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD,CDMA/CA

Unit 3: (10 Hours)

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routingprotocols.

Unit 4: (8 Hours)

Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

Unit 5: (6 Hours)

Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography

Suggested books :

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
3. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
4. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
5. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

EXA-505 (A) Analog and Digital Communication

EXA-505 (A)	Analog and Digital Communication	3L:0T:0P	3 Credits	3Hrs/Week

Course Outcomes:

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

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1 : Introduction (6 Hours)

Review of signals and systems, Frequency domain representation of signals, Principles of AmplitudeModulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Unit 2 : Probability (10Hours)

Review of probability and random process. Gaussian and white noise characteristics,Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De- emphasis, Threshold effect in angle modulation.

Unit 3 : Sampling (10 Hours)

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Unit 4 : Interfacing (10 Hours)

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations. BasebandPulse Transmission- Inter symbol Interference and Nyquist criterion.Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Unit 5 : Digital Modulation (6 Hours)

Digital Modulation tradeoffs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

EXA-505(B) Electromagnetic Fields

EXA-505	Electromagnetic Fields	3L:0T:0P	3 credits	3Hrs/Week

Course Preamble:

- 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.

Course 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

EXA-506 Industrial Training-I (Minor)

EXA-506	**Industrial Training-I (Minor)**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

COURSE OBJECTIVE::

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.

Course 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.
- Organizational 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

EXA-601 Power Systems – II

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

Course 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 and

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.

Text/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.

EXA-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)

EXA-602 Electrical Drives

EXA-602	Electrical Drives	3L:0T:0P	3 credits	3Hrs/Week

Course 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.

Text / 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.

EXA-602	**Electrical Drives Laboratory**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

LIST OF EXPERIMENT

1. Study of thyristors controlled DC Drive.

2. Study of Chopper fed DC Drive.

3. Study of AC Single phase motor-speed control using TRIAC.

4. PWM Inverter fed

3 phase Induction Motor control using PSPICE / MATLAB / PSIM Software.

5. VSI / CSI fed Induction motor Drive analysis using MATLAB / SPICE / PSIM Software.

6. Study of V/f control operation of 3phase induction motor drive.

7. Study of permanent magnet synchronous motor drive fed by PWM Inverter using Software.

8. Regenerative / Dynamic braking operation for DC Motor - Study uses software.

9. Regenerative / Dynamic braking operation of AC motor - study uses software.

10.PC/PLC based AC/DC motor control operation.

Program Elective - II

EXA-603 (A) Computer Architecture

EXA-603 (A)	Computer Architecture	3L:0T:0P	3 credits	3Hrs/Week

Course 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

EXA-603 (B) Digital Signal Processing

EXA-603 (B)	Digital Signal Processing	3L:0T:0P	3 credits	3Hrs/Week

COURSE OBJECTIVE::

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.

Course 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; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform,

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

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

Unit -3 Design of FIR Digital filters(10Hrs):

: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop 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.

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

Program Elective - III

EXA-604 (A) Electrical Energy Conservation and Auditing

EXA-604 (A)	Electrical Energy Conservation and Auditing	3L:0T:0P	3 credits	3Hrs/Week

Course Outcomes:

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

- Understand the current energy scenario and importance of energy conservation.
- Understand the concepts of energy management.
- Understand the methods of improving energy efficiency in different electrical systems.
- Understand the concepts of different energy efficient devices.

Unit 1: Energy Scenario (6 Hours)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Unit 2: Basics of Energy and its various forms (6 Hours)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Unit 3: Energy Management & Audit (10 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-
requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Energy Efficient Technologies in Electrical Systems

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Unit 4: Energy Efficiency in Electrical Systems (10 Hours)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Unit 5: Energy Efficiency in Industrial Systems (10 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

EXA-604 (B) Industrial Electrical Systems

EXA-604 (B)	Industrial Electrical Systems	3L:0T:0P	3 credits	3Hrs/Week

Course 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 select the 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.

