

SCHEME & SYLLABUS

B. Tech (Electrical Engineering)

Choice Based Credit System



Department of Electrical Engineering
University Institute of Engineering and Technology
Sant Baba Bhag Singh University
2021

1. ABOUT THE DEPARTMENT

The department offers a vibrant environment for education in Electrical Engineering. Our mission is to provide a high-quality education and prepare students to design and develop products as well as practical solutions to problems in public and private sectors. Currently, the department of Electrical Engineering offers B. Tech. in Electrical Engineering.

Faculty members in the Electrical Engineering department hold B. Tech/ M. Tech/ PhD degrees from prestigious government institutions. Faculty members have specialization in diverse fields of Electrical Engineering such as Power systems, Electrical Machines, Electrical Drives, High Voltage Engineering, Control systems, Instrumentation, Biomedical Engineering, Signal Processing, and Data Mining.

The faculty members have published significant number of research and review articles in reputed International Journals as well as in the Proceedings of various International and National Seminars, Conferences, Symposia and Workshops. Members of the faculty have also contributed chapters to books published by well-known international publishers.

2. SALIENT FEATURES OF THE DEPARTMENT

- The department's faculty is highly qualified and has extensive teaching experience.
- Excellent teaching methodology with a focus on interactive learning through the use of audio- visual aids.
- Well-equipped and upgraded labs to provide students with hands-on learning opportunities.
- IIT Delhi's Virtual Labs platform is being used to provide additional Virtual Lab classes.
- The curriculum is well-balanced, with a good mix of research and industry-oriented courses.
- Students attend regular workshops, seminars, and guest lectures to learn about the latest technology and industry practices.
- Mini-projects and in-plant trainings to provide students with hands-on experience.
- Industrial visits to various renowned companies to expose students to a variety of environments.

3. VISION OF THE DEPARTMENT

To impart knowledge, develop skills and prepare graduates in achieving global excellence in Electrical Engineering education, industry and research.

4. MISSION OF THE DEPARTMENT

- To prepare engineering graduates with deep understanding of fundamentals of Electrical Engineering.
- To prepare professionals with good technical abilities, a positive attitude and ethical values.
- To collaborate with industry, research organizations and academia to encourage creativity and innovation.

5. ELIGIBILITY CRITERIA

Programme	Duration	Eligibility
B.Tech in Electrical Engineering	4 years	<p>Passed 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry/ Biotechnology/ Biology/ Technical Vocational subject/ Computer Science/ Information Technology/ Informatics Practices/ Agriculture/ Engineering Graphics/ Business Studies.</p> <p>Obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together.</p> <p style="text-align: center;">OR</p> <p>Passed Diploma (in Engineering and Technology) examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted.</p>
B.Tech in Electrical Engineering (Lateral Entry to second year)	3 years	<ol style="list-style-type: none"> a. Passed Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology. b. Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject. c. Provided that the students belonging to B.Sc. Stream, shall clear the subjects Engineering Graphics/ Engineering Drawing and Engineering Mechanics of the First Year Engineering Programme along with the Second year subjects. d. Provided that the students belonging to B.Sc. Stream shall be considered only after filling the supernumerary seats in this category with students belonging to the Diploma stream. e. Passed D.Voc. Stream in the same or allied sector. f. In the above cases, a suitable bridge Courses, if required such as in Mathematics may be conducted.

6. PROGRAMME OUTCOMES (POs)

PO1: *Engineering knowledge:* Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

PO2: *Problem analysis:* Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.

PO3: *Design/development of solutions:* Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: *Conduct investigations of complex problems:* Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: *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.

PO6: *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.

PO7: *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.

PO8: *Ethics:* Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: *Individual and teamwork:* Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

PO10: *Communication:* Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations and give and receive clear instructions.

PO11: *Project management and finance:* Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

PO12: *Life-long learning:* Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

7. PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Graduates will demonstrate their knowledge in the effective implementation during their practice of profession of Electrical Engineering with due regard to environment and social concerns.

PSO2: Graduates will demonstrate their knowledge in analysis, design and laboratory experimentation regarding Electrical Engineering.

PSO3: Graduates will be motivated for continuous self learning in engineering practice and pursue research in advanced areas of Electrical Engineering in order to offer engineering services to the society, ethically.

8. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To prepare Electrical Engineering students to work for government or private sector companies responsible for the development of the power sector and to demonstrate their abilities in electrical maintenance for the industry.

PEO2: To prepare Electrical Engineering students to contribute to the teaching profession, as well as research and development, by pursuing higher education.

PEO3: To prepare students so that they can work well in multicultural and multidisciplinary groups as part of their profession.

9. CHOICE BASED CREDIT SYSTEM (CBCS)

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill-based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. The basic idea is to look into the needs of the students so as to keep up to date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

10. CURRICULUM STRUCTURE

B.Tech Degree Programme has a curriculum with Syllabi consisting of following type of courses:

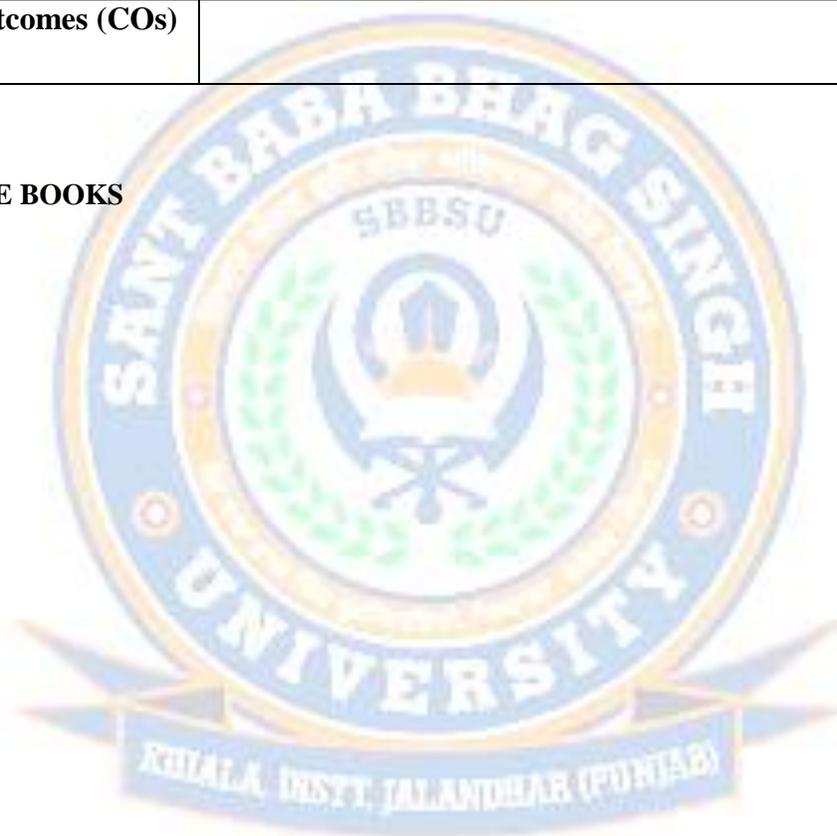
S. No.	Definition	Credits
1.	Basic Science courses	26
2.	Engineering Science courses including workshop, Engineering Design, basics of electrical/mechanical/computer etc.	20
3.	Humanities and Social Sciences including Management courses	15
4.	Professional Core courses	53
5.	Professional Elective courses relevant to chosen specialization/branch	18

13. SYLLABUS FORMAT

Course Code	
Course Title	
Type of Course	
L:T:P	
Credits	
Course Pre-requisites	
Course Objectives	
Course Outcomes (COs)	

SYLLABUS

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Course Scheme for B. Tech (Electrical Engineering)

General Course Structure

Course Code and Definition

CourseCode	Definition
BS	BasicScience
ES	EngineeringScience
HS	HumanitiesScience
PC	ProfessionalCore
PE	ProfessionalElective
OE	OpenElective
MC	MandatoryCourse
PROJ	Project
SI	Summer Internship

Course Scheme for B. Tech (Electrical Engineering)**SEMESTER I****I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	BS	MAT151	Engineering Mathematics-I	3	1	0	3	1	0	4	4
2.	BS	CHM105	Engineering Chemistry	3	1	0	3	1	0	4	4
3.	ES	CSE111	Programming for Problem Solving	3	0	0	3	0	0	3	3
4.	HS	ENG121	Communication Skills-I	2	0	0	2	0	0	2	2

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
5.	ES	ME105	Workshop/ Manufacturing Practices	1	0	4	1	0	2	5	3
6.	ES	CSE113	Programming for Problem Solving Laboratory	0	0	4	0	0	2	4	2
7.	HS	ENG123	Communication Skills-I Laboratory	0	0	2	0	0	1	2	1
8.	BS	CHM107	Engineering Chemistry Laboratory	0	0	3	0	0	1.5	3	1.5
9.	MC	PT101/ PT103/ PT105	Physical Training-I (NSO/NCC/NSS)	0	0	2	NC			2	NC

Total Contact Hours = 29**Total Credit Hours = 20.5**

SEMESTER II**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	BS	MAT152	Engineering Mathematics – II	3	1	0	3	1	0	4	4
2.	BS	PHY105	Engineering Physics	3	1	0	3	1	0	4	4
3.	ES	EE102	Basic Electrical Engineering	3	1	0	3	1	0	4	4
4.	ES	ME101	Engineering Graphics and Design	1	0	4	1	0	2	5	3

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
5.	BS	PHY107	Engineering Physics Laboratory	0	0	3	0	0	1.5	3	1.5
6.	ES	EE104	Basic Electrical Engineering Laboratory	0	0	2	0	0	1	2	1
7.	MC	PT102/ PT104/ PT106	Physical Training-II (NSO/NCC/NSS)	0	0	2	NC			2	NC

Total Contact Hours = 24**Total Credit Hours = 17.5**

SEMESTER III**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PC	EE215	Electrical Circuit Analysis	3	1	0	3	1	0	4	4
2.	PC	EE217	Analog Electronics Circuits	3	0	0	3	0	0	3	3
3.	PC	EE219	Electrical Machines-I	3	0	0	3	0	0	3	3
4.	PC	EE221	Electromagnetic Fields	3	1	0	3	1	0	4	4
5.	ES	ME221	Engineering Mechanics	3	1	0	3	1	0	4	4
6.	BS	MAT251	Engineering Mathematics -III	3	1	0	3	1	0	4	4
7.	BS	BOT002	General Biology	2	1	0	2	1	0	3	3

II. Practical Subjects

S. No	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
8.	PC	EE223	Analog Electronics Circuits Laboratory	0	0	2	0	0	1	2	1
9.	PC	EE225	Electrical Machines Laboratory-I	0	0	2	0	0	1	2	1
10.	MC	PT201/P T203/P T205	Physical Training-III (NSO/NCC/NSS)	0	0	2	NC			2	NC

Total Contact Hours = 31**Total Credit Hours = 27**

SEMESTER IV**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PC	EE216	Digital Electronics	3	0	0	3	0	0	3	3
2.	PC	EE218	Electrical Machines-II	3	0	0	3	0	0	3	3
3.	PC	EE220	Power Electronics	3	0	0	3	0	0	3	3
4.	PC	EE222	Signals and Systems	2	1	0	2	1	0	3	3
5.	HS	SSC007	Universal Human Values: Understanding Harmony	3	0	0	3	0	0	3	3
6.	MC	EVS002	Environmental Sciences	3	0	0	NC			3	NC

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
7.	PC	EE224	Digital Electronics Laboratory	0	0	2	0	0	1	2	1
8.	PC	EE226	Electrical Machines Laboratory-II	0	0	2	0	0	1	2	1
9.	PC	EE228	Power Electronics Laboratory	0	0	2	0	0	1	2	1
10.	MC	PT202/ PT204/ PT206	Physical Training-IV (NSO/NCC/NSS)	0	0	2	NC			2	NC

Total Contact Hours = 26**Total Credit Hours = 18**

SEMESTER V**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PC	EE319	Power Systems-I (Apparatus and Modelling)	3	0	0	3	0	0	3	3
2.	PC	EE321	Control Systems	3	0	0	3	0	0	3	3
3.	PC	EE323	Microprocessors	3	0	0	3	0	0	3	3
4.	PE		Professional Elective-I	3	0	0	3	0	0	3	3
5.	OE		Open Elective-I	3	0	0	3	0	0	3	3
6.	HS	SSC006	Human Values and Professional Ethics	3	0	0	3	0	0	3	3
7.	MC	LAW005	Constitution of India	3	0	0	NC			3	NC

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
8.	PC	EE325	Power Systems Laboratory-I	0	0	2	0	0	1	2	1
9.	PC	EE327	Control Systems Laboratory	0	0	2	0	0	1	2	1
10.	PC	EE329	Microprocessors Laboratory	0	0	2	0	0	1	2	1
11.	MC	PT301/303/305	Physical Training-V (NSO/NCC/NSS)	0	0	2	NC			2	NC

III. Professional Elective-I

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE331	Electrical Machine Design	3	0	0	3	0	0	3	3

Total Contact Hours = 29

Total Credit Hours = 21

Note:-Visits to power system installations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis and Electro-magnetic transient program (EMTP) and Numerical Relays are suggested.

SEMESTER VI**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PC	EE330	Power Systems-II (Operation and Control)	3	0	0	3	0	0	3	3
2.	PC	EE332	Measurements and Instrumentation	2	0	0	2	0	0	2	2
3.	PC	EE334	Electronics Design	1	0	0	1	0	0	1	1
4.	PE		Professional Elective-II	3	0	0	3	0	0	3	3
5.	PE		Professional Elective-III	3	0	0	3	0	0	3	3
6.	OE		Open Elective-II	3	0	0	3	0	0	3	3
7.	HS	MGT007	Organizational Behaviour	3	0	0	3	0	0	3	3

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
8.	PC	EE336	Power Systems Laboratory-II	0	0	2	0	0	1	2	1
9.	PC	EE338	Measurements and Instrumentation Laboratory	0	0	2	0	0	1	2	1
10.	PC	EE340	Electronics Design Laboratory	0	0	4	0	0	2	4	2
11.	MC	PT302/ PT304/ PT306	Physical Training-VI (NSO/NCC/NSS)	0	0	2	NC			2	NC

III. Professional Elective-II

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE342	Control Systems Design	3	0	0	3	0	0	3	3
2.	PE	EE344	Power System Protection	3	0	0	3	0	0	3	3
3.	PE	EE346	Line Commutated and Active Rectifiers	3	0	0	3	0	0	3	3

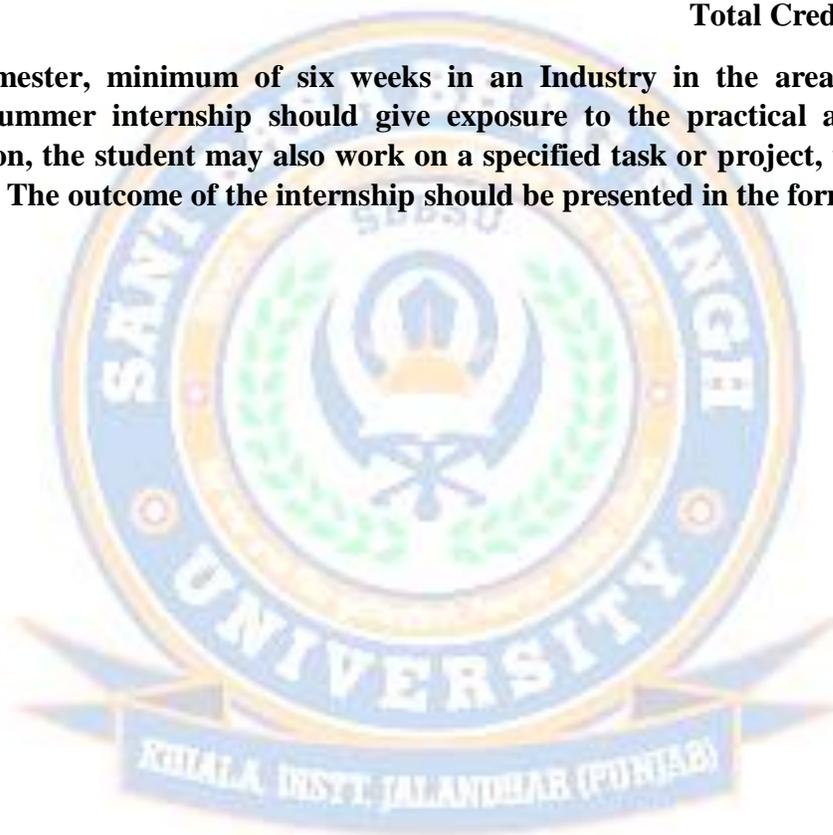
IV. Professional Elective-III

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE348	Computer Architecture	3	0	0	3	0	0	3	3
2.	PE	EE350	Computational Electromagnetics	3	0	0	3	0	0	3	3
3.	PE	EE352	Electromagnetic Waves	3	0	0	3	0	0	3	3

Total Contact Hours = 28

Total Credit Hours = 22

Note:- After 6th semester, minimum of six weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project, which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.



SEMESTER VII**I. Theory Subjects (including Non- Credit Courses)**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE		Professional Elective – IV	3	0	0	3	0	0	3	3
2.	PE		Professional Elective – V	3	0	0	3	0	0	3	3
3.	OE		Open Elective-III	3	0	0	3	0	0	3	3
4.	OE		Open Elective-IV	3	0	0	3	0	0	3	3
5.	HS	ENG205	Effective Technical Communication Skills	3	0	0	3	0	0	3	3
6.	PE		Professional Elective – VI	3	0	0	3	0	0	3	3
7.	OE		Open Elective – V	3	0	0	3	0	0	3	3
8.	OE		Open Elective-VI	3	0	0	3	0	0	3	3
9.	SI	EE411	Summer Internship	NC							

II. Practical Subjects

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
7.	PROJ	EE413	Project Work	0	0	6	0	0	3	6	3

III. Professional Elective-IV

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE415	Wind and Solar Energy Systems	3	0	0	3	0	0	3	3
2.	PE	EE417	HVDC Transmission Systems	3	0	0	3	0	0	3	3
3.	PE	EE419	Power Quality and FACTS	3	0	0	3	0	0	3	3
4.	PE	EE421	High Voltage Engineering	3	0	0	3	0	0	3	3

IV. Professional Elective-V

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE423	Digital Control Systems	3	0	0	3	0	0	3	3
2.	PE	EE425	Electrical Energy Conservation and Auditing	3	0	0	3	0	0	3	3
3.	PE	EE427	Industrial Electrical Systems	3	0	0	3	0	0	3	3
4.	PE	EE429	Electrical Drives	3	0	0	3	0	0	3	3

III. Professional Electives-VI

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	PE	EE431	Digital Signal Processing	3	0	0	3	0	0	3	3
2.	PE	EE433	Electrical and Hybrid Vehicles	3	0	0	3	0	0	3	3
3.	PE	EE435	Power System Dynamics and Control	3	0	0	3	0	0	3	3
4.	PE	EE437	Advanced Electric Drives	3	0	0	3	0	0	3	3

Total Contact Hours = 30

Total Credit Hours = 27



SEMESTER VIII**II. Practical Subjects**

S. No.	Type	Subject Code	Subject Name	Contact Hours			Credits			Total Contact Hours	Total Credit Hours
				L	T	P	L	T	P		
1.	SI	EE416	Six Months Industrial Training	0	0	16	0	0	8	16	8

Total Contact Hours = 16

Total Credit Hours = 08

Total Credits = 161



DETAILS OF B.TECH (EE) COURSES

Course	Credit			Total
	Lecture	Tutorial	Practical	
	(#Subject * Credit)	(#Tutorial * Credit)	(#Practical * Credit)	
I. PC (14 Papers)	1x1=1 2x2=4 11x3=33	3x1=3	10x1=10 1x2=2	53
II. PE (6 Papers)	6x3=18			18
III. ES (5 Papers)	3x3=9 2x1=2	2x1=2	1x1=1 3x2=6	20
IV. BS (6 Papers)	1x2=2 5x3=15	6x1=6	2x1.5=3	26
V. HS (5 Papers)	4x3=12 1x2=2		1x1=1	15
VI. OE (6 Papers)	6x3=18			18
VII. SI (1 Paper)			1x8=8	08
VIII. PROJ (1 Papers)			1x3=3	03
Total				161

MC- 8 units

SUMMARY OF SCHEME

Sem	L	T	P	Contact hrs/wk	Credits	HS	BS	ES	PC	PE	OE	Project	SI	MC
1	12	2	15	29	20.5	3	9.5	8	-	-	-	-	-	1 unit (NC)
2	10	3	11	24	17.5	-	9.5	8	-	-	-	-	-	1 unit (NC)
3	20	5	6	31	27	-	7	4	16	-	-	-	-	1 unit (NC)
4	17	1	8	26	18	3	-	-	15	-	-	-	-	2 units (NC)
5	21	0	8	29	21	3	-	-	12	3	3	-	-	2 units (NC)
6	18	0	10	28	22	3	-	-	10	6	3	-	-	1 unit (NC)
7	24	0	6	30	27	3	-	-	-	9	12	3	1 unit (NC)	
8	0	0	16	16	8	-	-	-	-	-	-	8	-	
Total	122	11	80	213	161									

Course Code	MAT151
Course Title	Engineering Mathematics-I
Type of Course	BS
L:T:P	3:1:0
Credits	4
Course Pre-requisites	+2 Non-Medical
Course Objectives	The course aims to equip the students with standard concepts and tools of mathematics at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. Understand the essential tool of matrices and linear algebra in a comprehensive manner. 2. To deal with functions of several variables that are essential in most branches of engineering. 3. Comprehend tool of power series and Fourier series for learning advanced Engineering Mathematics. 4. Appreciate the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems. 5. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

SYLLABUS

UNIT I

Algebra of matrices, inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT II

Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

UNIT III

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

Evolutes and Involutes, Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L' Hospital's rule; Maxima and minima.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna Publishers
2.	Fourier Series and Boundary Value Problems	Churchill	McGraw Hill
3.	Complex Variables & Applications	Churchill	McGraw Hill
4.	Advanced Engineering Mathematics (6 th Edition, 1995)	Wylie and Barren	Mcgrawhill,
5.	Advanced Engineering Mathematics (10 th Edition)	Erwin Kreyszig	Wiley

Course Code	CHM105
Course Title	Engineering Chemistry
Type of Course	BS
L:T:P	3:1:0
Credits	4
Course Pre-requisites	NA
Course Objectives	The objectives of the engineering chemistry are to relate the students with basic concepts of chemistry. Some new topics have been introduced to the syllabus for the development of the right attitudes by the engineering students to cope with new technology.
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. Rationalize bulk properties and processes using thermodynamic considerations. 2. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques 3. Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity. 4. List major chemical reactions that are used in the synthesis of molecules.

SYLLABUS

UNIT I

Atomic and molecular structure Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multi center orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT II

Spectroscopic techniques and applications: 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 characterization techniques. Diffraction and scattering.

Intermolecular forces and potential energy surfaces:

Ionic, dipolar and van DerWaals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H₃, H₂F and HCN and trajectories on these surfaces.

UNIT III

Use of free energy in chemical equilibria: Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Periodic properties: 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

UNIT IV

Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Organic reactions and synthesis of a drug molecule: Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Engineering chemistry	J.C. Curiacose and J.Raja Ram	Tata Mcgraw-Hill Co. New Delhi
2.	Inorganic Chemistry,	Gary L. Miessler, Paul J. Fischer and Donald A. Tarr	Pearson
3.	Introduction to spectroscopy. (2008).	Pavia, D. L., Lampman, G. M., Kriz, G. S., and Vyvyan, J. A.	Cengage Learning.
4.	Principles of Organic Synthesis	Norman and Coxon	CRC Press

Course Code	CSE111
Course Title	Programming for Problem Solving
Type of Course	ES
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Basics of computer and knowledge of any high level language
Course Objectives	To familiarize the students of all branches in engineering with computer organization, operating systems, problem solving and programming in C++.
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. To formulate simple algorithms for arithmetic and logical problems. 2. To translate the algorithms to programs (in C language). 3. To test and execute the programs and correct syntax and logical errors. 4. To implement conditional branching, iteration and recursion. 5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach. 6. To use arrays, pointers and structures to formulate algorithms and programs. 7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. 8. To apply programming to solve simple numerical method problems, namely root finding of function, differentiation of function and simple integration.

SYLLABUS

UNIT I

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

UNIT II

Arithmetic expressions and precedence : Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching. Iteration and loops . Arrays: Arrays (1-D, 2-D), Character

arrays and Strings. Basic Algorithms : Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

UNIT III

Function and Recursion: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

UNIT IV

Structure and Pointers: Structures, Defining structures and Array of Structures Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (can be done in lab)

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Schaum's Outline of Programming with C	Byron Gottfried	McGraw-Hill
2.	Programming in ANSI C	E. Balaguruswamy	Tata McGraw-Hill

Course Code	ENG121
Course Title	Communication Skills-I
Type of Course	HS
L:T:P	2:0:0
Credits	2
Course Pre-requisites	NA
Course Objectives	<ol style="list-style-type: none"> 1. To assist the students to acquire proficiency, both in spoken and written language. 2. To develop comprehension, improve writing skills, and enhance skills in spoken English.
Course Outcomes (COs)	The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

SYLLABUS

UNIT I

Vocabulary Building: The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms, and standard abbreviations.

UNIT II

Basic Writing Skills: Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Identifying Common Errors in Writing: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

UNIT III

Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, writing introduction and conclusion,

Writing Practices: Comprehension, Précis Writing, Essay Writing.

UNIT IV

Oral Communication: Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

(This unit involves interactive practice sessions in Language Lab)

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Effectual Communication Skills	Bhupender Kour	S.K. Kataria and Sons
2.	Communications Skills	R. Datta Roy and K.K. Dheer	Vishal Publishing Company
3.	The Essence of Effective Communication	Ludlow and Panthon	Prentice Hall of India
4.	Essentials of Business Communication	Pal and Rorualling	S. Chand and Sons, New Delhi



Course Code	ME105
Course Title	Workshop/ Manufacturing Practices
Type of Course	ES
L:T:P	1:0:4
Credits	3
Course Pre-requisites	+2 Physics and Mathematics
Course Objectives	Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Understanding different manufacturing techniques and their relative advantages/ disadvantages with respect to different applications. 2. Selection of a suitable technique for meeting a specific fabrication need. 3. Acquire a minimum practical skill with respect to the different manufacturing methods and develop the confidence to design & fabricate small components for their project work and also to participate in various national and international technical competitions. 4. Introduction to different manufacturing methods in different fields of engineering.

SYLLABUS

LECTURES

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Electrical & Electronics
4. Carpentry
5. Metal casting
6. Welding (arc welding & gas welding), brazing

WORKSHOP PRACTICE

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop
6. Casting
7. Smithy

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Workshop Technology	HS Bawa	McGraw-Hill Publishing Company Limited
2.	Workshop Technology I,II,III	S K Hajra, Choudhary and A K Choudhary	Media Promoters and Publishers Pvt. Ltd., Bombay
3.	Manual on Workshop Practice	K Venkata Reddy	MacMillan India Ltd. New Delhi
4.	Basic Workshop Practice Manual	T Jeyapoovan	Vikas Publishing House (P) Ltd., New Delhi



Course Code	CSE113
Course Title	Programming for Problem Solving Laboratory
Type of Course	ES
L:T:P	0:0:4
Credits	2
Course Pre-requisites	Basics of computer and knowledge of any high level language
Course Objectives	To familiarize the students of all branches in engineering with computer organization, operating systems, problem solving and programming in C++.
Course Outcomes (COs)	<p>The learner will be able to-</p> <ol style="list-style-type: none"> 1. Understand the basic building blocks of general purpose digital computer system like computer hardware/software, memory and peripheral devices, internet applications and services. 2. Understand the program development life cycle using various tools like flowcharts and algorithms and pseudo-code. 3. Classify operators, expressions, character set, data types and control structures. 4. Design and develop modular programming and code reusability using library functions

SYLLABUS

UNIT I

Familiarization with the Computer System

1. To explain the part of the computer system such as system unit, input devices, output devices connected to the computer.
2. To explore the outside view of the system unit that includes the panels on front and ports at the rear.
3. To explore the inside view of the system unit that includes the motherboard, processor, expansion slots, various add-on cards, storage devices, power supply, fans.
4. To understand the booting process that includes switching on the system, execution of POST routine, then bootstrap loader, and loading of the operating system, and getting it ready for use.
5. To introduce the graphical user interface (desktop) of Windows operating System to explain the various elements of the desktop such as taskbar, icons (My Computer, Recycle Bin, etc.), short cuts, notification area.
6. To configure the desktop that includes selecting the wallpaper, selecting the screen saver with or without password protection, selecting the screen resolution and color quality.

UNIT II

Explore Office automation:

1. Creating, Formatting documents with Word, explore the various toolbar options, MailMerge, Spell Check, Word –Art.
2. Creating PowerPoint presentations with Power Point, Explore various views of PPT, Charts, Graphs, animation, multimedia.
3. Creating Sheets in Excel using formulas, chart and graphs

UNIT III

Programming using C++:

1. Implement programs using various operators in C++
2. Implement various Branch statements: if, if-else, nested if, switch
3. Implement various loop statements: for, while, do-while
4. Implement other control statements: go-to, exit function, continue
5. Implement various programs using arrays and string
6. Implement various programs classes and objects
7. Implement various programs using Pointers and structures
8. Implement various programs using File operations

UNIT IV

Computer Aided Tools and Internet

1. Exercise with CAD
2. Internet surfing and E-mail

Course Code	ENG123
Course Title	Communication Skills-I Laboratory
Type of Course	HS
L:T:P	0:0:2
Credits	1
Course Pre-requisites	NA
Course Objectives	The objective of this course is to provide the students sufficient practice for speaking and writing English efficiently.
Course Outcomes (COs)	<p>The learner will be able to:</p> <ol style="list-style-type: none"> 1. Listen to oral instructions in order to perform a given task. (The skills of Listening will be taught and tested through specially prepared materials) 2. The skills of Speaking will be developed conducting various communicative Activities- Role play, conversations, extempore etc. 3. The Reading Skills will be enhanced through comprehending and unseen texts. 4. The skills of Writing will be developed and assessed on Text based writing.

SYLLABUS

UNIT I

Speaking and Discussion Skills: Oral Presentation, Planning and organizing content for presentation, Use of audio /Visual Aids, Making Slides for presentation, Group Discussion, Debate, Extempore speaking, Interview Skills, Mock interview, Mock Dialogues (Pair Speaking), Cue Card Speaking, Meeting/ Conferences.

UNIT II

Listening Skills: Listening to any recorded material and asking oral/written questions for listening comprehension.

Reading Skills: Active Reading of passages for Reading comprehensions, paraphrase, Summary writing.

UNIT III

Writing Skills: Guidelines of effective writing, Paragraph Writing, Email Writing.

UNIT-IV

Grammar and Vocabulary: Parts of Speech, Tenses, and GRE words (List of 50 Words).

Course Code	CHM107
Course Title	Engineering Chemistry Laboratory
Type of Course	BS
L:T:P	0:0:3
Credits	1.5
Course Pre-requisites	NA
Course Objectives	The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Estimate rate constants of reactions from concentration of reactants /products as a function of time 2. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc. 3. Synthesize a small drug molecule and analyse a salt sample

SYLLABUS

1. Determination of surface tension and viscosity of liquids.
2. Determination of viscosity of oil by means of Red Wood Viscometer.
3. Thin layer chromatography: Determination of R_f value of a mixture by TLC.
4. Separation of methyl orange and phenolphthalein from given mixture by paper chromatography
5. Ion exchange column for removal of hardness of water/Determination of total hardness of water by EDTA method.
6. Determination of Total Residual Chlorine in water sample.
7. Colligative properties using freezing point depression
8. Determination of the rate constant of a reaction
9. Determination of cell constant and conductance of solutions
10. Potentiometry-determination of redox potentials and emfs:
11. Determine the strength of a solution pH metrically.
12. Synthesis of a polymer/drug: Preparation of Urea Formaldehyde Resin;
13. Synthesis of paracetamol
14. To bring catalysed condensation or to prepare a pure sample of dibenzalpropane
15. Saponification/acid value of an oil
16. Chemical analysis of a salt
17. Lattice structures and packing of spheres
18. Models of potential energy surfaces
19. Chemical oscillations-Iodine clock reaction
20. Determination of the partition coefficient to of a substance between two immiscible liquids
21. Adsorption of acetic acid by charcoal
22. Use of the capillary viscosity meters to demonstrate the isoelectric point as the pH of minimum viscosity for gel at in sols and/or coagulation of the white part of egg

Course Code	MAT152
Course Title	Engineering Mathematics-II
Type of Course	BS
L:T:P	3:1:0
Credits	4
Course Pre-requisites	+2 Mathematics, Engineering Mathematics-I
Course Objectives	The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. Comprehend the mathematical tools needed in evaluating multiple integrals and their usage. 2. Use mathematical tools for the solutions of differential equations that model physical processes. 3. Practice the tools of differentiation and integration of functions of a complex variable that are used in various techniques, dealing engineering problems.

SYLLABUS

UNIT I

Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal. curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT II

Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal. curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT III

Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal. curvilinear coordinates, Simple

applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

UNIT IV

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum- Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Higher Engineering Mathematics	Grewal, B.S.	Khanna Publishers, Delhi.
2.	Advanced Engineering Mathematics	Jain, R.K and Iyengar	Narosa Publishing Company
3.	Advanced Engineering Mathematics (Fifth Edition)	Erwin Kreyszig	John Wiley – 1999
4.	A text book of Engineering Mathematics	N.P. Bali and Manish Goyal	Laxmi Publications (Reprint 2010)

Course Code	PHY105
Course Title	Engineering Physics
Type of Course	BS
L:T:P	3:1:0
Credits	4
Course Pre-requisites	+2 Physics
Course Objectives	The aim of the subject is to enhance the knowledge of students about various aspects of fundamental of physics including mechanics, optics, wave optics, quantum mechanics; solid-state physics and its applications.
Course Outcomes (COs)	By the end of the course, students will be able to: 1. To get to know about fundamentals of physics. 2. To gain basic knowledge of optics, mechanics, optics, wave optics, quantum mechanics; solid state physics and its applications. 3. To understand the basics of optical devices. 4. To gain knowledge in basic concepts of physics relevant to engineering applications.

SYLLABUS

UNIT I

Forces in Nature: Newton's laws of motions and its completeness in describing particle motion; Potential energy function; $F = - \text{Grad } V$, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Kepler problem; Application: Satellite manoeuvres; Non-inertial frames of reference, Rotating coordinate system: Five-term acceleration formula- Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum.

UNIT II

Simple harmonic motion: damped and forced simple harmonic oscillator Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, Critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

UNIT III

Optics: Light as an electromagnetic wave; Reflectance of light; total internal reflection, and evanescent wave; Mirrors and lenses and optical instruments based; Interference of light; Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder

interferometer. Farunhofer diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power;

LASER: He-Ne LASER, ruby LASER, CO₂ LASER, Properties of laser beams, applications of lasers in science, engineering and medicine.

UNIT IV

Wave nature of particles and the Schrodinger equation: Introduction to Quantum mechanics, Wave nature of Particles, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, probability current, Expectation values, Free-particle wave function and wave-packets, Uncertainty principle; Free electron theory of metals, Fermi level, density of states, Bloch's theorem for particles in a periodic potential, Kronig-Penney model and origin of energy bands.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Engineering Mechanics	M K Harbola	2nd Ed. CENGAGE 2012
2.	Theory of Vibrations with Applications	W T Thomson	GEORGE ALLEN & UNWIN LTD, 2008
3.	Optics	A.Ghatak	Tata McGraw-Hill Education, 2005
4.	Quantum mechanics	D. J. Griffiths	2Nd Edn, Cambridge India, 2016

Course Code	EE102
Course Title	Basic Electrical Engineering
Type of Course	ES
L:T:P	3:1:0
Credits	4
Course Pre-requisites	Physics and Mathematics
Course Objectives	<ol style="list-style-type: none"> 1. To understand and analyze basic Electric and Magnetic circuits 2. To study the working principles of Electrical Machines and Power Converters. 3. To introduce components of Low Voltage Electrical Installations
Course Outcomes (COs)	<p>By the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 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. 5. Get an exposure to the working of power electronic converters.

SYLLABUS

UNIT I

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT II

AC Circuits

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three- phase balanced circuits, voltage and current relations in star and delta connections.

Transformers: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III

Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous

generators.

Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

UNIT IV

Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Basic Electrical Engineering	D.P. Kothari and I.J. Nagrath	Tata McGraw Hill, 2010
2.	Basic Electrical Engineering	D. C. Kulshreshtha	Tata McGraw Hill, 2009
3.	Electrical and Electronics Technology	L. S. Bobrow	Pearson, 2010
4.	Electrical Engineering Fundamentals	Vincent Deltoro	Prentice Hall, India, 1989
5.	Electrical and Electronics Technology (10 th Edition)	E. Huges	Pearson, 2010

Course Code	ME101
Course Title	Engineering Graphics and Design
Type of Course	ES
L:T:P	1:0:4
Credits	3
Course Pre-requisites	Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability 2. To prepare the students to communicate effectively 3. To prepare the students to use the techniques, skills, and modern engineering tools necessary for engineering practice
Course Outcomes (COs)	<p>By the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Introduction to engineering design and its place in society 2. Exposure to the visual aspects of engineering design 3. Exposure to engineering graphics standards 4. Exposure to solid modelling 5. Exposure to computer-aided geometric design 6. Exposure to creating working drawings 7. Exposure to engineering communication

SYLLABUS

UNIT I

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

Orthographic Projections: Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes

UNIT II

Projections of Regular Solids: Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Sections and Sectional Views of Right Angular Solids Covering:

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 III

Isometric Projections: 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.

Overview of Computer Graphics

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), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]

UNIT IV**Customisation & 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 tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Annotations, layering & other functions

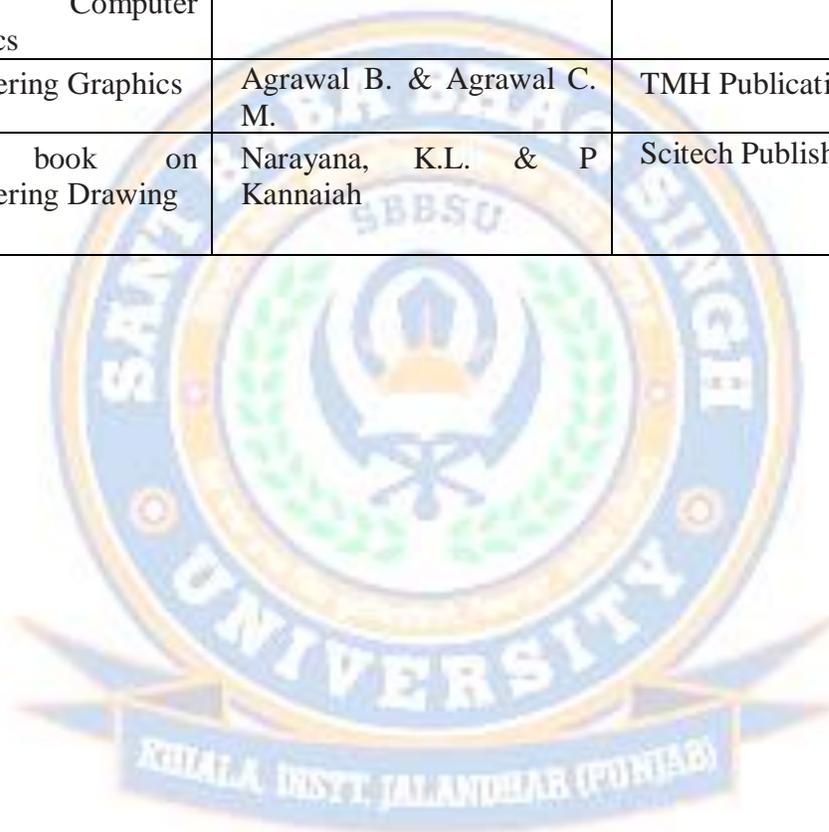
Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling

Demonstration of a simple team design project

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and

assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Engineering Drawing	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014)	Charotar Publishing House, 2014
2.	Engineering Drawing and Computer Graphics	Shah, M.B. & Rana B.C.	Pearson Education, 2008
3.	Engineering Graphics	Agrawal B. & Agrawal C. M.	TMH Publication, 2012
4.	Text book on Engineering Drawing	Narayana, K.L. & P Kannaiah	Scitech Publishers, 2008



Course Code	PHY107
Course Title	Engineering Physics Laboratory
Type of Course	BS
L:T:P	0:0:3
Credits	1.5
Course Pre-requisites	+2 with Physics as core subject
Course Objectives	The aim of the subject is to enhance the Practical knowledge of students about various aspects of fundamental of physics including mechanics, optics, wave optics, quantum.
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. Measure the Magnetic effects along axis of circular coil, magnetic dipole moment of a bar magnet. 2. Infer the characteristics, wavelength & diffraction of laser beam using Michelson interferometer, grating elements. 3. Determine numerical aperture, attenuation and propagation losses in optical fiber, various crystal structures, polarizability of a dielectric substance. 4. Determine the resistivity, band gap of semiconductor materials.