EXA-604 (C) Digital Control Systems

EXA-604 (C)	Digital Control Systems	3L:0T:0P	3 credits	3Hrs/Week

Course Outcomes:

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

1. Obtain discrete representation of LTI systems.

2. Analyse stability of open loop and closed loop discrete-time systems.

3. Design and analyse digital controllers.

4. Design state feedback and output feedback controllers.

Unit 1: Discrete System Representation and Analysis (12 hours)

Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit, Effects of Sampling and Quantization. Choice of sampling frequency.ZOH equivalent.

Unit 2 Z-Transform (6Hrs):

Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

Unit 3: Stability of Discrete Time System (6 hours)

Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

Unit 4: State Space Approach for discrete time systems (10 hours)

State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reachability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

Unit 5: Design of Digital Control System and Discrete output feedback control (8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator. Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

Text Books :

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.

2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.

3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, AddisonWesley,1998.

4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston,1980.

EXA-605 (A) VLSI Circuits

EXA-605 (A)	VLSI Circuits	3L:0T:0P	3 credits	3Hrs/Week

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.

EXA-605 (B) Image Processing

EXA-605 (B)	Image Processing	3L:0T:0P	3 credits	3Hrs/Week

COURSE OBJECTIVE:
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.

Course 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.

Text/Reference Books:

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

EXA-605 (C) Power Plant Engineering

EXA-605 (C)	Power Plant Engineering	3L:0T:0P	3 credits	3Hrs/Week

Preambles:

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

Course 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.

Text Books:

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 606 Projects-I (Minor)

EEA 606	Project-I (Minor)	0L:0T:3P	3 credits	6Hrs/Week

Course 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
4. limitations
5. understand statistical data analysis
6. Understand computerized data acquisition.

7. Conceive a problem statement either from rigorous literature survey or from the requirements
8. raised from need analysis.
9. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
10. Write comprehensive report on Minor project work.

Guidelines:

1. 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 Preambles of Minor project.
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
EXA-701 Power System Protection

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

COURSE OBJECTIVE:

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

Course 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.

Text/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.

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

Experiment

1. I.D.M.T. OVER CURRENT RELAY
2. 2 EARTH FAULT RELAY
3. OVER VOLTAGE RELAY
4. A,B,C,D,/HYBRID/IMAGE PARAMETERS OF TRANSMISSION LINE
5. TO STUDY OF SYMMETRICAL AND UNSYMMETRICAL FAULTS ON DC NETWORK ANALYZER
6. INSTANTANEOUS OVER CURRENT RELAY
7. L-G,L-L,L-L-G,L-L-LFAULT

EXA-702 Solar PV Application

EXA-702	**Solar PV Application**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Unit-I Solar Photovoltaic (10 Hrs): Solar Cell and its function, Solar Technologies, Solar Cell Parameters, Efficiency of Solar Cell, Solar PV Module, Rating of Solar PV Module, PV Module Parameters, Efficiency of PV Module, Measuring Module Parameters, Solar Photovoltaic Module Array Connection of PV Module in Series and Parallel, Estimation and Measurement of PV Module Power, Selection of PV Module

Unit-II Batteries (10 Hrs): Battery function, Types of Batteries, Battery parameters, Selection of Battery, Series Parallel combination of Batteries, Batteries for Photo voltaic System, Application of Batteries in Solar PV system, Battery Maintenance and Measurements, Battery Fault Detection and Test, Battery Installation for PV system.

Unit-III Controller (10 Hrs): Charge Controller, MPPT and Inverter Power MOSFET and IGBT, Opto coupler, Buck and Boost Converter, Fly back Converter, Full Bridge Inverter, Voltage and Current Feedback, DC to DC power converter, DC to AC Converter, AC to DC Converter, Battery Charge controller, Maximum Power Point Tracking, Specification of Inverter and charger.

Unit-IV Design (6 Hrs): Solar PV System Design and Integration Solar Radiation Energy Measurements, Estimating Energy requirement, Types of Solar PV System, Design methodology for SPV system, Design of Off Grid Solar Power Plant, Design and Development of Solar Street Light and Solar Lantern, Off Grid Solar power Plant.

Unit-V Installation (6 Hrs): Safety Installation and Trouble shooting of Standalone Solar PV System, Maintenance of Solar PV System, Safety in installation of Solar PV System.