SYLLABUS

1. To study the variation of magnetic field with distance along the axis of a circular coil carrying current.
2. To determine the magnetic dipole moment of a bar magnet and horizontal intensity of earth's magnetic field using a deflection galvanometer.
3. To study B-H curve using CRO.
4. To study the laser beam characteristics like divergence using diffraction grating aperture.
5. To determine the wavelength of a laser using Michelson interferometer.
6. To study diffraction using laser beam and thus to determine the grating element.
7. To find the refractive index of a material using spectrometer.
8. To find the refractive index of a liquid using a hollow prism and spectrometer.
9. To determine numerical aperture of an optical fiber.
10. To determine attenuation and propagation losses in optical fibers.
11. To study various crystal structures.
12. To find out polarizability of a dielectric substance.
13. To set up and observe Newton's rings.
14. To Determine Energy Band Gap of Semiconductor.
15. To determine the number of lines per millimeter of the grating using the green line of the mercury spectrum.
16. To calculate the wavelength of the other prominent lines of mercury by normal incidence method.
17. To find the acceleration of the cart in the simulator(Newton 2nd law)
18. To determine the resistivity of semiconductors by four probe Method.

Course Code	EE104
Course Title	Basic Electrical Engineering Laboratory
Type of Course	ES
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Physics and Mathematics
Course Objectives	<ol style="list-style-type: none"> 1. To Study different types of instruments for measurement of electrical quantities 2. To study the response or behavior of different types of electrical circuits. 3. To study the behavior of single-phase and three-phase transformer in different conditions. 4. To demonstrate the cut-out sections of various types of machines 5. To study the characteristics of various types of motors. 6. To develop knowledge about various types of converters and their applications
Course Outcomes (COs)	<p>By the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Measurement of electrical quantities 2. Analysis of the response or behavior of different types of electrical Circuits. 3. Analysis of the behavior of single-phase and three-phase transformer in different conditions. 4. Identification of the different sections of various types of machines. 5. Analysis of the characteristics of various types of motors. 6. Identification of the type of converter and knowledge about their applications.

SYLLABUS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.



Course Code	EE215
Course Title	Electrical Circuit Analysis
Type of Course	PC
L:T:P	3:1:0
Credits	4
Course Pre-requisites	Mathematics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To impart a basic knowledge of the network theorems and circuit analysis techniques. 2. To provide working knowledge for the transient and steady state response of electrical circuits. 3. To develop a clear understanding of the sinusoidal steady-state analysis. 4. To understand two port network circuit behavior.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Apply network theorems for the analysis of electrical circuits. 2. Obtain the transient and steady-state response of electrical circuits. 3. Analyze circuits in the sinusoidal steady-state (single-phase and three phase). 4. Analyze two port circuit behavior

SYLLABUS

UNIT I

Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

UNIT II

Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, timeconstants, steady state and transient state response.

Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits, Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

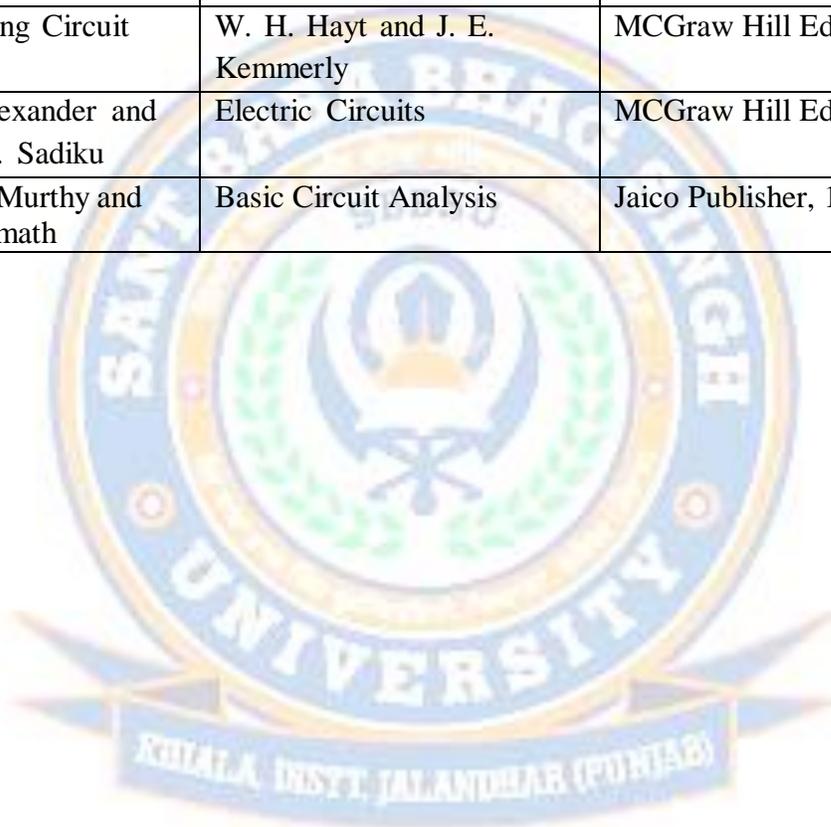
UNIT III

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

UNIT IV

Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Network Analysis	M. E. Van Valkenburg	Prentice Hall, 2006
2.	Networks and Systems	D. Roy Choudhury	New Age International Publications, 1998
3.	Engineering Circuit Analysis	W. H. Hayt and J. E. Kemmerly	MCGraw Hill Education, 2013
4.	C. K. Alexander and M. N. O. Sadiku	Electric Circuits	MCGraw Hill Education, 2004
5.	K. V. V. Murthy and M. S. Kamath	Basic Circuit Analysis	Jaico Publisher, 1999



Course Code	EE217
Course Title	Analog Electronics Circuits
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Physics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To develop a basic understanding of the working, characteristics and applications of semiconductor devices. 2. To provide knowledge about the designing and analysis of equivalent, rectifier and amplifier circuits.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the characteristics of transistors. 2. Design and analyze various rectifier and amplifier circuits. 3. Design sinusoidal and non-sinusoidal oscillators. 4. Understand the functioning of OP-AMP and design OP-AMP based circuits.

SYLLABUS

UNIT I

Diode circuits: P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave Rectifiers, Zener diodes, clamping and clipping circuits.

BJT circuits: 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 II

MOSFET circuits: 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 III

Differential, multi-stage and operational amplifiers: 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 IV

Linear applications of op-amp: 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: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Microelectronic Circuits	A.S. Sedra and K. C. Smith	Oxford University Press, 1998
2.	Introduction to Operational Amplifier theory and application	J.V. Wait, L.P. Huelsman and G.A. Korn	McGraw Hill U.S., 1992
3.	Microelectronics	Millman and A. Grabel	McGraw Hill Education, 1998
4.	The Art of Electronics	P. Horowitz and W. Hill	Cambridge University Press, 1989
5.	Analysis and Design of Analog Integrated Circuits	P.R. Gray, R.G. Meyer and S. Lewis	John Wiley & Sons, 2001

Course Code	EE219
Course Title	Electrical Machines-I
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Physics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To acquaint the student with the concept of magnetic circuits. 2. To expose the students to the concept of DC machines. 3. To familiarize students with single phase, three-phase and auto transformer.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the concepts of magnetic circuits. 2. Understand the operation of dc machines. 3. Analyze the differences in operation of different dc machine Configurations. 4. Analyze single phase and three phase transformers circuits.

SYLLABUS

UNIT I

Magnetic fields and magnetic circuits: Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

UNIT II

Electromagnetic force and torque: B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency

UNIT III

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

DC machine - motoring and generation: Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately

excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines.

UNIT IV

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

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Electric Machinery	A. E. Fitzgerald and C. Kingsley	McGraw Hill Education, 2013
2.	Performance and design of DC machines	A. E. Clayton and N. N. Hancock	CBS Publishers, 2004
3.	Performance and design of AC machines”,	M. G. Say	CBS Publishers, 2002
4.	Electrical Machinery	P. S. Bimbhra	Khanna Publishers, 2011
5.	Electric Machines	I. J. Nagrath and D. P. Kothari	McGraw Hill Education, 2010

Course Code	EE221
Course Title	Electromagnetic Fields
Type of Course	PC
L:T:P	3:1:0
Credits	4
Course Pre-requisites	Physics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To make students conversant about the basic laws of electromagnetism. 2. To introduce the concept of obtaining electric and magnetic fields for simple configurations under static conditions. 3. To expose the students to the concept of time varying electric and magnetic fields. 4. To familiarize students with Maxwell's equation in a variety of formats and media. 5. To provide information on the propagation of EM waves.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the basic laws of electromagnetism. 2. Obtain the electric and magnetic fields for simple configurations under static conditions. 3. Analyse time varying electric and magnetic fields. 4. Understand Maxwell's equation in different forms and different media. 5. To understand the propagation of EM waves.

SYLLABUS

UNIT I

Review of Vector Calculus: 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 and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

UNIT II

Static Electric Field: 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.

Conductors, Dielectrics and Capacitance: 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 III

Static Magnetic Fields: 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 IV

Time Varying Fields and Maxwell's Equations: 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.

RECOMMENDED BOOKS

S. No.	Name of the Book	Author(s)	Publisher
1.	Elements of Electromagnetics	M.N.O. Sadiku	Oxford University Publication, 2014
2.	Electromagnetism - Theory and applications	A Pramanik	PHI Learning Pvt. Ltd, New Delhi, 2009
3.	Electromagnetism-Problems with solution	A Pramanik	Prentice Hall India, 2012
4.	The electromagnetic field in its engineering aspects	G. W. Carter	Longmans, 1954
5.	Fundamentals of Electromagnetism	W.J. Duffin	Mc Graw Hill Publication, 1980
6.	Advanced Electricity and Magnetism	W.J. Duffin	Mc Graw Hill, 1968
7.	The Fundamentals of Electromagnetism	E.G. Cullwick	University Press, 1966
8.	Introductory Engineering Electromagnetics	B.D. Popovic	Addison-Wesley Educational Publishers, International Edition, 1971
9.	Engineering Electromagnetics	W. Hayt	Mc Graw Hill Education, 2012

Course Code	ME221
Course Title	Engineering Mechanics
Type of Course	ES
L:T:P	3:1:0
Credits	4
Course Pre-requisites	Physics
Course Objectives	<ol style="list-style-type: none"> 1. The objective of this Course is to provide an introductory treatment of <i>Engineering Mechanics</i> to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters. 2. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. 3. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures. 2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems. 3. Apply basic knowledge of math and physics to solve real-world problems. 4. Understand measurement error, and propagation of error in processed data. 5. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts) 6. Understand basic dynamics concepts – force, momentum, work and energy. 7. Understand and be able to apply Newton's laws of motion

SYLLABUS

UNIT I

Introduction to Engineering Mechanics covering: 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.

Introduction to vectors and tensors and coordinate systems, Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Friction: Concept and Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction, Angle of Repose; Coefficient of friction; Motion of Bodies, wedge friction, screw jack & differential screw jack.

UNIT II

Centroid and Centre of Gravity covering: Centroid of simple figures from first principle, centroid of composite sections, Centre of Gravity and its implications; Area moment of inertia, Polar moment of inertia:- Definition, Principal moments and axes of inertia, Parallel and perpendicular axes theorems, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

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

Bending Moment and Torsional Motion: Beams & types of beams; Frames & Machines, Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Virtual Work and Energy Method: Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

UNIT III

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Free body diagrams, Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

Introduction to Kinetics of Rigid Bodies covering: Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Newton-Euler's laws of rigid body motion, Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation; Angular velocity of a rigid body, and its rate of change; Integration of angular velocity to find orientation, Angular momentum about a point; Inertia tensor, Five term acceleration formula, Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles

UNIT IV

Mechanical Vibrations covering: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping

and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials from the above modules covering: To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc Apparatus; Helical block; To draw a load efficiency curve for a screw jack, General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Engineering Mechanics	Shames, I. H.	Pearson Education India, 2006
2.	Vector Mechanics for Engineers, Dynamics	Beer, Johnston, Clausen and Staab	McGraw Hill Higher Education, 2003
3.	Engineering Mechanics: Statics and Dynamics	Hibler, T.A.	Prentice Hall, 2012
4.	Engineering Mechanics	Timoshenko and Young	Tata McGraw Hill Education Private Limited, 2006

Course Code	MAT251
Course Title	Engineering Mathematics-III
Type of Course	BS
L:T:P	3:1:0
Credits	4
Course Pre-requisites	+2 Mathematics, Engineering Mathematics-I, Engineering Mathematics-II
Course Objectives	This course is an introduction to a broad range of mathematical techniques for solving problems that arise in Science and Engineering. The goal is to provide a basic understanding of the derivation, analysis and use of these techniques in engineering applications.
Course Outcomes (CO)	At the end of this course, students will demonstrate the ability to: <ol style="list-style-type: none"> 1. Solve field problems in engineering involving PDEs. 2. Use Numerical methods' techniques to solve ordinary differential equations and partial differential equations arising in engineering problems. 3. Get an overview of probability and statistics to engineers.

SYLLABUS

UNIT-I

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method. Flows, vibrations and diffusions, second-order linear equations and their classification, Initial and boundary conditions (with an informal description of well-posed problems), D'Alembert's solution of the wave equation; Separation of variables method to simple problems in Cartesian coordinates.

UNIT II

Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's $1/3^{\text{rd}}$ and $3/8$ rules. Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predictor-corrector methods.

UNIT III

Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation. Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank –Nicholson methods) , finite differences explicit method for wave equation.

UNIT IV

Probability spaces, conditional probability, Discrete random variables, Independent random variables, Poisson approximation to the binomial distribution, infinite sequence of Bernoulli trials, sums of

independent random variables; expectation of discrete random variables, moments Variance of a Sum , Chebyshev's Inequality.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(S)	Publisher
1.	Higher Engineering Mathematics (Third Edition)	Dr. K.R. Kachot	Mahajan Pub. House, Ahmedabad
2.	Advanced Engineering Mathematics (5th Edition)	Erwin Kreyszig	John Wiley – 1999
3.	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna, New Delhi.
4.	Elementary Differential Equations	W. E. Boyce and R. DiPrima	John Wiley – 2005
5.	Discrete Mathematics	Schaum series by Lipschutz	McGraw Hill
6.	Statistical Methods	S.P. Gupta	McGraw Hill Education.



Course Code	BOT002
Course Title	General Biology
Type of Course	BS
L:T:P	2:1:0
Credits	3
Course Pre-requisites	Basics of Biology
Course Objectives	To study concept of biology in relations to engineering and to acquaint the students about other field of biology like classification of organism, genetics, biomolecules, macromolecules, enzymes, metabolism and biological information system.
Course Outcomes (COs)	At the end of this course, students will demonstrate the ability to: <ol style="list-style-type: none"> 1. Describe how biological observations of 18th Century that lead to major discoveries. 2. Convey that classification <i>per se</i> is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological 3. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring 4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine 5. Classify enzymes and distinguish between different mechanisms of enzyme action. 6. Identify DNA as a genetic material in the molecular basis of information transfer. 7. Analyze biological processes at the reductionistic level 8. Apply thermodynamic principles to biological systems. 9. Identify and classify microorganisms.

SYLLABUS

UNIT I

Introduction: Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Classification: Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial

(e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.

UNIT II

Genetics: Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene Mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

Biomolecules: Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Enzymes: Enzymology: How to monitor enzyme catalyzed reactions. How does enzyme Catalyze reactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

UNIT III

Information Transfer: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Macromolecular analysis: Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

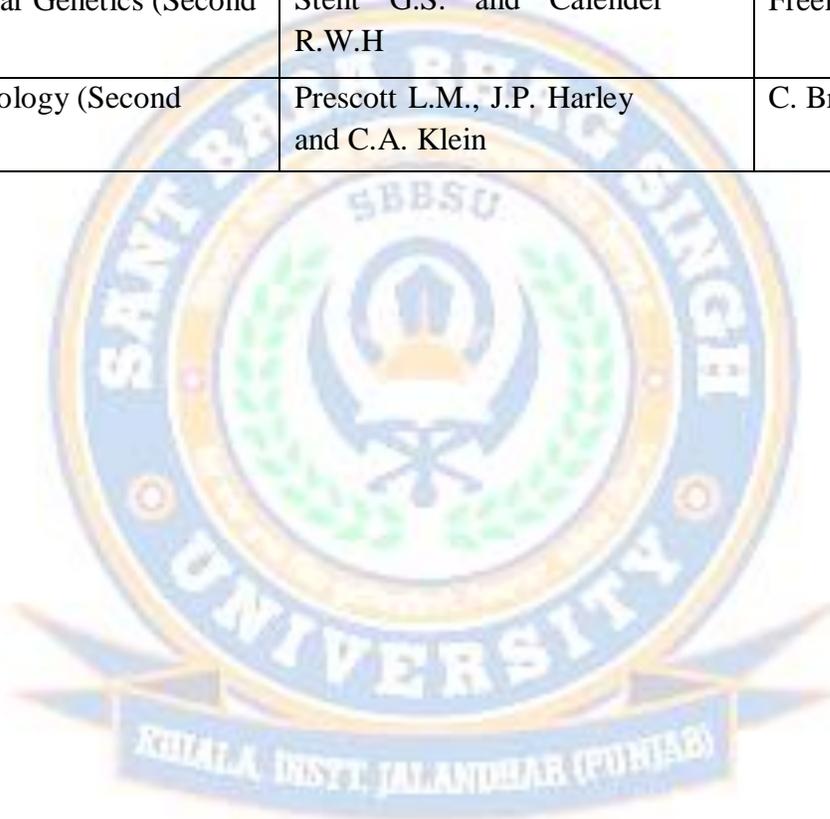
UNIT IV

Metabolism: Thermodynamics as applied to biological systems. Exothermic and endothermic versus Endergonic and exergonic reactions. Concept of K_{eq} and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy Charge.

Microbiology: Concept of single celled organisms. Concept of species and strains. Identification and Classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.

RECOMMENDED BOOKS

S. No.	Name of the Book	Author(S)	Publisher
1.	Biology: A global approach	Campbell N.A., Reece J.B., Urry Lisa, Cain M.L., Wasserman S.A., et al	Pearson Education Ltd
2.	Outlines of Biochemistry	Conn E.E., Stumpf P.K., Bruening G, Doi R.H.	Wiley and Sons
3.	Principles of Biochemistry (V Edition)	Nelson D.L., Cox M.M.W.H.	Freeman and Company
4.	Molecular Genetics (Second Edition)	Stent G.S. and Calender R.W.H	Freeman and Company
5.	Microbiology (Second Edition)	Prescott L.M., J.P. Harley and C.A. Klein	C. Brown Publishers



Course Code	EE223
Course Title	Analog Electronics Circuits Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Physics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To impart basic knowledge about the characteristics of semiconductor devices. 2. To provide practical experience on design and analyze diode and transistor based circuits. 3. To provide information about the the functioning of OP-AMP and Design OP-AMP based circuits.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Study of the characteristics of diodes and transistors. 2. Design and analyze diode and transistor based circuits. 3. Understand the functioning of OP-AMP and design OP-AMP based circuits.

SYLLABUS

1. To draw I-V characteristics of PN junction diode.
2. To draw I-V characteristics of Zener diode
3. To design half wave rectifier.
4. To design full wave and bridge rectifiers.
5. To study transistor characteristics in common base, common Collector, and common emitter configurations.
6. To study the I-V characteristics of MOSFET.
7. To design various clippers and clampers using diodes.
8. To obtain the frequency response of an amplifier and calculate the gain bandwidth of the amplifier.
9. To design a transistor series voltage regulator with current limits and observe current feedback characteristics.
10. To study the characteristics of a complementary symmetry amplifier.
11. Application of Op-Amp (741) as inverting and non-inverting amplifier.
12. To use the OP-AMP as summing, scaling and averaging amplifier.

Course Code	EE225
Course Title	Electrical Machines Laboratory-I
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Physics, Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To gain an understanding of how dc machines work.. 2. To examine the functioning of various dc machine configurations and to measure key parameters. 3. To investigate single-phase and three-phase transformer circuits under various conditions.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the operation of dc machines. 2. Analyze the operation of different dc machine configurations and measurement of its important parameters. 3. Analyze single phase and three phase transformer circuits in different conditions

SYLLABUS

1. To perform load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit, voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of direct current DC machine and to draw sketches of different components.
8. To measure armature and field resistance of DC shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of DC shunt/series/compound generator.
10. To draw speed-torque characteristics of DC shunt/series /compound generator.
11. To study DC motor starters.
12. To perform Swinburne's test (no load test) to determine losses of DC shunt motor.

Course Code	EE216
Course Title	Digital Electronics
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Physics
Course Objectives	<ol style="list-style-type: none"> 1. To acquire the basic knowledge of logic families and logic gates. 2. To prepare students to perform the analysis and design of various digital electronic circuits.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand working of logic families and logic gates. 2. Design and implement Combinational and Sequential logic circuits. 3. Understand the process of Analog to Digital conversion and Digital to Analog conversion. 4. Be able to use PLDs to implement the given logical problem.

SYLLABUS

UNIT I

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

UNIT II

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

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

UNIT III

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

UNIT IV

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

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Modern Digital Electronics	R.P. Jain	McGraw Hill Education, 2009
2.	Digital logic and Computer design	M.M. Mano	Pearson Education India, 2016
3.	Fundamentals of Digital Circuits	A Kumar	Prentice Hall India, 2016

Course Code	EE218
Course Title	Electrical Machines-II
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electrical Machines-I
Course Objectives	<ol style="list-style-type: none"> 1. To comprehend the students about rotating magnetic field principles. 2. To familiarize the students with the working of ac machines. 3. To acquaint the students with the performance characteristics of ac machines'.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the concepts of rotating magnetic fields. 2. Understand the operation of ac machines. 3. Analyze performance characteristics of ac machines.

SYLLABUS

UNIT I

Fundamentals of AC machine windings

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

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

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.

Single-phase induction motors

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications.

UNIT IV**Synchronous machines**

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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Electric Machinery	A. E. Fitzgerald and C. Kingsley	McGraw Hill Education, 2013
2.	Performance and design of AC machines	M. G. Say	CBS Publishers, 2002
3.	Electrical Machinery	P. S. Bimbhra	Khanna Publishers, 2011
4.	Electical Machines	I. J. Nagrath and D. P. Kothari	McGraw Hill Education, 2010
5.	Alternating current machines	A.S. Langsdorf	McGraw Hill Education, 1984
6.	Principles of Electric Machines and Power Electronics	P. C. Sen	John Wiley & Sons, 2007

Course Code	EE220
Course Title	Power Electronics
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electrical Circuit Analysis, Analog Electronics Circuits
Course Objectives	<ol style="list-style-type: none"> 1. To understand and acquire knowledge about various power semiconductor devices. 2. To prepare the students to analyze and design different power converter circuits.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the differences between signal level and power level devices. 2. Analyze controlled rectifier circuits. 3. Analyze the operation of DC-DC choppers. 4. Analyze the operation of voltage source inverters.

SYLLABUS

UNIT I

Power switching devices: Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT II

Thyristor rectifiers: 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

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.

DC-DC boost converter

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

UNIT IV: Single-phase voltage source inverter

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

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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Power electronics: circuits, devices, and application	M. H. Rashid,	Pearson Education India, 2009.
2.	Power Electronics: Converters, Applications and Design	N. Mohan and T.M. Undeland	John Wiley & Sons, 2007
3.	Fundamentals of Power Electronics	R. W. Erickson and D. Maksimovic	Springer Science & Business Media, 2007.
4.	Power Electronics: Essentials and Applications	L. Umanand	Wiley India, 2009.

Course Code	EE222
Course Title	Signals and Systems
Type of Course	PC
L:T:P	2:1:0
Credits	3
Course Pre-requisites	Mathematics
Course Objectives	<ol style="list-style-type: none"> 1. To introduce the concepts and techniques associated with the understanding of signals and systems. 2. To familiarize with techniques suitable for analyzing and synthesizing both continuous-time and discrete time systems which provides foundation for more advanced subjects like signal processing, system theory, control and robotics.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the concepts of continuous time and discrete time systems. 2. Analyze systems in complex frequency domain. 3. Understand sampling theorem and its implications.

SYLLABUS

UNIT I

Introduction to Signals and Systems: Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

UNIT II

Behavior of continuous and discrete-time LTI systems

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT III

Fourier, Laplace and z- Transforms

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT)

and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

UNIT IV

Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Signals and systems	A. V. Oppenheim, A. S. Willsky and S. H. Nawab	Prentice Hall India, 1997
2.	Digital Signal Processing: Principles, Algorithms, and Applications	J. G. Proakis and D. G. Manolakis	John Wiley and Sons, 2007
3.	Signals and systems	H. P. Hsu	McGraw Hill Education, 2017
4.	Discrete-Time Signal Processing	A. V. Oppenheim and R. W. Schafer	Prentice Hall, 2009
5.	Fundamentals of Signals and Systems	M. J. Robert	McGraw Hill Education, 2007

Course Code	SSC007
Course Title	Universal Human Values: Understanding Harmony
Type of Course	HS
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Nil
Course Objectives	<ol style="list-style-type: none"> 1. Development of a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence. 2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence 3. Strengthening of self-reflection. 4. Development of commitment and courage to act.
Course Outcomes (COs)	<p>By the end of the course, students are expected:</p> <ol style="list-style-type: none"> 1. To become more aware of themselves, and their surroundings (family, society, nature) 2. More responsible in life, and in handling problems with sustainable solutions. 3. Keeping human relationships and human nature in mind.

SYLLABUS

UNIT I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I.
2. Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II

Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’.

1. Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility.
2. Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).
3. Understanding the characteristics and activities of ‘I’ and harmony in ‘I’.

4. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
5. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life.

Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence.
5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct

3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
 - a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
 - b) At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. to discuss the conduct as an engineer or scientist etc.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Human Values	A.N. Tripathi	New Age Intl. Publishers, New Delhi, 2004
2.	Amarkantak	Jeevan Vidya, EkParichaya, A Nagaraj	Jeevan Vidya Prakashan
3.	Rediscovering India:	Dharampal	
4.	The Story of My Experiments with Truth	Mohandas Karamchand Gandhi	

Course Code	EVS002
Course Title	Environmental Sciences
Type of Course	MC
L:T:P	3:0:0
Credits	NC
Course Pre-requisites	Nil
Course Objectives	To make students aware about environment and need of maintaining it with best possible knowledge.
Course Outcomes (COs)	By the end of the course, students are expected to: 1. Measure environmental variables and interpret results. 2. Evaluate local, regional, and global environmental topics related to resource use and management. 3. Propose solutions to environmental problems related to resource use and management.

SYLLABUS

UNIT I

Introduction to Environment and Ecosystem: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness, Concept of Ecosystem, Structure, interrelationship, producers, Consumers and decomposers, ecological pyramids-biodiversity, and importance. Hot spots of biodiversity.

UNIT II

Environmental Pollution & Natural Resources: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects, and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides, Natural Resources, and associated problems, use and over exploitation, case studies of forest resources and water resources.

UNIT III

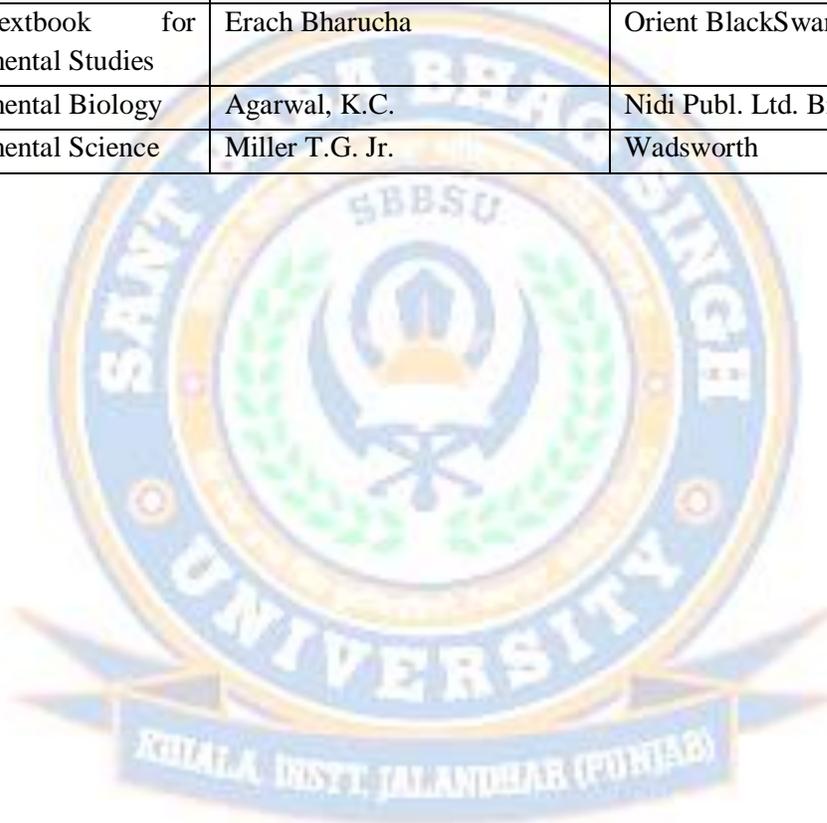
Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation.

UNIT IV

Human Population and the Environment & Field Work: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural; Study of common plants, insects, birds; Study of simple ecosystems-pond, river, hill slopes, etc.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	A Textbook for Environmental Studies	Erach Bharucha	Orient BlackSwan
2.	Environmental Biology	Agarwal, K.C.	Nidi Publ. Ltd. Bikaner
3.	Environmental Science	Miller T.G. Jr.	Wadsworth



Course Code	EE224
Course Title	Digital Electronics Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Physics
Course Objectives	<ol style="list-style-type: none"> 1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits. 2. To prepare students to perform the analysis and design of various digital electronic circuits.
Course Outcomes (COs)	<p>By the end of the course, students are expected to:</p> <ol style="list-style-type: none"> 1. Understand working of logic circuits. 2. Design and implement Combinational and Sequential logic circuits.

SYLLABUS

1. To study the logic gates and verify the truth tables of OR, AND, NOT, XOR, X-NOR, NAND & NOR Gates.
2. Realization of Half adder & Full adder using basic gates.
3. Realization of Half adder & Full adder using universal gates.
4. Realization of Half subtractor & Full subtractor using basic gates.
5. Realization of Half subtractor & Full subtractor using universal gates.
6. Truth table verification and realization of Half adder and Full adder using MUX.
7. Truth table verification and realization of Half subtractor and Full subtractor using DE-MUX.
8. Truth table verification of T, RS, D, JK, MASTER SLAVE, JK flip flops..
9. Design a 4-bit Magnitude comparator using logic gates.
10. Design a 4-bit Binary to Gray and Gray to Binary code converter.
11. Shift Registers: Study of SISO, SIPO, PISO, PIPO shift registers.

Course Code	EE226
Course Title	Electrical Machines Laboratory – II
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Electrical Machines-I
Course Objectives	<ol style="list-style-type: none"> 1. To expose the students to the equivalent circuit parameters of single-phase and three- phase Induction motor. 2. To introduce students to various speed control strategies for induction motors. 3. To provide working knowledge for drawing the open and short circuit characteristics of three-phase alternator, as well as the V and inverted V curves of synchronous motor. 4. To develop a clear understanding of the voltage regulation of an alternator by different tests. 5. To grasp the idea of synchronizing two or more three-phase alternators
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Obtain equivalent circuit parameters of single-phase and three- phase Induction motor. 2. Control speed of Induction motors by different methods. 3. Draw open and short circuit characteristics of three-phase alternator and V and inverted V curves of synchronous motor. 4. Find out voltage regulation of an alternator by different tests. 5. Synchronize two or more 3-phase alternators.

SYLLABUS

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
2. To perform no-load and blocked-rotor tests on three-phase Induction motor to obtain equivalent circuit.
3. To study the speed control of three-phase Induction motor by Kramer's Concept.
4. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
5. To study star- delta starters and a) to draw electrical connection diagram b) to start the three-phase Induction motor using it and c) to reverse the direction of three-phase Induction motor.
6. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque –speed characteristics.
7. To perform no-load and blocked-rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory.

8. To perform no load and short circuit test on three-phase alternator and draw open and short circuit characteristics.
9. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
10. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
11. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
12. Starting of synchronous motors using (i) Auxiliary motor (ii) Using Damper windings



Course Code	EE228
Course Title	Power Electronics Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Electrical Circuit Analysis, Analog Electronics Circuits
Course Objectives	<ol style="list-style-type: none"> 1. To provide details on the characteristics of SCR and UJT transistors, as well as triggering pulses for them. 2. To give students hands-on experience analyzing the performance of different rectifier and converter circuits. 3. To provide hands-on experience with thyristor-based motor speed control.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Students will be able to verify the characteristics of SCR and UJT and triggering pulses for them. 2. They will be able to visualize and analyze the performance of various rectifier and converter circuits. 3. They will be able to control the speed of motors using thyristor.

SYLLABUS

1. To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To draw V-I characteristics of an UJT and to use UJT as relaxation oscillator.
3. To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
4. To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
5. Study of the microprocessor-based firing control of a bridge converter.
6. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
7. To study Jones chopper or any chopper circuit to check the performance.
8. Thyristorised speed control of a D.C. Motor.
9. Speed Control of induction motor using thyristors.
10. Study of series inverter circuit and to check its performance.
11. Study of a single-phase cycloconverter.
12. To check the performance of a McMurray half-bridge inverter.

Course Code	EE319
Course Title	Power System-I (Apparatus & Modelling)
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Basic Electrical Engineering, Electrical Machines
Course Objectives	<ol style="list-style-type: none"> 1. To impart a basic knowledge of the concept of power system. 2. To make students conversant about the power system components. 3. To acquaint the student with the assessment of fault currents for various types of faults. 4. To familiarize students with over-voltage generation and insulation coordination. 5. To know about the power system protection methods. 6. To educate students on the concept of high-voltage direct current (HVDC) power transmission and renewable energy generation.
Course Outcome s (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the concepts of power systems. 2. Understand the various power system components. 3. Evaluate fault currents for different types of faults. 4. Understand the generation of over-voltages and insulation coordination. 5. Understand basic protection schemes. 6. Understand concepts of HVDC power transmission and renewable energy generation.

SYLLABUS

UNIT I

Basic Concepts: Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

UNIT II

Power System Components: Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance

calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines. Transformers: Three-phase connections and Phase-shifts. Three-winding transformers, auto- transformers, Neutral Grounding transformers. Tap-Changing in transformers. Transformer Parameters. Single phase equivalent of three-phase transformers. Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

UNIT III

Over-voltages, Fault Analysis and Protection Systems: Generation of Over-voltages: Lightning and Switching Surges. Protection against Over- voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Fault Analysis and Protection Systems: Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding.

Switchgear: Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

UNIT IV

Introduction to DC Transmission & Renewable Energy Systems: DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC). LCC and VSC based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators. Power Electronics interfaces of wind generators to the grid.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Power System Analysis	J. Grainger and W. D. Stevenson	McGraw Hill Education, 1994
2.	Electric Energy Systems Theory	O. I. Elgerd	McGraw Hill Education, 1995
3.	Power System Analysis	A. R. Bergen and V. Vittal	Pearson Education Inc., 1999
4.	Modern Power System Analysis	D. P. Kothari and I. J. Nagrath	McGraw Hill Education, 2003
5.	Electric Power Systems	B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac	Wiley, 2012



Course Code	EE321
Course Title	Control Systems
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Signals and Systems
Course Objectives	<ol style="list-style-type: none"> 1. To comprehend the fundamentals of mathematical modelling of linear-time-invariant systems using transfer function and state-space representations. 2. To familiarize students with the concept of stability and how to evaluate it for linear-time invariant systems. 3. To equip learners with the design of simple feedback controllers.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the modelling of linear-time-invariant systems using transfer function and state-space representations. 2. Understand the concept of stability and its assessment for linear-time invariant systems. 3. Design simple feedback controllers.

SYLLABUS

UNIT I

Introduction to control problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Time Response Analysis: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

UNIT II

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

UNIT III

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

UNIT IV

State variable Analysis: Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Introduction to Optimal Control and Non linear Control: Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Control Systems: Principles and Design	M. Gopal	McGraw Hill Education, 1997
2.	Automatic Control System	B. C. Kuo	Prentice Hall, 1995
3.	Modern Control Engineering	K. Ogata	Prentice Hall, 1991
4.	Control Systems Engineering	I. J. Nagrath and M. Gopal	New Age International, 2009

Course Code	EE323
Course Title	Microprocessors
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Digital Electronics
Course Objectives	<ol style="list-style-type: none"> 1. To introduce students with the assembly language programming. 2. To expose the students with the 8051's interfacing with peripherals such as I/O, A/D, D/A, timer, and so on. 3. To equip the students with designing of microprocessor based systems.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Do assembly language programming. 2. Do interfacing design of peripherals like I/O, A/D, D/A, timer etc. 3. Develop microprocessor based systems.

SYLLABUS

UNIT I

Fundamentals of Microprocessors: Fundamentals of Microprocessor Architecture. 8-bit Microprocessor 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.

The 8051 Architecture: 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 II

Instruction Set and Programming: 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 III

Memory and I/O Interfacing: 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, and memory devices.

External Communication Interface: Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT IV

Applications: LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	M.A. Mazidi, J.G. Mazidi and R.D. McKinlay	Pearson Education, 2007
2.	8051 Microcontroller	K.J. Ayala	Delmar Cengage Learning, 2004
3.	Embedded System	R. Kamal	McGraw Hill Education, 2009
4.	Microprocessor Architecture: Programming and Applications with the 8085	R.S. Gaonkar	Penram International Publishing, 1996
5.	Computer Organization and Design: The Hardware/Software interface"	D.A. Patterson and J. H. Hennessy	Morgan Kaufman Publishers, 2013.
6.	Microprocessors & Interfacing	D.V. Hall	McGraw Hill Higher Education, 1991.

Course Code	EE325
Course Title	Power Systems Laboratory – I
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Basic Electrical Engineering, Electrical Machines
Course Objectives	<ol style="list-style-type: none"> 1. To introduce the characteristics of different transmission line models, 2. To study the characteristics of different types of relays. 3. Familiarization with an electrical software by solving different power system problems
Course Outcomes (COs)	<p>By the end of the course, students will be able to:</p> <ol style="list-style-type: none"> 1. Analyze the performance of transmission lines. 2. Analyze the performance of different types of relays. 3. Analysis of the symmetrical and unsymmetrical faults in power system using simulation based experiments.

SYLLABUS

(A) Hardware Based:

1. To measure negative sequence and zero sequence reactance of Synchronous Machines.
2. Fault analysis for line-to-line (L-L), Line-to-Ground (L-G) and double line to ground fault.
3. To study the performance of a transmission line and compute its ABCD parameters.
4. To study the earth resistance using three spikes.
5. To study the IDMT over current relay and determine the time current characteristics.
6. To study percentage differential relay.
7. To study Impedance, MHO and Reactance type distance relays.
8. To study operation of oil testing set.

(B) Simulation Based Experiments (using MATLAB or any other software)

9. To obtain steady state, transient and sub-transient short circuit currents in an alternator.
10. To perform symmetrical fault analysis in a power system.
11. To perform unsymmetrical fault analysis in a power system.