References:

8. Chetan Singh Solanki, Solar Photovoltaic's: Fundamental Technologies and applications, 2 nd Edition, Prentice Hall India Learning Private Limited, 2011
9. H.P. Garg & Prakash, Solar Energy-Fundamentals and applications, TMH Publication, 2000
10. Tomas Markvart Solar Electricity, 2 nd Edition, John Wiley Publication, 12 May 2000
11. Michael boxwell, The Solar Electricity Handbook, Greenstream publishing, 2013

EXA-702	**Solar PV Application**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

1. Identifying and measuring the parameters of a solar PV module in the field

2. Series and Parallel Connection of PV modules

3. Estimating the effect of sun tracking on energy generation by solar PV modules

4. Efficiency measurement of Standalone Solar PV System

5. Measurement of current – voltage characteristics of crystalline silicon solar cell

a) Measurement by using 4 quadrant power supply and solar cell as load

i) in dark and ii) under illumination.

6. Measurement of current-voltage characteristics of two solar cells connected

a) in series and b) in parallel.

7. Dependence of current- voltage characteristics of crystalline silicon solar cell on

a) light intensity and b) temperature of solar cell

Program Elective-IV

EXA -703 (A) Power System Dynamics and Control

EXA 703 (A)	Power System Dynamics and Control	3L:0T:0P	3 credits	3Hrs/Week

Course 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 (110 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.

Text/Reference Books

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.

EXA-703 (B) HVDC Transmission Systems

EXA-703 (B)	HVDC Transmission Systems	3L:0T:0P	3 credits	3Hrs/Week

Course 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.

Text/References:

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

EXA-703 (C) Special Machines

EXA-703 (C)	Special Machines	3L:0T:0P	3 credits	3Hrs/Week

COURSE OBJECTIVE:

To introduce the theory, construction, design, control electronics, and in-depth analysis of several non-traditional machines such as stepper motors, switched reluctance motors, permanent magnet synchronous motors and brushless DC machines

Unit I-Stepper Motor (7 Hrs): Introduction, Types, Hybrid stepper motor- construction, principle of operation, two phases energized at a time, conditions for operation, different configurations, VR Stepper motor- single stack and multi stack, Drive systems and circuit for open loop and Closed loop control of stepping motor, Dynamic characteristics ,Single phase stepper Motor, Expression of voltage, current and torque for stepper motor and criteria for synchronization.

Unit II - Switched Reluctance Motor (6 Hrs): Constructional features, principle of operation, Design Aspects and profile of the SRM, Torque equation, Power converters and rotor sensing mechanism, expression of torque and torque-speed characteristics.

Unit III - Permanent Magnet synchronous motor(6 Hrs): Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self control, Vector control, Current control schemes.

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Unit IV - Permanent Magnet Brushless DC Motor(10 Hrs): Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessor based controller.

Unit V - Synchronous Reluctance Motors(10 Hrs): Constructional features: axial and radial air gap Motors, Operating principle, reluctance torque, phasor diagram, motor characteristics – Linear induction machines.

References:-

1. Vekatratnam, "Special Electrical Machines", Universities Press
2. Fitzerald and Kingsley," Electrical Machines" McGraw Hill. Miller. T. J. E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
3. Kenjo. T and Nagamori. S, "Permanent Magnet and Brushless DC Motors", Clarendon Press, Oxford, 1989.
4. Kenjo. T, "Stepping Motors and their Microprocessor Control", Clarendon Press, Oxford, 1989
5. Krishnan R, "Switched Reluctance Motor Drives", Modelling, Simulation, Analysis, Design and applications, CRC press

Open Core Elective-III

EXA-704(A) High Voltage Engineering

EXA-704(A)	High Voltage Engineering	3L:0T:0P	3 credits	3Hrs/Week

Course 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 (8 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 (7 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 (7 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.

Unit 4: Measurements of High Voltages and Currents (7 Hours)

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 5: Lightning and Switching Over-voltages (7 Hours)

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

Unit 6: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 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.

Text/Reference Books

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.

EXA-704(B) Control System Design

EXA-704(B)	**Control System Design**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

COURSE OBJECTIVE: :

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

Course Outcomes:

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

1. Understand various design specifications.

2. Designcontrollerstosatisfythedesireddesignspecificationsusingsimplecontroller

structures(P,PI,PID, compensators).