Course Code	EE327
Course Title	Control Systems Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Signals and Systems
Course Objectives	<ol style="list-style-type: none"> 1. To provide working knowledge on the characteristics of error detectors, servo motors. 2. To develop a clear understanding of the speed control of servo Motor 3. To provide hands on experience on simulation of the differential equations. 4. To provide hands-on experience on designing of compensation networks and their performance analysis.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Analyze the characteristics of error detectors, servo motors 2. Speed control of Servo Motor 3. Simulation of the differential equations and calculation of time response specifications 4. Design compensation networks and analyze the performance characteristics.

SYLLABUS

1. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications.
4. To study the Speed – Torque characteristics of an DC Servo Motor and explore its applications.
5. To study the variations of time lag by changing the time constant using control engineering trainer
6. To simulate a third order differential equations using an analog computer and calculate time response specifications.
7. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer.
8. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems
 - a) To study the operation of a position sensor and study the conversion of position in to corresponding voltage
 - b) To study an PI control action and show its usefulness for minimizing steady state error of time response.
9. To measure Force / Displacement using Strain Gauge in a wheat stone bridge
10. To design a Lag compensator and test its performance characteristics.
11. To design a Lead-compensator and test its performance characteristics.
12. To design a Lead-Lag compensator and test its performance characteristics.

Course Code	EE329
Course Title	Microprocessors Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Digital Electronics
Course Objectives	<ol style="list-style-type: none"> 1. To introduce students with the assembly language programming. 2. To expose the students with the 8085's interfacing with peripherals. 3. To equip the students with designing of microprocessor based systems.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Do assembly language programming. 2. Do interfacing of peripherals like I/O, A/D, D/A, timer etc. 3. Develop microprocessor based systems.

SYLLABUS

1. Study of 8085 Microprocessor kit.
2. Write a program to add two 8-bit numbers.
3. Write a program to add two 16-bit numbers.
4. Write a program to subtract two 8-bit numbers.
5. Write a program to subtract two 16-bit numbers.
6. Write a program to multiply two 8-bit numbers using repetitive addition method.
7. Write a program to multiply two 8 bit numbers by bit rotation method.
8. Write a program to divide two 8-bit numbers.
9. Write a program to divide two 16-bit numbers.
10. Write a program to find largest number in an array of data.
11. Write a program to find smallest number in an array of data.
12. Write a program to find square root of a number.
13. Write a program to arrange numbers in ascending order.
14. Write a program to arrange numbers in descending order.
15. Write a program to control traffic light system using 8085.
16. Write a program to control speed of DC motor using 8255 PPI.

Course Code	EE331
Course Title	Electrical Machine Design
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electrical Machines
Course Objectives	<p>The objectives of the course are to make the students,</p> <ol style="list-style-type: none"> 1. To have a better understanding of how electrical machines are built and how they work. 2. To get an insight into different aspects that influence the design of electrical machines, such as electrical, magnetic, and thermal loads. 3. To expose the students to the principles of electrical machine design and carry out a basic design of an AC machine 4. To train individuals how to use software to do machine design calculations.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the construction and performance characteristics of electrical machines. 2. Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines. 3. Understand the principles of electrical machine design and carry out a basic design of an AC machine. 4. Use software tools to do design calculations.

SYLLABUS

UNIT I

Introduction: Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT II

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

UNIT III

Induction Motors 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, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Synchronous Machines: 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 IV

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

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	A Course in Electrical Machine Design	A. K. Sawhney	Dhanpat Rai and Sons, 1970
2.	Theory & Performance & Design of A.C. Machines	M.G. Say	ELBS London
3.	Principles of Electrical Machine Design with computer programmes	S. K. Sen	Oxford and IBH Publishing, 2006
4.	Text Book of Electrical Engineering Drawings	K. L. Narang	SatyaPrakashan, 1969
5.	Electrical Machine Design Data Book	A. Shanmugasundaram, G. Gangadharan and R. Palani	New Age International, 1979
6.	Computer Aided Design of Electrical Machines	K. M. V. Murthy	B.S. Publications, 2008

Course Code	SSC006
Course Title	Human Values and Professional Ethics
Type of Course	HS
L:T:P	3:0:0
Credits	3
Course Pre-requisites	None
Course Objectives	To help the students to discriminate between valuable and superficial in the life. To help students develop sensitivity and awareness; leading to commitment and courage to act on their own belief. This Course will encourage the students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life. This course is an effort to fulfil our responsibility to provide our students significant input about understanding.
Course Outcomes (COs)	By the end of the course, students will be able to: <ol style="list-style-type: none"> 1. Learn the moral issues and problems in engineering; find the solution to those problems. 2. Learn the need for professional ethics, codes of ethics and roles, concept of safety, risk assessment. 3. Gain exposure to Environment Ethics & computer ethics; know their responsibilities and rights.

SYLLABUS

UNIT I

Course Introduction-Need, Basic Guidelines, Content and Process for Value Education:

Understanding the need, basic guidelines, content and process for Value Education, Understanding Happiness and Prosperity correctly.

Understanding Harmony in the Human Being : Understanding the harmony with self and the Body: Sanyam and Swasthya.

UNIT II

Harmony in Human Relationship: Understanding harmony in the Family- the basic unit of human interaction, visualizing a universal harmonious order in society. **Understanding Harmony in the Nature and Existence:** Understanding the harmony in the Nature, Holistic perception of harmony at all levels of existence.

UNIT III

Understanding of Harmony on Professional Ethics: Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems.

UNIT IV

Strategy for transition from the present state to Universal Human Order: At the level of individual, at the level of society. Case studies: typical holistic technologies, management models and production systems.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	A Foundation Course in Value Education	R R Gaur, R Sangal	Excel Books Publishers
2.	Energy & Equity	Ivan Illich	The Trinity Press, Worcester, and HarperCollins, USA
3.	Human Values and Professional Ethics	Rishabh Anand	Satya Prakashan, New Delhi

Course Code	LAW005
Course Title	Constitution of India
Type of Course	MC
L:T:P	3:0:0
Credits	NC
Course Pre-requisites	None
Course Objectives	To provide the students knowledge about Basic features of Indian Constitution and various rights provided under the Constitution .
Course Outcomes (COs)	At the end of the completion of course students are expected to learn: 1. To understand and explain concepts in constitutional law. 2. Identify and discuss in depth the sources of constitution. 3. To understand how the governance system is working in the country. 4. To understand the relations between Centre and State including legislative, executive and financial. 5. Understand the distinction between various constitutional organs and their relations with each other and concept of separation of power.

SYLLABUS

UNIT I

Constitution of India: - Basic features of the Indian Constitution: Sovereign, Socialist, Secular and Democratic Republic, Preamble of the Constitution of India: Text and features of Indian Federation and its importance, Nature of Indian Federalism and Centre-State Relations

UNIT II

Fundamental Duties: Fundamental Duties included in the Constitution, Importance of Fundamental Duties, Directive Principles of the State Policy: Nature and Classification of Directive Principles, Criticism & Importance of Directive Principles, Parliament: Characteristics, Powers & Actual role of Parliament, Decline in the position of Parliament.

UNIT III

President: Method & Stages of President Election, Powers and Position of the President, Prime Minister: Appointment of the Prime Minister, Powers, Changing role of Prime Minister, Supreme Court: Its Composition, Powers and Functions of Supreme Court, Position and Independence of judiciary.

UNIT IV

Governor: Appointment, Powers and position of the Governor, Chief Minister: Powers and Position of the State Council Minister & Chief Minister, High Court: Its Composition, Powers and Functions of Supreme Court.

RECOMMENDED BOOKS

S. No.	Name of the Book	Author(s)	Publisher
1.	Indian Constitutional Law	M.P.Jain	Lexis Nexis, 2014
2.	Introduction to Constitution	D.D. Basu	Lexis Nexis, 2014
3.	Constitutional Law of India	H.M Seervai	Universal Law Publishing, 201



Course Code	EE330
Course Title	Power Systems – II (Operation and Control)
Type of Course	PC
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power System-I
Course Objectives	<ol style="list-style-type: none"> 1. To prepare the students to analyze steady-state power system using numerical methods. 2. To understand and acquire knowledge about the stability constraints in a synchronous grid. 3. To develop a clear understanding on how to control the voltage, frequency, and power flow. 4. To learn how to monitor and control a power system. 5. To learn the fundamentals of power system economics.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Use numerical methods to analyze a power system in steady state. 2. Understand stability constraints in a synchronous grid. 3. Understand methods to control the voltage, frequency and power flow. 4. Understand the monitoring and control of a power system. 5. Understand the basics of power system economics.

SYLLABUS

UNIT I

Power Flow Analysis: 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 nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

UNIT II

Stability Constraints in synchronous grids: 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 4th 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 III

Control of Frequency and Voltage: 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

Monitoring and Control: 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 IV**Power System Economics and Management**

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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Power System Analysis	J. Grainger and W. D. Stevenson	McGraw Hill Education, 1994
2.	Electric Energy Systems Theory	O. I. Elgerd	McGraw Hill Education, 1995
3.	Power System Analysis	A. R. Bergen and V. Vittal	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

Course Code	EE332
Course Title	Measurements and Instrumentation
Type of Course	PC
L:T:P	2:0:0
Credits	2
Course Pre-requisites	Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To understand and acquire knowledge about the designing and testing of DC and AC bridges. 2. To develop a clear understanding on instruments' dynamic response and calibration. 3. To make the students familiar with a variety of measurement equipment, their characteristics, how they work, and their limitations. 4. To Know how to analyze statistical data. 5. To familiarize students with the use of computers to collect data.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Design and validate DC and AC bridges. 2. Analyze the dynamic response and the calibration of instruments. 3. Learn about various measurement devices, their characteristics, their operation and their limitations. 4. Understand statistical data analysis. 5. Understand computerized data acquisition.

SYLLABUS

UNIT I

Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity, Errors in Measurements.

UNIT II

Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, Cp, Cpk.

UNIT III

Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.

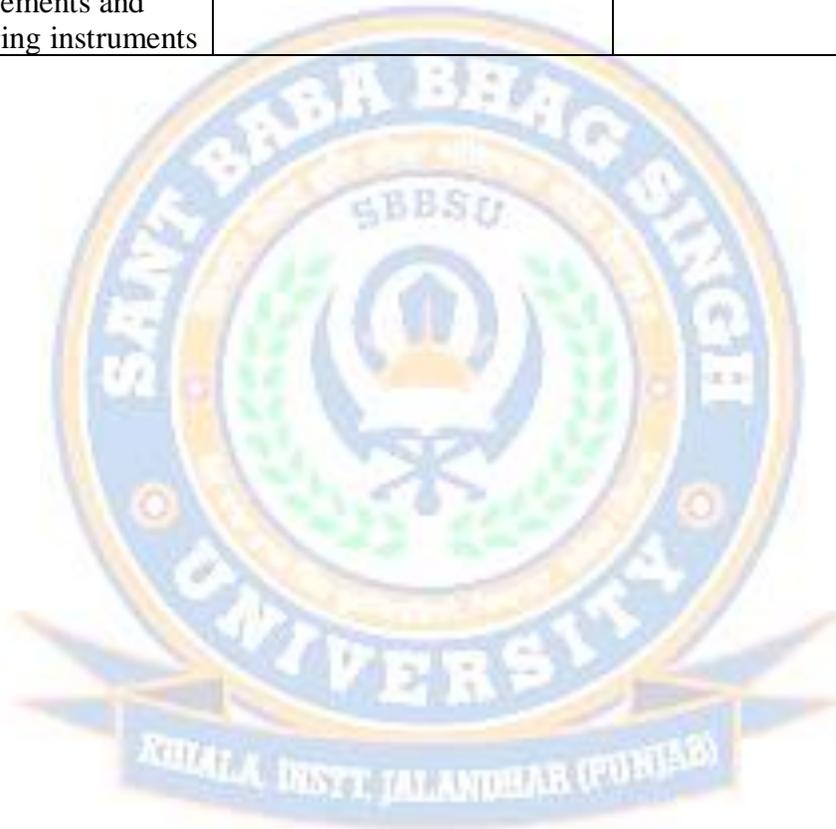
Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.

Measurements of R, L and C.

UNIT IV

Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers, Digital Storage Oscilloscope.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Electronics Instrumentation and Measurements	Bell David	APrentice Hall, India
2.	Electrical and Electronics Measurement and Instrumentation	Sawhney A. K	Dhanpat Rai and Sons
3.	Electrical Measurements and Measuring instruments	Golding Edward William	Charles Wheelers India



Course Code	EE334
Course Title	Electronics Design
Type of Course	PC
L:T:P	1:0:0
Credits	1
Course Pre-requisites	Digital Electronics, Analog Electronics
Course Objectives	<ol style="list-style-type: none"> 1. To make students conversant about the practical challenges that arise when employing electronic circuits to implement applications. 2. To acquaint the student with the selection of components, software, and hardware platforms that is appropriate.
Course Outcomes (COs)	<p>At the end of the course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the practical issues related to practical implementation of applications using electronic circuits. 2. Choose appropriate components, software and hardware platforms.

SYLLABUS

UNIT I

Basic concepts on measurements; Noise in electronic systems.

UNIT II

Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition

Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems.

UNIT III

Electronic system design employing microcontrollers, CPLDs, and FPGAs

UNIT IV

PCB design and layout; System assembly considerations.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Microelectronic circuits	A. S. Sedra and K. C. Smith	Oxford University Press, 2007
2.	The Art of Electronics	P. Horowitz and W. Hill	Cambridge University Press, 1997
3.	Noise Reduction Techniques in Electronic Systems	H.W.Ott	Wiley, 1989
4.	Printed Circuit Boards: Design and Technology	W.C. Bosshart	Tata McGraw Hill, 1983
5.	Printed Circuit Design	G.L. Ginsberg	McGraw Hill, 1991



Course Code	EE336
Course Title	Power Systems Laboratory – II
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Power System-I
Course Objectives	<ol style="list-style-type: none"> 1. To prepare the students to analyze steady-state power system using numerical methods. 2. To understand and acquire knowledge about the stability constraints in a synchronous grid. 3. To develop a clear understanding on how to control the voltage, frequency, and power flow. 4. To learn how to monitor and control a power system. 5. To learn the fundamentals of power system economics.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Use numerical methods to analyze a power system in steady state. 2. Understand stability constraints in a synchronous grid. 3. Understand methods to control the voltage, frequency and power flow. 4. Understand the monitoring and control of a power system. 5. Understand the basics of power system economics.

SYLLABUS

1. Short circuit calculations and calculation of circuit breaker ratings for a power system network.
2. (a) Y-bus formation using MATLAB/PSCAD/POWER WORLD
(b) Z-bus formulation using MATLAB/PSCAD/POWER WORLD
3. Load flow analysis by Gauss Seidal Method.
4. Load flow analysis by Newton Raphson Method.
5. To obtain power system stability on High Voltage Alternating Current (HVAC) system with the help of Flexible Alternating Current Transmission Systems (FACTS) devices using MATLAB/PSCAD/POWER WORLD.
6. Optimal Capacitor placement on a system having variable reactive power and low voltage profile.
7. To obtain relay co-ordination on a power system.
8. To find synchronous reactances (transient, sub-transient) during fault analysis.
9. To study the characteristics of a distance relay.
10. To study and design a synchronous machine for stability study using swing equation with the help of MATLAB/PSCAD/POWER WORLD.

Course Code	EE338
Course Title	Measurements and Instrumentation Laboratory
Type of Course	PC
L:T:P	0:0:2
Credits	1
Course Pre-requisites	Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To understand and acquire knowledge about the designing and testing of DC and AC bridges. 2. To develop a clear understanding on instruments' dynamic response and calibration. 3. To make the students familiar with a variety of measurement equipment, their characteristics, how they work, and their limitations. 4. To Know how to analyze statistical data. 5. To familiarize students with the use of computers to collect data.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Design and validate DC and AC bridges. 2. Analyze the dynamic response and the calibration of few instruments. 3. Learn about various measurement devices, their characteristics, their operation and their limitations. 4. Understand statistical data analysis. 5. Understand computerized data acquisition

SYLLABUS

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator.
7. Selection of trigger source and trigger level, selection of time-scale and voltage scale.
8. Bandwidth of measurement and sampling rate.
9. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
10. Usage of DSO to capture transients like a step change in R-L-C circuit.
11. Current Measurement using Shunt, CT, and Hall Sensor.

Course Code	EE340
Course Title	Electronics Design Laboratory
Type of Course	PC
L:T:P	0:0:4
Credits	2
Course Pre-requisites	Digital Electronics, Analog Electronics
Course Objectives	<ol style="list-style-type: none"> 1. To prepare the students to create a Printed Circuit Board and populate/solder it with components. 2. To collaborate with other students to develop and implement an application.
Course Outcomes (COs)	<p>At the end of the course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Design a Printed Circuit Board, get it made and populate/solder it with components. 2. Work as a team with other students to implement an application.

SYLLABUS

1. PCB design and layout.
2. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Course Code	EE342
Course Title	Control Systems Design
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Control Systems
Course Objectives	<ol style="list-style-type: none"> 1. To make students familiar with various design specifications. 2. To prepare the students to create controllers that meet the desired design specifications by utilizing simple controller structures (P, PI, PID, compensators). 3. To learn how to design controllers using the state-space approach.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Understand various design specifications. 2. Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators). 3. Design controllers using the state-space approach.

SYLLABUS

UNIT I

Design Specifications

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 II

Design of Classical Control System in the time domain

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

Design of Classical Control System in frequency domain

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

UNIT III

Design of PID controllers

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.

Control System Design in state space

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.

UNIT IV

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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Control system Engineering	N. Nise	John Wiley, 2000
2.	Control System Engineering	I.J. Nagrath and M. Gopal	Wiley, 2000
3.	Digital Control Engineering	M. Gopal	Wiley Eastern, 1988
4.	Modern Control Engineering	K. Ogata	Prentice Hall, 2010
5.	Automatic Control system	B. C. Kuo	Prentice Hall, 1995
6.	Linear control system analysis and design (conventional and modern)	J. J. D'Azzo and C. H. Houpis	McGraw Hill, 1995
7.	Design of feedback Control Systems	R.T. Stefani and G.H. Hostetter	Saunders College Pub, 1994

Course Code	EE344
Course Title	Power System Protection
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power System
Course Objectives	<ol style="list-style-type: none"> 1. To provide knowledge for the various components of a security system. 2. To develop a clear understanding for assessing the fault current caused by various types of faults in a network. 3. To learn about the protection schemes used for various power system components. 4. To learn about the fundamental principles of digital security. 5. To learn about power system protection schemes and how to use wide-area measurements.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Understand the different components of a protection system. 2. Evaluate fault current due to different types of fault in a network. 3. Understand the protection schemes for different power system components. 4. Understand the basic principles of digital protection. 5. Understand system protection schemes, and the use of wide-area measurements

SYLLABUS

UNIT I

Introduction and Components of a Protection System: Principles of Power System Protection, Relays, Instrument transformers, Circuit Breakers

Faults and Over-Current Protection: Review of Fault Analysis, Sequence Networks. Introduction to Overcurrent Protection and overcurrent relay co-ordination.

UNIT II

Equipment Protection Schemes: Directional, Distance, Differential protection. Transformer and Generator protection. Bus bar Protection, Bus Bar arrangement schemes.

Digital Protection: Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasing issues.

UNIT III

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

System Protection: Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, undervoltage 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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Protective Relaying: Principles and Applications	J. L. Blackburn	Marcel Dekker, New York, 1987
2.	Fundamentals of power system protection	Y. G. Paithankar and S. R. Bhide	Prentice Hall, India, 2010
3.	Computer Relaying for Power Systems	A. G. Phadke and J. S. Thorp	John Wiley & Sons, 1988
4.	Synchronized Phasor Measurements and their Applications	A. G. Phadke and J. S. Thorp	Springer, 2008
5.	Protective Relaying for Power Generation Systems	D. Reimert	Taylor and Francis, 2006.

Course Code	EE346
Course Title	Line Commutated and Active Rectifiers
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Analog Electronics and Power Electronics
Course Objectives	<ol style="list-style-type: none"> 1. To learn about the circuits that are controlled. 2. To develop a clear understanding of the pulse and multi-pulse configurations of the line-commutated rectifiers. 3. To help students understand how PWM rectifiers work in various modes
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Analyze controlled rectifier circuits. 2. Understand the operation of line-commutated rectifiers in pulse and multi-pulse configurations. 3. Understand the operation of PWM rectifiers in rectification and regeneration modes and lagging, leading and unity power factor mode.

SYLLABUS

UNIT I

Diode rectifiers with passive filtering: Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current wave shape, effect of source inductance; commutation overlap.

UNIT II

Thyristor rectifiers with passive filtering: Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current wave shape.

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

UNIT III

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

Ac-dc bidirectional boost converter: Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and

unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

UNIT IV

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

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Principles of Thyristorised Converters	G. De	Oxford & IBH Publishing Co, 1988
2.	Principles of Power Electronics	J.G. Kassakian, M. F. Schlecht and G. C. Verghese	Addison-Wesley, 1991
3.	Power Electronics: Essentials and Applications	L. Umanand	Wiley India, 2009
4.	Power Electronics: Converters, Applications and Design	N. Mohan and T. M. Undeland	John Wiley & Sons, 2007
5.	Fundamentals of Power Electronics	R. W. Erickson and D. Maksimovic	Springer Science & Business Media, 2001

Course Code	EE348
Course Title	Computer Architecture
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Microprocessors
Course Objectives	<ol style="list-style-type: none"> 1. To make students conversant about the fundamentals of microprocessors 2. To educate students in creating 8086 family microprocessor based assembly language programmes. 3. To organize a modern computer system and be able to apply it to real-world scenarios. 4. To implement embedded applications using the ATOM processor.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Understand the concepts of microprocessors, their principles and practices. 2. Write efficient programs in assembly language of the 8086 family of microprocessors. 3. Organize a modern computer system and be able to relate it to real examples. 4. Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes. 5. Implement embedded applications using ATOM processor.

SYLLABUS

UNIT I

Introduction to computer organization: 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.

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

UNIT II

Input – output Organization: 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 III

16 and 32 microprocessors: 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

Pipelining: Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.

UNIT IV

Different Architectures: VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Computer organization	V. Carl, G. Zvonko and S. G. Zaky	McGraw Hill, 1978
2.	The Intel microprocessors	B. Brey and C. R. Sarma	Pearson Education, 2000
3.	Computer Architecture A Quantitative Approach	J. L. Hennessy and D. A. Patterson	Morgan Kauffman, 2011
4.	Computer organization	W. Stallings	PHI, 1987
5.	Modern Embedded Computing	P. Barry and P. Crowley	Morgan Kaufmann, 2012
6.	Microprocessors, PC Hardware and Interfacing	N. Mathivanan	Prentice Hall, 2004
7.	Microcomputer Systems: The 8086/8088 Family	Y. C. Lieu and G. A. Gibson	Prentice Hall India, 1986
8.	The 8086/8088 Design, Programming, Interfacing	J. Uffenbeck	Prentice Hall, 1987
9.	IBM PC and Clones	B. Govindarajalu	Tata McGraw Hill, 1991
10.	8086 Assembly Language Programming	P. Able	Prentice Hall India

Course Code	EE350
Course Title	Computational Electromagnetics
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electromagnetic Fields
Course Objectives	<ol style="list-style-type: none"> 1. To learn the fundamentals of electromagnetics. 2. To acquire knowledge about the computational techniques used in computing fields. 3. To make students conversant about the techniques used to solve simple real-world problems.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Understand the basic concepts of electromagnetics. 2. Understand computational techniques for computing fields. 3. Apply the techniques to simple real-life problems.

SYLLABUS

UNIT I

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

UNIT II

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

UNIT III

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

Finite Element Method (FEM): Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

UNIT IV

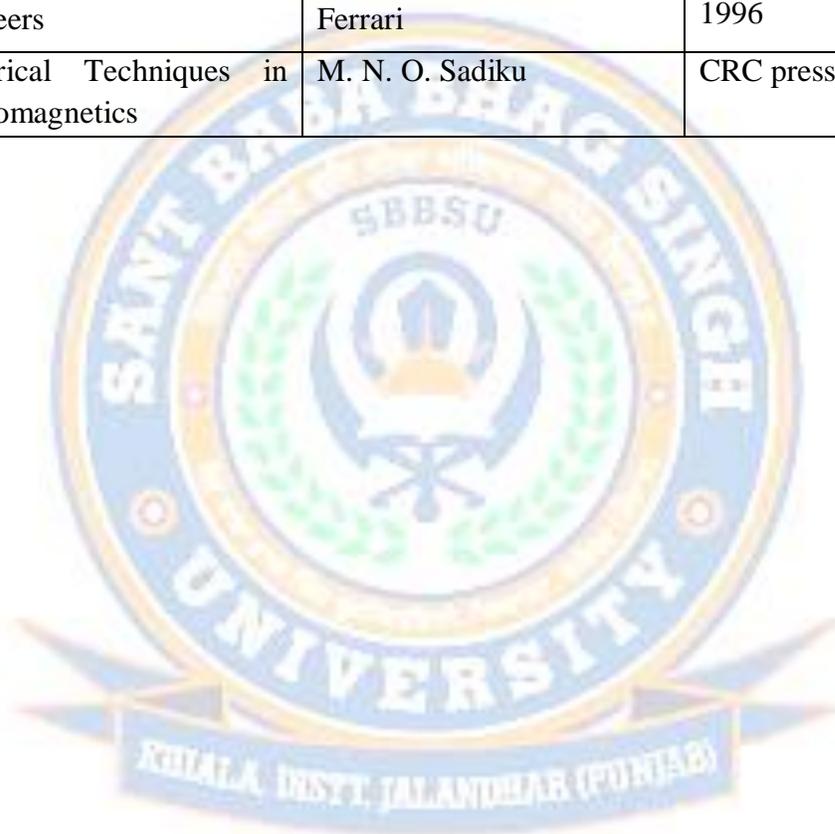
Special Topics

Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit - field computations, electromagnetic - thermal and electromagnetic - structural coupled computations, solution of equations, method of moments, Poisson's fields.

Applications: Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

RECOMMENDED BOOKS

S. No.	Name of the Book	Author(s)	Publisher
1.	Finite Element for Electrical Engineers	P. P. Silvester and R. L. Ferrari	Cambridge University press, 1996
2.	Numerical Techniques in Electromagnetics	M. N. O. Sadiku	CRC press, 2001



Course Code	EE352
Course Title	Electromagnetic Waves
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electromagnetic Fields
Course Objectives	<ol style="list-style-type: none"> 1. To make students conversant about calculating voltage and current at every point along the transmission line under various load situations. 2. To familiarize students with solution of real-world plane wave issues using a variety of boundary conditions. 3. To educate students on the concept of wave propagation field equations in particular instances like lossy and low loss dielectric mediums. 4. To impart a basic knowledge of the concept of the TE and TM mode patterns of field distributions in a rectangular wave-guide. 5. To familiarize students with antenna radiation analysis.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions. 2. Provide solution to real life plane wave problems for various boundary conditions. 3. Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectric media. 4. Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide. 5. Understand and analyse radiation by antennas.

SYLLABUS

UNIT I

Transmission Lines: Introduction, Concept of distributed elements, Equations of voltage and current, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

UNIT II

Maxwell's Equations: Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

UNIT III

Uniform Plane Wave: Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Plane Waves at Media Interface

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

UNIT IV

Waveguides: Parallel plane waveguide: Transverse Electric (TE) mode, transverse Magnetic(TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides.

Antennas: Radiation parameters of antenna, Potential functions, Solution for potential functions, Radiations from Hertz dipole, Near field, Far field, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole, Hertz dipole in receiving mode.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Electromagnetic Waves	R. K. Shevgaonkar	Tata McGraw Hill, 2005
2.	Field and Wave Electromagnetics	D. K. Cheng	Addison-Wesley, 1989
3.	Elements of Electromagnetics	M. N.O. Sadiku	Oxford University Press, 2007
4.	Advanced Engineering Electromagnetics	C. A. Balanis	John Wiley & Sons, 2012
5.	Antenna Theory: Analysis and Design	C. A. Balanis	John Wiley & Sons, 2005

Course Code	MGT007
Course Title	Organizational Behavior
Type of Course	HS
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Nil
Course Objectives	<ol style="list-style-type: none"> 1. To improve the student's Personality and Attitude. 2. To improve the skill of theories of Motivation 3. To improve the skill of Group Behaviour
Course Outcomes (COs)	<p>At the end of the course, the students will be able to:</p> <ol style="list-style-type: none"> 1. Students would be able to build up Organizational Behaviour, Personality and Attitude. 2. Students would be able to develop Group Behaviour & Communication skill. 3. An ability to handle the Organizational Politics. CO4: An ability to improve Organizational Design structure

SYLLABUS

UNIT I

Organization Behavior: its Concepts, Features and Importance, Challenges and Opportunities for OB. Foundations of Individual Behavior. Learning, Concept, Theories and Principles of learning, Reinforcement. Perception, Concept, Perceptual Process, Factors in Interpersonal perception. Attitude, Concept, Components, Attitude formation, Values & Beliefs.

UNIT II

Leadership, Concept, Theories and Leadership Styles in Management.

Transactional Analysis: Life positions, Levels of Self Awareness-Johari window Model, Ego States.

Motivation: Nature, importance, process, Theories of Motivation, Application of Motivation

Perception: Concept, Theories of Personality, Determinants of Personality

UNIT III

Group Dynamics: Concept and nature of group formation, Models of Group formation, Theories of group formation. Group decision making techniques. Difference between group and team, Types of Teams, Power and Politics: Concept, Bases of power, Tactics to gain Power, Techniques of politics. Stress Management: Meaning, Concept, Causes of Organization Stress, Stress Management.

UNIT IV

Organization Change: Concept, Change Agents, Resistance to change, Overcoming resistance to

change, Organization Culture: Concept, functions of Organization Culture, Development and implications of Organization Culture, Creating and sustaining Organization Culture. Organization Development: Concept, Interventions of Organization Development.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Microelectronic circuits	A. S. Sedra and K. C. Smith	Oxford University Press, 2007
2.	The Art of Electronics	P. Horowitz and W. Hill	Cambridge University Press, 1997



Course Code	EE415
Course Title	Wind and Solar Energy Systems
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Non Conventional Energy Resources
Course Objectives	<ol style="list-style-type: none"> 1. To provide knowledge about the energy scenario and the resulting increase in renewable energy generation. 2. To acquaint the students with the fundamental physics of wind and solar energy generation. 3. To familiarize the students with the power electronic interfaces used in wind and solar generation. 4. To comprehend the students about the issues associated with the grid-integration of solar and wind energy systems.
Course Outcomes (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources. 2. Understand the basic physics of wind and solar power generation. 3. Understand the power electronic interfaces for wind and solar generation. 4. Understand the issues related to the grid-integration of solar and wind energy systems.

SYLLABUS

UNIT I

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

UNIT II

Wind Generator Topologies

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

UNIT III

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

Solar photovoltaic: Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a

PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms, converter control.

UNIT IV

Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Solar Thermal Power Generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Wind Power in Power Systems	T. Ackermann	John Wiley and Sons Ltd., 2005
2.	Renewable and Efficient Electric Power Systems	G. M. Masters	John Wiley and Sons, 2004
3.	Solar Energy: Principles of Thermal Collection and Storage	S. P. Sukhatme	McGraw Hill, 1984
4.	Grid integration of wind energy conversion systems	H. Siegfried and R. Waddington	John Wiley and Sons Ltd., 2006
5.	Renewable Energy Applications	G. N. Tiwari and M. K. Ghosal	Narosa Publications, 2004
6.	Solar Engineering of Thermal Processes	J. A. Duffie and W. A. Beckman	John Wiley & Sons, 1991

Course Code	EE417
Course Title	HVDC Transmission Systems
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power System
Course Objectives	<ol style="list-style-type: none"> 1. To acquire knowledge about the benefits of direct current transmission over alternating current transmission. 2. To know how Line Commutated Converters and Voltage Source Converters work. 3. To familiarize the HVDC transmission system's control techniques. 4. To understand how an HVDC system can increase power system stability.
Course Outcomes (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the advantages of dc transmission over ac transmission. 2. Understand the operation of Line Commutated Converters and Voltage Source Converters. 3. Understand the control strategies used in the HVDC transmission system. 4. Understand the improvement of power system stability using an HVDC system.

SYLLABUS

UNIT I

DC Transmission Technology: 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 II

Analysis of Line Commutated: 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 III

Control of HVdc Converters: Principles of Link Control in a LCCHV dc 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.

Components of HVdc systems: 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 IV

Stability Enhancement using HVdc Control: 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 HV dc Technology. Introduction to Modular Multi-level Converters.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	HVDC Power Transmission Systems	K. R. Padiyar	New Age International Publishers, 2011
2.	High Voltage Direct Current Transmission	J. Arrillaga	Peter Peregrinus Ltd., 1983
3.	Direct Current Transmission	E. W. Kimbark	Vol.1, Wiley- Interscience, 1971

Course Code	EE419
Course Title	Power Quality and FACTS
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Transmission & Distribution
Course Objectives	<ol style="list-style-type: none"> 1. To recognize ac transmission characteristics, as well as the effects of shunt and series reactive compensation. 2. To familiarize students with the working principles of FACTS devices as well as their operating characteristics. 3. To comprehend students with the fundamentals of power quality. 4. To provide a better understanding of how devices work in order to improve power quality.
Course Outcomes (CO)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation. 2. Understand the working principles of FACTS devices and their operating characteristics. 3. Understand the basic concepts of power quality. 4. Understand the working principles of devices to improve power quality.

SYLLABUS

UNIT I

Transmission Lines and Series/Shunt Reactive Power Compensation

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

Thyristor-based Flexible AC Transmission Controllers (FACTS)

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

UNIT II

Voltage Source Converter based (FACTS) controllers: Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic

Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

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

UNIT III

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

DSTATCOM: Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

UNIT IV

Dynamic Voltage Restorer and Unified Power Quality Conditioner: Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	N. G. Hingorani and L. Gyugyi	Understanding FACTS: Concepts and Technology of FACTS Systems	Wiley-IEEE Press, 1999.
2.	K. R. Padiyar	FACTS Controllers in Power Transmission and Distribution	New Age International (P) Ltd. 2007.
3.	T. J. E. Miller	Reactive Power Control in Electric Systems	John Wiley and Sons, New York, 1983
4.	R. C. Dugan	Electrical Power Systems Quality	Mc Graw Hill Education, 2012.
5.	G. T. Heydt	Electric Power Quality	Stars in a Circle Publications, 1991

Course Code	EE421
Course Title	High Voltage Engineering
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power System
Course Objectives	<ol style="list-style-type: none"> 1. To impart a basic knowledge of the fundamental physics of insulating materials' breakdown processes in solid, liquid, and gaseous states. 2. To make students conversant about the D. C., A.C., and Impulse voltage creation and measurement. 3. To familiarize students with the standard testing on high-voltage equipment and insulating materials. 4. To educate students on the concept of how over-voltages occur in a power system and how to protect against them.
Course Outcomes (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials. 2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. 3. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards. 4. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

SYLLABUS

UNIT I

Breakdown in Gases: 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.

Breakdown in liquid and solid Insulating materials: 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 II

Generation of High Voltages:

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

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

UNIT III

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

UNIT IV

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories: 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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	High Voltage Engineering	M. S. Naidu and V. Kamaraju	McGraw Hill Education, 2013
2.	High Voltage Engineering	C. L. Wadhwa	New Age International Publishers, 2007
3.	High Voltage Engineering Fundamentals	D. V. Razevig	Khanna Publishers, 1993
4.	High Voltage Engineering Fundamentals	E. Kuffel, W. S. Zaengl and J. Kuffel	Newnes Publication, 2000
5.	High Voltage and Electrical Insulation Engineering	R. Arora and W. Mosch	John Wiley & Sons, 2011
6.	Various IS standards for HV Laboratory Techniques and Testing		

Course Code	EE423
Course Title	Digital Control Systems
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Control Systems
Course Objectives	<ol style="list-style-type: none"> 1. To familiarize the students with discrete representation of LTI systems. 2. To know how to find the stability of discrete-time open loop and closed loop systems. 3. To acquaint the students with the designing of digital controllers.
Course Outcomes (COs)	<p>At the end of the course, the student will be able to:</p> <ol style="list-style-type: none"> 1. Obtain discrete representation of LTI systems. 2. Analyze stability of open loop and closed loop discrete-time systems. 3. Design and analyse digital controllers. 4. Design state feedback and output feedback controllers.

SYLLABUS

UNIT I

Discrete Representation of Continuous Systems: 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.

Discrete System Analysis: 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 II

Stability of Discrete Time System: 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.

State Space Approach for discrete time systems: State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability & observability.

UNIT III

Design of Digital Control System: 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.

UNIT IV

Discrete output feedback control: Design of discrete output feedback control. Fast output sampling (FOS) and periodic output feedback controller design for discrete time systems.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Digital Control Engineering	K. Ogata	Prentice Hall, Englewood Cliffs, 1995
2.	Digital Control Engineering	M. Gopal	Wiley Eastern, 1988
3.	Digital Control of Dynamic Systems	G. F. Franklin, J. D. P. Workman	Addison-Wesley, 1998
4.	Digital Control System	B.C. Kuo	Holt and Rinehart

Course Code	EE425
Course Title	Electrical Energy Conservation and Auditing
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To provide knowledge about the current energy scenario and the significance of energy conservation. 2. To familiarize the students with the concepts of energy management. 3. To educate students on the methods for increasing energy efficiency in various electrical systems. 4. To educate students on the concepts of various energy-efficient devices.
Course Outcomes (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the current energy scenario and importance of energy conservation. 2. Understand the concepts of energy management. 3. Understand the methods of improving energy efficiency in different electrical systems. 4. Understand the concepts of different energy efficient devices.

SYLLABUS

UNIT I

Basics of Energy Scenario and its various forms: 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. 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 II

Energy Efficiency, Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach- understanding energy costs, bench marking, energy performance, matching energy use to 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 Efficiency in Electrical Systems: 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 III

Energy Efficiency in Industrial Systems: 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.

UNIT IV

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.

RECOMMENDED BOOKS/ REFERENCES			
S. No.	Name of the Book	Author(s)	Publisher
1.	Utilization of Electrical Energy and Conservation	S.C.Tripathy	McGraw Hill, 1991.
2.	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)		
3.	Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)		
4.	Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)		

Course Code	EE427
Course Title	Industrial Electrical Systems
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Basic Electrical Engineering
Course Objectives	<ol style="list-style-type: none"> 1. To introduce electrical wiring systems for residential, commercial, and industrial consumers, as represented by standard symbols and drawings, SLD. 2. To familiarize students with the various components of industrial electrical systems. 3. To impart knowledge on the analysis and selection of appropriate sizes for various electrical system components.
Course Outcomes (COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD. 2. Understand various components of industrial electrical systems. 3. Analyze and select the proper size of various electrical system components.

SYLLABUS

UNIT I

Electrical System Components: 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 II

Residential and Commercial Electrical Systems: 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 III

Illumination Systems: 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 IV

Industrial Electrical Systems I: 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.

Industrial Electrical Systems II: 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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Electrical Wiring, Estimating & Costing	S. L. Uppal and G. C. Garg	Khanna publishers, 2008
2.	Electrical Design, Estimating & Costing	K. B. Raina	New age International, 2007
3.	Electrical estimating and costing	S. Singh and R. D. Singh	Dhanpat Rai and Co.,1997
4.	Residential Commercial and Industrial Systems	H. Joshi	McGraw Hill Education, 2008

Course Code	EE429
Course Title	Electrical Drives
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Electrical Machines
Course Objectives	<ol style="list-style-type: none"> 1. To recognize the differences between dc and induction motors. 2. To acquaint the students with the fundamentals of dc and induction motor speed control. 3. To comprehend the students about the power electronic converters used to control the speed of dc and induction motors.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the characteristics of dc motors and induction motors. 2. Understand the principles of speed-control of dc motors and induction motors. 3. Understand the power electronic converters used for dc motor and induction motor speed control.

SYLLABUS

UNIT I

DC motor characteristics: 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.