3. Design controllers using the state-space approach.

Unit 1: Design Specifications (6 hours)

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response.Effect of addition of pole on system performance. Effect of addition of zero on system response.

Unit 2: Design of Classical Control System in the time domain (6 hours)

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

Unit 3: Design of Classical Control System in frequency domain (8 hours):

Compensator design in frequency domain to improve steady state and transient response. Feedback and Feed forward compensator design using bode diagram.

Unit 4: Design of PID controllers (12 hours):

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.

Unit 5: Control System Design in state space (12 hours):

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & Observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer.

Separation Principle, Nonlinearities and its effect on system performance,Various types of non-linearities.Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books :

1. N. Nise, “Control system Engineering”, John Wiley,2000.

2. I. J. Nagrath and M. Gopal, “Control system engineering”, Wiley,2000.

3. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.

4. K. Ogata, “Modern Control Engineering”, Prentice Hall,2010.

5. B. C. Kuo, “Automatic Control system”, Prentice Hall,1995.

6. J. J. D’Azzo and C. H. Houpis, “Linear control system analysis and design (conventional and modern)”, McGraw Hill,1995.

7. R. T. Stefani and G. H. Hostetter, “Design of feedback Control Systems”,Saunders College Pub, 1994.

EXA-705 Projects-I (Major)

EXA-705	**Project-I (Minor)**	**0L:0T:10P**	**4 credits**	**10Hrs/Week**

Course Outcomes:

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

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

Guidelines:

1. The Major-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 Major 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 Preambles of Minor project.
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.

EXA-706 Self Study/GD/Seminar

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

COURSE OBJECTIVE:

The main Preamble 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.

Couse 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.

EXA-801 Advanced Electric Drives

EXA-801	Advanced Electric Drives	3L:0T:0P	3 credits	3Hrs/Week

Course Outcomes:

At the end of this course, students will demonstrate the ability to 1. Understand the operation of power electronic converters and their control strategies. 2. Understand the vector control strategies for ac motor drives 3. Understand the implementation of the control strategies using digital signal 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. Unit 6: 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.

Text / 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.

EXA-802 (A) EHVAC & DC

EXA-802 (A)	EHVAC & DC	3L:0T:0P	3 credits	3Hrs/Week

Unit- I Introduction: (6Hrs)
EHV A.C. and D.C. links, Kind of D.C. links, limitations and advantages of A.C. and D.C. transmission, principal application of A.C. and D.C. transmission, trends in EHV A.C. and D.C. transmission, power handling capacity, firing angle control, overlapping.

Unit- II FACTS Devices: (10Hrs)
Basic types of controller, series controller, static synchronous series compensator(SSSC), thyristor-controlled series capacitor(TCSC), thyristor controlled series reactor(TCSR), shunt controller (STATCOM), static VAR compensator(SVC), series series controller, combined series-shunt controller, unified power flow controller (UPFC), thyristor controlled phase shifting transformer(TCPST).

Unit- III Converters in EHV D.C: (10Hrs)
Components of EHV D.C. system, converter circuits, rectifier and inverter valves, reactive power requirements, harmonics generation, adverse effects, classification, remedial measures to suppress, filters, ground return, converter faults & protection ,commutation failure, multi terminal D.C. lines.

Unit- IV Controlling: (10Hrs)
Control of EHV D.C. system, control characteristics, constant current control, constant extinction angle control, ignition angle control, parallel operation of HVAC & DC system, problems & advantages.

Unit- V Transmission Systems: (6Hrs)
Travelling waves on transmission systems, attenuation, distortion, effect of junction and termination on propagation of traveling waves, over voltages in transmission system, lightning, switching and temporary over voltages, control of lighting and switching over voltages.

References:

1. S. Rao,- "EHV AC & DC Transmission" Khanna pub.
2. Kimbark,-" HVDC Transmission" john willy & sons pub.
3. Arrillaga,- "HVDC Transmission"2nd Edition ,IEE londan pub.
4. Padiyar, -"HVDC Transmission" 1st Edition ,New age international pub.
5. T.K. Nagsarkar,M.S. Sukhiza, -"Power System Analysis", Oxford University
6. Narain.G. Hingorani, l. Gyugyi-"Undustanding of FACTS concept and technology", john willy & sons pub.
7. 7.P.Kundur- "H.V.D.C. Transmission" McGraw Hill

EXA-802 (B) Machine Learning

EXA-802 (B)	Machine Learning	3L:0T:0P	3 credits	3Hrs/Week

UNIT-I Introduction: (10Hrs)

Learning, Types of Machine Learning. Some Basic Statistics: Averages, Variance and Covariance, Gaussian distribution, Bayes theorem. Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm. Learning with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II Time Series : (6Hrs)

AR, MA, ARMA, ARIMA , ARMAX for predictions using time dependent data. Linear Discriminants: Linear Separability, Linear Regression , Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis SUPPORT Vector Machines: Optimal Separation, Kernels The Bias-Variance Tradeoff.

UNIT-III Bayesian learning: (6Hrs)

Introduction, Bayes Optimal Classifier, Naive Bayes Classifier, Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm, Neural Networks : The Perceptron, Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation

UNIT-IV Clustering: (10Hrs)

Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming Ensemble learning: Boosting, Bagging

UNIT-V Case studies : (10Hrs)

Use of Data sets , Data Pre-processing and application of the suitable algorithms .

Suggested Reading:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill, 1997

2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009

3. Margaret H Dunham, Data Mining, Pearson Edition., 2003.

4. Galit Shmueli, Nitin R Patel, Peter C Bruce, Data Mining for Business Intelligence, Wiley India Edition, 2007 5. Rajjan Shinghal, Pattern Recognition, Oxford University Press, 2006.

EXA-802 (C) Modern Manufacturing Processes

EXA-802 (C)	Modern Manufacturing Processes	3L:0T:0P	3 credits	3Hrs/Week

COURSE OBJECTIVE:

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

Course 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

Text Books:

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

EXA 803(A) Economic Policies in India

EEA 803(A)	Economic Policies in India	3L:0T:0P	3 credits	3Hrs/Week

Unit –I Basic features and problems of Indian Economy: -(6 Hrs)
Nature of Indian Economy, demographic features and Human Resource Development (HDI), Problems of Poverty, Unemployment, Inflation, income inequality, Black money in India.

Unit-II Sectoral composition of Indian Economy (6 Hrs)
- Issues in Agriculture sector in India ,land reforms Green Revolution and agriculture policies of India , Industrial development , small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.
Unit-III Economic Policies :- (6 Hrs)
Economic Planning in India , Planning commission v/s NITI Aayog, monetary policy in India, Fiscal Policy in India,

Unit IV Centre state Finance Relations, (6 Hrs)
Finance commission in India. LPG policy in India.

Unit-V External sector in India: -(6 Hrs)
India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

Suggested Readings:

1. Dutt Rudder and K.P.M Sunderam (2001): Indian Economy, S Chand & Co. Ltd. New Delhi.

2. Mishra S.K & V.K Puri (2001) "Indian Economy and –Its development experience", Himalaya Publishing House.

3. KapilaUma: Indian Economy: Policies and Performances, Academic Foundation

4. Bardhan, P.K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.

5. Jalan, B. (1996), India's Economic Policy- Preparing for the Twenty First Century, Viking, New Delhi.

EXA 803 (B) Cyber Law and Ethics

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

COURSE OBJECTIVE:

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

Course 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 Hrs)

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 Hrs)

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 Hrs)

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 Hrs)

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 Hrs)

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

EXA 803(C) Internet of Things

EEA 803(C)	Internet of Things	3L:0T:0P	3 credits	3Hrs/Week

COURSE OBJECTIVE:

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.

Course 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 Hrs)**

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 Hrs)**

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

Unit 3 Network & Communication **(10 Hrs)**

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 Hrs)**

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

Unit 5 Other IoT applications **(6 Hrs)**

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

Reference Books:

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"

EXA- 804 Projects –II (Major)

EXA- 804	Projects –II (Major)	0L:0T:6P	6 credits	12Hrs/Week

COURSE OBJECTIVE:

The object of Project Work II & Dissertation 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, under the guidance of a Supervisor from the Department alone orjointly 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

(09) 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	□			□				□			□	