Chopper fed DC drive: 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 II

Multi-quadrant DC drive: 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.

Closed-loop control of DC Drive: 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.

UNIT III

Induction motor characteristic: 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.

Scalar control or constant V/f control of induction motor: 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.

UNIT IV

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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Power Semiconductor Controlled Drives	G. K. Dubey	Prentice Hall, 1989.
2.	Electric Motor Drives: Modeling, Analysis and Control	R. Krishnan	Prentice Hall, 2001
3.	Fundamentals of Electrical Drives	G. K. Dubey	CRC Press, 2002.
4.	Control of Electric Drives	W. Leonhard	Springer Science & Business Media, 2001.

Course Code	ENG205
Course Title	Effective Technical Communication
Type of Course	HS
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Communication Skills-I
Course Objectives	<ol style="list-style-type: none"> 1. To provide a fundamental understanding of how to write technical and professional communication documents. 2. To teach people how to communicate in a variety of formal circumstances that occur in organizations. 3. To demonstrate and evaluate technical expertise in terms of ethical issues. 4. To set goals for self-improvement and practise self-evaluation.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Write various formal documents of technical and professional communication. 2. Communicate in diverse formal situations taking place in organizations. 3. Illustrate and examine the knowledge of ethical aspects of engineering. 4. Demonstrate and explain social and professional etiquettes. 5. Plan self-development and practice self-assessment.

SYLLABUS

UNIT I

Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

UNIT II

Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Human factors, Managing technical communication projects, time estimation, Single sourcing, Localization.

UNIT III

Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation,

Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

UNIT IV

Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Guide to writing as an Engineer	David F. Beer and David McMurrey	John Willey. New York, 2004
2.	Diane Hacker	Pocket Style Manual	Bedford Publication, New York, 2003.
3.	Shiv Khera	You Can Win	Macmillan Books, New York, 2003
4.	Technical Communications	Raman Sharma	Oxford Publication, London, 2004.
5.	Applied Writing for Technicians,	Dale Jungk	McGraw Hill, New York, 2004
6.	Business Correspondence and Report Writin	Sharma, R. and Mohan, K.	TMH New Delhi 2002.

Course Code	EE431
Course Title	Digital Signal Processing
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Signals and Systems
Course Objectives	<ol style="list-style-type: none"> 1. To make students conversant about representation of signals in the frequency, continuous and discrete time domain. 2. To acquaint the student with the use of the z-transform to analyse discrete-time systems. 3. To familiarize students with Discrete-Fourier Transform (DFT) and FFT techniques. 4. To know how to create digital filters for a variety of uses. 5. To educate students on the use of digital signal processing to analyze real-world signals.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain. 2. Analyse discrete-time systems using z-transform. 3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. 4. Design digital filters for various applications. 5. Apply digital signal processing for the analysis of real-life signals.

SYLLABUS

UNIT I

Discrete-time signals and systems: Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

UNIT II

Z-transform: z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using ztransform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

UNIT III

Discrete Fourier Transform: Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

UNIT IV

Design of Digital filters: Design of FIR Digital filters: 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. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

Applications of Digital Signal Processing: Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Digital Signal Processing: A computer based approach	S. K. Mitra	McGraw Hill, 2011
2.	Discrete Time Signal Processing	A.V. Oppenheim and R. W. Schafer	Prentice Hall, 1989
3.	Digital Signal Processing: Principles, Algorithms And Applications	J. G. Proakis and D.G. Manolakis	Prentice Hall, 1997
4.	Theory and Application of Digital Signal Processing	L. R. Rabiner and B. Gold	Prentice Hall, 1992
5.	Introduction to Digital Signal Processing	J. R. Johnson	Prentice Hall, 1992
6.	Digital Signal Processing	D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss	John Wiley & Sons, 1988

Course Code	EE433
Course Title	Electrical and Hybrid Vehicles
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power Electronics, Electrical Machines
Course Objectives	<ol style="list-style-type: none"> 1. To acquire a working knowledge of the models used to describe hybrid cars and their performance. 2. To familiarize the students with the types of energy storage options. 3. To equip learners with the various options for energy storage systems.
Course Outcomes (COs)	<ol style="list-style-type: none"> 1. Understand the models to describe hybrid vehicles and their performance. 2. Understand the different possible ways of energy storage. 3. Understand the different strategies related to energy storage systems.

SYLLABUS

UNIT I

Introduction: Conventional Vehicles, Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT II

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

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

UNIT III

Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV

Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Energy Management Strategies

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

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

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives	C. Mi, M. A. Masrur and D. W. Gao	John Wiley & Sons, 2011
2.	Hybrid Electric Vehicles: Energy Management Strategies	S. Onori, L. Serrao and G. Rizzoni	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

Course Code	EE435
Course Title	Power System Dynamics and Control
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power System, Control Systems
Course Objectives	<ol style="list-style-type: none"> 1. To comprehend the students about the issue of power system stability and its implications for the system. 2. To acquaint the students with the numerical integration methods to analyze linear dynamical systems. 3. To prepare the students for investigating the stability. 4. To learn the stability enhancement methods.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 1. Understand the problem of power system stability and its impact on the system. 2. Analyse linear dynamical systems and use of numerical integration methods. 3. Model different power system components for the study of stability. 4. Understand the methods to improve stability.

SYLLABUS

UNIT I

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

UNIT II

Analysis of Linear Dynamical System and Numerical Methods: 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 III

Modeling of Synchronous Machines and Associated Controllers: 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.

Modeling of other Power System Components: Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads. Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems.

UNIT IV

Stability Analysis: 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.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Power System Dynamics, Stability and Control	K.R. Padiyar	B. S. Publications, 2002
2.	Power System Stability and Control	P. Kundur	McGraw Hill, 1995
3.	Power System Dynamics and Stability	P. Sauer and M. A. Pai	Prentice Hall, 1997

Course Code	EE437
Course Title	Advanced Electric Drives
Type of Course	PE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	Power Electronics, Digital Signal Processing (DSP)
Course Objectives	<ol style="list-style-type: none"> 1. To familiarize students how power electronic converters work and how they are controlled. 2. To equip learners with the ac motor drive vector control techniques. 3. To impart a basic knowledge on how to use digital signal processors to create control techniques.
Course Outcomes (COs)	<p>At the end of this course, students will demonstrate the ability to</p> <ol style="list-style-type: none"> 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.

SYLLABUS

UNIT I

Power Converters for AC drives: 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-Q drive.

UNIT II

Induction motor drives: 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).

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

UNIT III

Permanent magnet motor drives

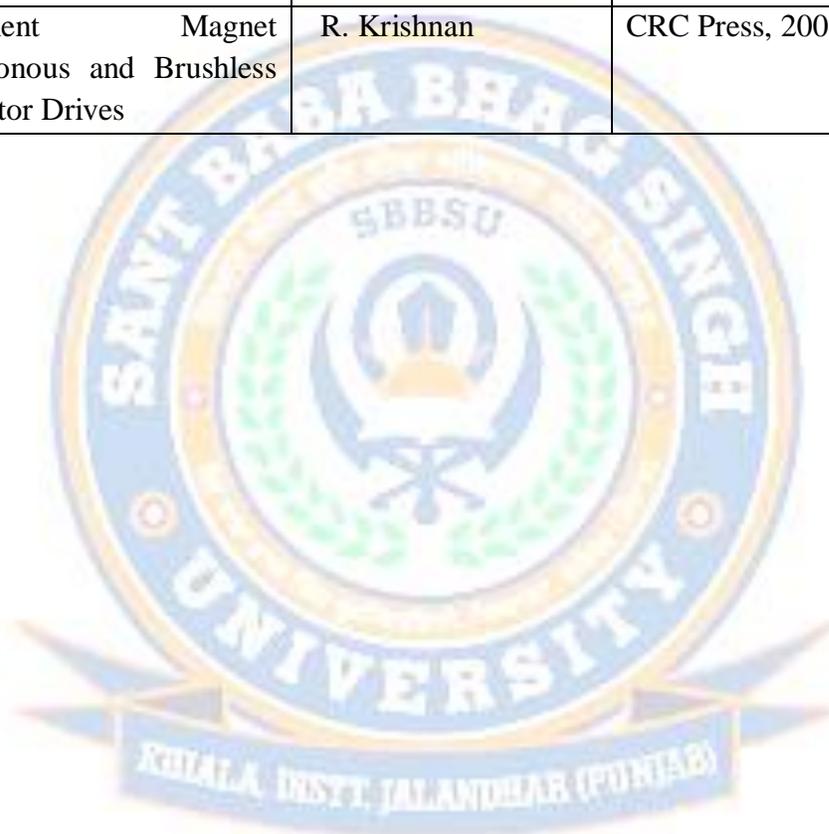
Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Switched reluctance motor drives: Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

UNIT IV

DSP based motion control: Use of DSPs in motion control, various DSPs available, and realization of some basic blocks in DSP for implementation of DSP based motion control.

RECOMMENDED BOOKS			
S. No.	Name of the Book	Author(s)	Publisher
1.	Modern Power Electronics and AC Drives	B. K. Bose,	Pearson Education, Asia, 2003
2.	Analysis of Electric Machinery and Drive Systems	P. C. Krause, O. Wasynczuk and S. D. Sudhoff	John Wiley & Sons, 2013
3.	DSP based Electromechanical Motion Control	H. A. Taliyat and S. G. Campbell	CRC press, 2003
4.	Permanent Magnet Synchronous and Brushless DC motor Drives	R. Krishnan	CRC Press, 2009



CourseCode	CSE381
CourseTitle	Basics of Computer Networks
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	This subject gives the basic knowledge to analyse architectures and computational designs and synthesize new and better architectures.
Course Outcomes(COs)	After successful completion of the course the students will demonstrate: <ol style="list-style-type: none"> 1. Understand basics of computer network 2. Describe ISO-OSI reference model 3. Explain various layers of OSI model 4. Implement and demonstrate networking

SYLLABUS

UNIT I

Introduction To Computer Networks: Definition of a Computer Network; Hardware and Software components, Network Communication Standards, OSI Reference Model, TCP/IP Model, Overview of network topologies, Basic topologies- bus, ring, star, mesh and hybrid, Local area networks, Metropolitan area networks, Wide area networks, Wireless networks.

UNIT II

Data Communications: Theoretical basis for communication; Fourier analysis, Band limited signals, Maximum data rate of a channel: Transmission impairments; Attenuation distortion, Delay distortion, Dispersion, Noise: Data transmission modes; Serial & Parallel, Simplex, Half duplex & full duplex, Synchronous & Asynchronous transmission.

UNIT III

Transmission media and Protocols: Transmission medium: Guided & Unguided media, Twisted pair, Coaxial cable, Optical fiber, Comparison of fiber optics and copper wire: Wireless transmission; Electromagnetic spectrum, Radio transmission, Microwave transmission, LAN connectors, Lower Layer Protocols - ARCnet, Ethernet, Ethernet Communication, Fast Ethernet, Gigabit Ethernet, Token Ring, Token Ring Frame format, Fault Management and tolerance, FDDI, Middle Layer Protocols- TCP/IP, Higher Layer Protocols- HTTP, FTP, SMTP, IMAP.

UNIT IV

Networking Devices: Introduction; Goal of networking devices: Repeaters; Uses of Repeaters: Hubs; Classification of Hubs, Switches; Working with Hubs and Switches,

Bridges, Types of Bridges: Routers; Dedicated Hardware versus Server-Based Routers, Gateways; Other Devices; Modems, Proxy Server, Wireless router, Brouter, Wireless Access Point (WAPs).

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Communication Networks: Fundamentals and Concepts and Key Architectures	Communication Networks: Fundamentals and Concepts and Key Architectures	TMH
2.	Computer Networks	A.S. Tanenbaum	PHI
3.	Introduction to Data Communication and Networks	Forouzan, Coombs and Fagan	TMH
4.	Data and Communication	William Stallings	PHI



CourseCode	CSE383
CourseTitle	Introduction To Big Data Analytics
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. It introduces some of the application areas where Internet of Things can be applied.
Course Outcomes(COs)	Students will learn about the middleware for Internet of Things. Understand the concepts of Web of Things Course Contents.

SYLLABUS

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

Hadoop Eco System: Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase :HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL, Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Hadoop: The Definitive Guide	Tom White	Third Edit on, O'reily Media, 2012
2.	Big Data Analytics	Seema Acharya SubhasiniChellappan	Wiley, 2015
3.	Intelligent Data Analysis	Michael Berthold, David J. Hand	Springer, 2007
4.	Big Data and Business Analytics	Jay Liebowitz	Auerbach Publications, CRC press, 2013



CourseCode	CE338
CourseTitle	Ground Water
TypeofCourse	PC
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To make an inventory of the present quality in relation to soil use, type of soil and hydro geological conditions. 2. To distinguish long term changes in quality. 3. To provide data for quality control and groundwater management.
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Use information from wells, the topography of the ground and a water table contour map, to carry out the following: interpret cross-section, calculate the thickness of the unsaturated zone and the rate of groundwater flow. 2. Deduce the direction in which groundwater is flowing and estimate the depth to the saline interface in a coastal area from the height of the water table. 3. Distinguish between unconfined and confined aquifers and recognize conditions in confined aquifers that will produce a flowing artesian well.

SYLLABUS

UNIT I

Physical properties of groundwater and aquifers.

UNIT II

Principles and fundamental equations of porous media flow and mass transport.

UNIT III

Well hydraulic sand pumping test analysis.

UNIT IV

Role of groundwater in the hydrologic cycle, groundwater quality and contamination.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Groundwater	Raghunath H.M.	New Age International (P) Limited
2.	Groundwater hydrology	Todd D.K.	Wiley 2005
3.	Groundwater hydrology	M. Karamouz	CRC Press



CourseCode	CE340
CourseTitle	Construction Practice
TypeofCourse	PC
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To know the various conventional construction materials, properties and their uses. 2. To know and understand the general construction processes and their sequences 3. To know and understand the various techniques which are useful for the substructure construction 4. To know and understand the various techniques which are useful for the superstructure construction
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Understand various conventional construction materials, properties and their uses. 2. Describe various latest and modern construction materials, properties and their uses. 3. Understand the various techniques which are useful for the substructure construction. 4. Understand the various techniques which are useful for the superstructure construction

SYLLABUS

UNIT I

Building planning, site selection, orientation from environmental and other factors, principles of planning buildings, open airspaces, requirement of parts of buildings, lighting and ventilation, requirements of various rooms, Building byelaws.

UNIT II

Components of building and their purpose and types; foundations, walls, columns, roofs, doors, windows; Bands and openings in the buildings; seismic requirements; Mechanical, Electrical & Plumbing (MEP) works in buildings; Vertical transport in structures; Building finishes; Basic design of foundation of buildings, Terms used in brick masonry, Bonds and types of mortars. Excavation, dewatering, shoring, underpinning and scaffolding, drilling, blasting, well sinking and pile driving, coffer dams, formwork-fabrication and use.

UNIT III

Construction techniques for special structures such as slip forming and other special formwork systems for high-rise buildings, Damp proofing; causes and effect of dampness, materials and methods of damp proofing; Termite proofing: pre and post construction treatment; Thermal insulation, methods of

thermal insulation, thermal insulation of roofs and exposed walls; Doors and windows, Staircases: parts and type of stairs, dimensioning of staircase.

UNIT IV

Internal and external painting-types and methods of application; various types of finishes; Fire protection- fire hazards, characteristics of fire-resisting materials and common building materials; Cracks in walls, floors and ceilings- causes and repairs techniques; Routine maintenance of buildings and structures.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Building Construction	B.C. Punmia and Ashok Kumar Jain	Laxmi Publications
2.	Building Materials	S.K. Duggal	New age international publishers
3.	Building Construction	Varghese P.C.	Prentice Hall India Pvt., Limited
4.	Building Construction and Material	Sushil Kumar	Standard Publishers



CourseCode	EE343
CourseTitle	Electrical Materials
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. Impart a fundamental understanding of material principles. 2. To have a better understanding of material selection concepts for design purposes. 3. To familiarize students with the properties of materials.
Course Outcomes(COs)	<p>Students will be able to exhibit the following abilities by the end of the course:</p> <ol style="list-style-type: none"> 1. Understanding of the basic concepts of materials. 2. Use of simplified materials selection concepts for design purposes. 3. Understanding of the properties of Materials.

SYLLABUS

UNIT I

Elementary Materials Science Concepts: Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect. Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

UNIT II

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

UNIT-III

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity.

UNIT IV

Semiconductors: Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Electrical Engineering Materials	AdrianusJ Dekker	PHILearningPublishers.
2.	Electrical Properties of Materials 8th Edition	L.Solymar	OxfordUniversityPress NewDelhi.
3.	Introduction to Electrical Engineering Material 4th Edition	C.Indulkar	S.Chand &CompanyLtd- NewDelhi



CourseCode	EE345
CourseTitle	Electric Power Utilization
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To understand the basic principles of light control and types of light schemes. 2. To impart how to design the traction system considering economic and technology up- gradation.
Course Outcomes(COs)	<p>At the end of the course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Illustrate working principle electric power utilization and their application in rel life. 2. Employ mathematical and graphical analysis considering different practical issues to design traction system; analyses the performance parameter of the traction system. 3. Examine various applications in indoor and outdoor application areas where use of light sources are essential. 4. Select most suitable type of illumination source for efficient conversion and recognize different process of utilizing electric energy for heating and Electrolytic process.

SYLLABUS

UNIT I

Electric Drives: Electrical drives & Mechanical drives, Concept of electrical drives, Basic features of industrial drives, review of operating and starting characteristics of different types of electric motors for various drives (AC and DC motors). Estimation of rating and heating of motors, Load equalization (Fly wheel effect), Drives for particular services.

Electric Traction: Introduction to Indian railways system , Electric Locomotive Classes, Various types of Traction system, single phase feeding arrangement prevalent in India. Sub-station. arrangements, Different Types of Catenary construction and line insulation, Span and dropper design Calculations.

UNIT II

Electric Heating and Welding: Methods of electric heating, types of electric heating, constructional details and performance of resistance heating furnace. Dielectric heating, Alternating current

(AC).and Direct current (DC) Welding, Resistance and Arc Welding. Electric Beam Welding, Laser Welding. Typical construction of electrical welding AC and DC set.

UNIT III

Illumination: Production of light by different methods, terms used, laws of illumination, Different Artificial light sources, their construction and operating principles, Design of lighting schemes and equipment used for indoor, industrial and flood lighting.

UNIT IV

Refrigeration and Air conditioning: Refrigeration system, Domestic refrigeration, Air conditioner, Comfort Air conditioning, Effective temperature Electrolysis: Laws of Electrolysis, Process voltage, current, energy, efficiency, Applications of electrolysis.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Modern Electric Traction	Partab H	DhanpatRai
2.	Electric Drives	De N.K. and SenP.K	PHI publication
3.	Electric Motor Drives	Berde M.S	Khanna Publishers
4.	Utilization of Electric Power and Electric Traction	Gupta J.B	S.K. Kataria and Sons
5.	Electric Energy Utilization and Conservation	Tripathy S. C.	Tata McGraw Hill
6.	Utilization of Electric Energy	Taylor E.O	Orient Blackswan
7.	Electric Motors and Drives: Fundamentals, Types and Applications	Hughes Austin	Newnes, (2005)

Course Code	ME371
Course Title	Total Quality Management
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	To facilitate the understanding of total quality management principles and processes
Course Outcomes(COs)	The students will able to: Able to use the tools and techniques of TQM in manufacturing and service sectors.

SYLLABUS

UNIT I

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT II

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT III

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT IV

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures. Quality systems, need for ISO 9000, ISO 9001-9008; Quality system-elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Principles of Pollution Abatement	Sven Erik Jørgensen	Elsevier
2.	Environmental Pollution and Control	P. R. Trivedi	PH Publishing Corporation
3.	Advanced Air and Noise Pollution Control	Lawrence K. Wang PhD	Humana Press



CourseCode	ME373
CourseTitle	Industrial Engineering Management
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To familiarize the students with management of industrial resources and production operations
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Students shall be able to describe basic concepts and theories within the area of industrial management 2. Students shall be able to present organization analysis. 3. Students shall also be able to use simple project planning technique

SYLLABUS

UNIT I

Introduction: Definition and scope of industrial engineering Role of an industrial engineering Role of an industrial engineer in industry, Functions of industrial engineering department and its organization, Qualities of an industrial engineer. Plant Layout and Material Handling: Different types of layouts viz. Product, process and combination layouts, Introduction to layouts based on the GT, JIT and cellular manufacturing systems, Development of plant layout. Types of material handling equipment, relationship of material handling with plant layouts.

UNIT II

Work-study: Areas of application of work study in industry; Method study and work measurements and their inter-relationship. Reaction of management and labour to work study; Role of work study in improving plant productivity and safety. Method Study: Objectives and procedure for methods analysis: Select, Record, Examine, Develop, Define, Install and Maintain. Recording techniques, Micromotion and macro-motion study: Principles of motion economy, Normal work areas and workplace design.

UNIT III

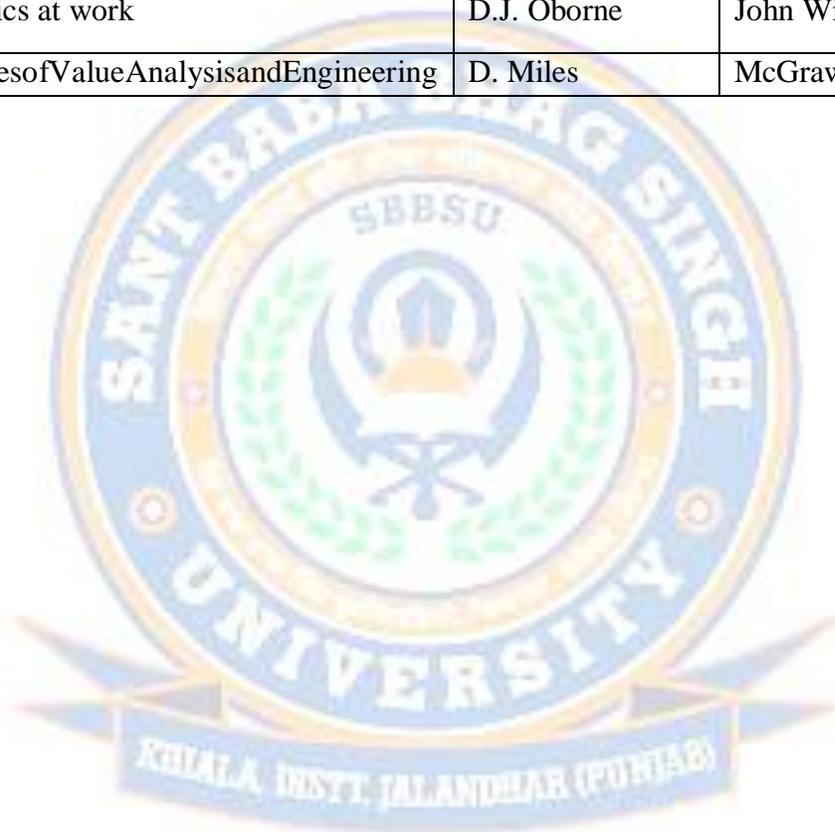
Work Measurement: Objectives, Work measurement techniques - time study, work sampling, pre-determined motion time standards (PMTS) Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, standard time. Value Engineering: Types of values, concept of value engineering, phases of value engineering studies, application of value engineering.

UNIT IV

Work Design: Concepts of job enlargement, job enrichment and job rotation. Effective job design considering technological and behaviour factors. Ergonomics: Introduction to ergonomic

considerations in designing man- machine systems with special reference to design of displays and controls.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Introduction to Work study	GaylerShotbolt	Tata McGraw Hill
2.	Work Study and Ergonomics	H.S. Shan	DhanpatRai and Co. Ltd
3.	Motion and time study	R. Bernes	John-Wiley
4.	Ergonomics at work	D.J. Osborne	John Wiley
5.	TechniquesofValueAnalysisandEngineering	D. Miles	McGrawHill



CourseCode	ME375
CourseTitle	Material Management
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To introduce to the students the various concepts of materials management
Course Outcomes(COs)	The students will be able to 1. Develop an ability to perform the role of a materials manager in an organization. 2. Manage the activities of materials manager like purchasing, inventory analysis, storage etc.in a scientific manner. 3. Shall be able to improve due date performance through use of MRP techniques within capacity constraints

SYLLABUS

UNIT I

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II

Management of purchase: Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship Negotiations.

UNIT III

Management of stores and logistics 12 Stores function – Location – Layout – Stock taking – Materials handling Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT IV

Materials plan for forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models Finite production. Inventory management 10 ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Engineering Management	Dr. R. Kesavan, C.Elanchezian and T.Sundar Selwyn	Eswar Press
2.	Purchasing Management, and Material	Lamer Lee and Donald W. Dobler	Tata McGraw Hill, 2002
3.	Handbook Management of Materials	Gopalakrishnan.P	Prentice India Hall



CourseCode	CSE382
CourseTitle	Cyber Security
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To prepare students with the technical knowledge and skills needed to protect and defend computer systems and networks.
Course Outcomes(COs)	The students will be able to- a) Analyze and evaluate the cyber security needs of an organization. b) Determine and analyze software vulnerabilities and security solutions to reduce the risk of exploitation. c) Measure the performance and troubleshoot cyber security systems

SYLLABUS

UNIT I

Foundations of Cyber Security Concepts

Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning). Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners

UNIT II

Cryptography and Cryptanalysis

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security, Security Protocols: - security at the Application Layer, PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT III

Infrastructure and Network Security

Python programming environment Overview. Introduction to System Security, Server Security, OS Security, Physical Security, Introduction to Networks, Network packet Sniffing, Network Design Simulation. DOS/ DDOS attacks. Asset Management and Audits, Vulnerabilities and Attacks. Intrusion detection and Prevention Techniques, Host based Intrusion prevention Systems, Security Information Management.

UNIT IV

Cyber Security Vulnerabilities & Safe Guards

Internet Security, Cloud Computing & Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication.

UNIT V

Cyber Laws and Forensics

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013. Introduction to Cyber Forensics, Need of Cyber Forensics, Cyber Evidence, Documentation and Management of Crime Scene, Image Capturing and its importance, Partial Volume Image, Web Attack Investigations, Denial of Service Investigations, Internet Crime Investigations, Internet Forensics, Steps for Investigating Internet Crime, Email Crime Investigations.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Cryptography and Network Security	William Stallings	Pearson Education/PHI, 2006
2.	Cryptography and Network Security	V.K. Jain	Khanna Publishing House
3.	Information and Cyber Security	Gupta Sarika	Khanna Publishing House, Delhi
4.	Cryptography and Network Security	Atul Kahate	McGraw Hill
5.	Cryptography and Information Security	V.K. Pachghare	PHI Learning

CourseCode	CSE384
CourseTitle	Ad-Hoc Wireless Networks
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	This subject provides the knowledge of Ad-hoc and sensor networks.
Course Outcomes(COs)	The learner will be able to- 1. Understand concepts of Ad-hoc networks 2. Describe and understand MAC protocols and its issues 3. Explain WSN routing and QIOS in WSN 4. Examine necessity for mesh network

SYLLABUS

UNIT I

Introduction: A basic cellular system, performance criteria, operation of cellular systems, planning a cellular system, analog & digital cellular systems. Examples of Wireless Communication Systems: Paging Systems, Cordless Telephone Systems, Cellular Telephone Systems. GSM system: Architecture and features; GSM Services ; Authentication ; Incoming & outgoing call flow ; Handover in GSM.

Ad-Hoc MAC

Introduction, Issues in Ad-Hoc Wireless Networks. MAC Protocols, Issues, Classifications of MAC protocols, Multi channel MAC& Power control MAC protocol.

UNIT II

Ad-Hoc Network Routing & TCP

Issue, Classifications of routing protocols, Hierarchical and Power aware. Multicast routing, Classifications, Tree based, Mesh based. Ad Hoc Transport Layer Issues. TCP Over Ad-Hoc, Feedback based, TCP with explicit link, TCP-BuS, Ad-Hoc TCP, and Split TCP.

UNIT III

WSN -MAC

Introduction, Sensor Network Architecture, Data dissemination, Gathering. MAC Protocols, self-organizing, Hybrid TDMA/FDMA and CSMA based MAC.

WSN Routing, Localization & QOS

Issues in WSN routing , OLSR, AODV. Localization, Indoor and Sensor Network Localization. QoS in WSN.

UNIT IV

Wireless Systems & Standards: GPRS/ EDGE specification features and architecture, 3G systems: Application of 3G&UMTS & CDMA 2000 standards.

Mesh Networks

Necessity for Mesh Networks, MAC enhancements, IEEE 802.11s Architecture, Opportunistic routing, Self configuration and Autoconfiguration, Capacity Models, Fairness, Heterogeneous Mesh Networks, Vehicular Mesh Networks.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Ad Hoc Wireless Networks – Architectures and Protocols	C.Siva Ram Murthy and B.Smanoj	Pearson Education
2.	Wireless Sensor Networks	Feng Zhao and Leonidas Guibas,	Morgan Kaufman Publishers.
3.	Ad Hoc Mobile Wireless Networks	C.K.Toh	Pearson Education
4.	Wireless Mesh Networking	Thomas Krag and SebastinBuettrich	O'Reilly Publishers



CourseCode	ME372
CourseTitle	Environmental Pollution and Abatement
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To understand the various nature of pollutants, sources and effects on human body and nature.
Course Outcomes(COs)	The students will be able to: 1. Quantify and analyze the pollution load. 2. Analyze/design of suitable treatment for wastewater 3. Model the atmospheric dispersion of air pollutants

SYLLABUS

UNIT-I

Historical perspective. Human respiratory system; effects of pollutants on human health. Classification and sources of pollutants. CO, CO₂, O₂, N₂ cycles, sources, and sinks.

UNIT-II

Reactions of pollutants in the atmosphere, and their effects; smokes, smog, fog, acid rain and ozone layer. Global warming and its effects. Regulatory laws and standards. Atmospheric lapse rate, inversions, and heat balance. Atmospheric diffusion of pollutants, transport, transformation, and deposition.

UNIT-III

Air sampling and pollutant measurement methods, principles, and instruments. Ambient air quality and emission standards. Control principles: removal of gaseous pollutants by absorption, adsorption, chemical reaction, and other methods.

UNIT-IV

Selective catalytic reduction of NO_x, Particulate emission control; settling chambers, cyclone separation, wet collectors, fabric filters and electrostatic precipitators. Clean coal technology and shifted emphasis on non-carbon sources of energy.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Principles of Pollution Abatement	Sven Erik Jørgensen	Elsevier
2.	Environmental Pollution and Control	P. R. Trivedi	PH Publishing Corporation
3.	Advanced Air and Noise Pollution Control	Lawrence K. Wang PhD	Humana Press

CourseCode	ME374
CourseTitle	Management Information System
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	Recognize contemporary MIS theory and how information systems support business strategy, business processes, and practical applications in an organization.
Course Outcomes(COs)	The students will be able to <ol style="list-style-type: none"> 1. Relate the basic concepts and technologies used in the field of management information systems. 2. Compare the processes of developing and implementing information systems. 3. Outline the role of the ethical, social, and security issues of information systems.

SYLLABUS

UNIT I

Information and Decision Making: Concept of information; data versus information, characteristics of information, classification of information, cost and value of information, Use of information in the decision making process, information requirements for decision making, types of decisions, decision making process, decision making models role of information system, decision support systems, expert systems.

UNIT II

Management Information Systems (MIS): Concept, Characteristics and importance of management information systems, types of information systems role of computers in management information systems, hierarchy of data processing systems, operating elements of MIS, information needs of MIS, storage and retrieval of data processing, functions of information systems, management reports. Analysis and design cycle for MIS. Various approaches to system analysis and design. Strategic and project Planning for MIS, analysis and design, matching mission, objectives and plans of MIS with business plans, project planning for MIS, Conceptual system design, Detailed system design, Implementation, Evaluation and Maintenance of MIS

UNIT III

Computer Networks and Data Communication Computer network: Local Area networks; characteristics topologies network structures, switching networks, OSI standards for multi-vendor network. I.A.N standards, application of networks, Data Communication concepts, types and modes

of transmission, hardware requirements, communication controllers, Data Communication software, data communication protocol.

UNIT IV

Data Base Management Systems: Introduction, data base designing, relational data base management system. Introduction to computerized data base management system.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Information System for Modern Management.	G. Mudrick, Joel E. Ross and James R. Clagget	Prentice Hall
2.	Management Information Systems	G. Davis and M. Olson	McGraw Hill
3.	Information systems for management	Henry C. Lucas	McGraw Hill



CourseCode	ME376
CourseTitle	Maintenance and Reliability Engineering
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To provide the students with the fundamental concepts, the necessary knowledge and the basic skills related to systems reliability and systems maintenance function 2. To expose them to the necessary engineering techniques used for analyzing, Planning, and controlling
Course Outcomes(COs)	<p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the maintenance function and its objectives and know how to prepare report about the maintenance function. 2. Gain the necessary knowledge about the types of maintenance and know how to use them when design maintenance systems. 3. Gain the necessary knowledge about failure distributions and apply 4. failure analysis techniques

SYLLABUS

UNIT I

Introduction: Objective and characteristics of maintenance function, Organization of the maintenance system, Operating practices in maintenance, Maintenance record keeping. Cost Aspect of Maintenance: Costs of machine breakdown, estimation of life cycle costs, Application of work measurement in maintenance, Manpower planning and training, Incentive payments for maintenance.

UNIT II

Planning of Maintenance Activities: Evaluation of alternative maintenance policies breakdown, preventive and predictive maintenance, fault diagnosis and condition monitoring techniques, simulation of alternative practices, Development of preventive maintenance schedule, House keeping practices, total productive maintenance. Maintenance Engineering: Maintenance requirements of mechanical, electrical, process and service equipment, Safety aspect in maintenance, Aspect of lubrication; chemical control of corrosion, Computerized maintenance information systems.

UNIT III

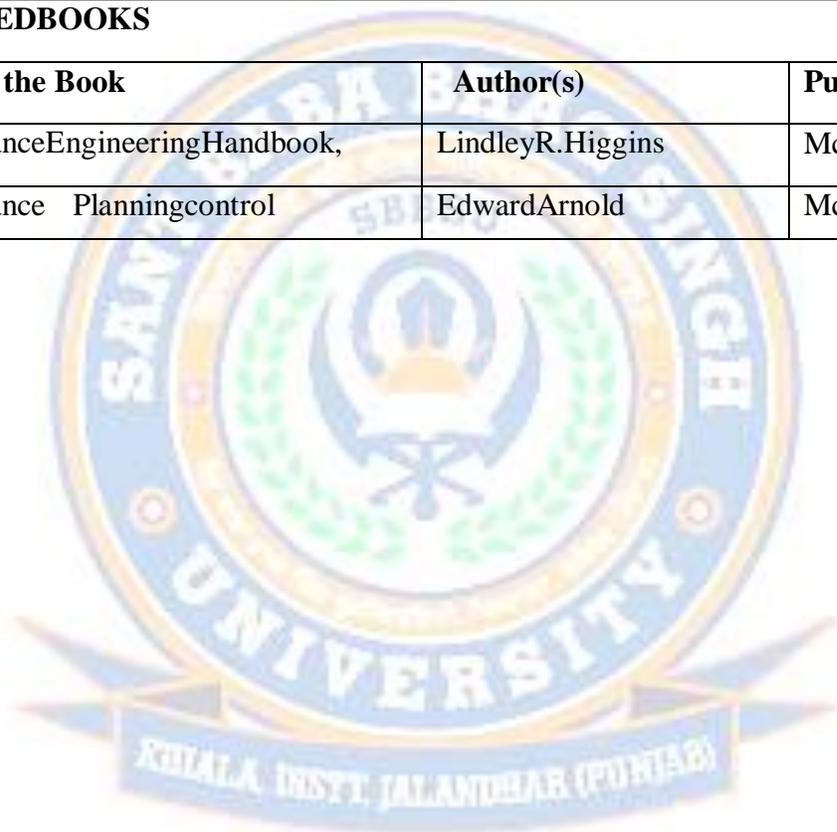
Reliability: Concept and definition, configuration of failure data, various terms used in failure data analysis in mathematical forms, component and system failures, uses of reliability concepts in design and maintenance of different system. Reliability and Availability of Engineering systems:

Quantitative estimation of reliability of parts, Reliability of parallel and series elements, Accuracy and confidence of reliability estimation, Statistical estimation of reliability indices, Machine failure pattern, Breakdown time distribution.

UNIT IV

Reliability improvement: Reliability in design, reliability in engineering, systems, systems with spares, reliability simulation, redundant and stand by systems, confidence levels, component improvement element, unit and standby redundancy optimization and reliability-cost tradeoff. Fault Tree Analysis: Introduction and importance, fault tree construction, reliability calculations from fault tree, tie set and cut set methods, event tree and numerical problems.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Maintenance Engineering Handbook,	Lindley R. Higgins	McGraw Hill
2.	Maintenance Planning control	Edward Arnold	McGraw Hill



CourseCode	EE364
CourseTitle	Wavelet Theory and Applications
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To acquire knowledge about Recognize the wavelet principle and distinguish between continuous and discrete wavelet transforms. 2. Using multi-resolution analysis, familiarize students with various wavelets and their time-frequency resolution properties. 3. To learn how to implement discrete wavelet transforms utilizing multi-rate digital filters. 4. To comprehend the students about wavelet packets 5. To learn about applications of wavelet transforms in various fields.
CourseOutcomes(CO)	<p>At the end of the course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand wavelet basis and characterize continuous and discrete wavelet transforms 2. Understand multi resolution analysis and identify various wavelets and evaluate their time- frequency resolution properties 3. Implement discrete wavelet transforms with multi-rate digital filters 4. Understand about wavelet packets. 5. Understand the applications of wavelet transforms to different fields.

SYLLABUS

UNIT I

Introduction: Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Timefrequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

UNIT II

Continuous Wavelet Transform: Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

UNIT III

Discrete Wavelet Transform and Filterbanks: Orthogonal and biorthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

UNIT IV

Multi Resolution Analysis: Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets

Applications: Signal and Image compression, Detection of signal changes, analysis and classification of audio signals using CWT, Wavelet based signal de-noising and energy compaction, Wavelets in adaptive filtering, Adaptive wavelet techniques in signal acquisition, coding and lossy transmission, Digital Communication and Multicarrier Modulation, Trans multiplexers, Image fusion, Edge Detection and object isolation.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Fundamentals of Wavelets: Theory, Algorithms, and Applications (2nd Editions)	J.C. Goswami and A.K. Chan	Wiley, 2011
2.	Wavelets and their Applications	Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi	John Wiley & Sons, 2010
3.	A primer on Wavelets and their scientific applications	J S Walker	CRC press, 2002
4.	Wavelets and signal processing: An application based introduction	Stark	Springer, 2005
5.	Multirate Systems and Filter Banks	P. P. Vaidyanathan	Pearson Education, 2004

CourseCode	EE366
CourseTitle	Industrial Automation
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To familiarize the students about the advantages, functions, characteristics, and applications of a specific automation system. 2. To provide knowledge about PLC modules and their interfacing with I/O devices. 3. To comprehend the students about programming of PLCs for variety of applications. 4. To acquaint the students with the SCADA architecture, its interfacing with PLC, and applications.
CourseOutcomes(CO)	<p>At the end of the course, students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Describe the benefits, functions of the components, characteristics and applications of given automation system. 2. Identify specified modules of the PLC and their interfacing with the I/O devices. 3. Development of PLC programs for various applications. 4. Describe the SCADA architecture, Interfacing SCADA system with PLC and applications of SCADA.

SYLLABUS

UNIT I

Introduction to Industrial Automation: Need and benefits of industrial automation, Automation hierarchy, Basic components of automation System, Description of each component, Types of automation system: fixed, programmable, flexible. Different systems for industrial automation: PLC, HMI, SCADA, DCS, Drives.

UNIT II

PLC Fundamentals: Building blocks of PLC, CPU Memory organization, Input-Output modules (discrete and analog), Special I/O modules, Power supply. Fixed and modular PLC and their types, redundancy in PLC modules, I/O module selection criteria, interfacing different I/O devices with appropriate I/O modules.

UNIT III

PLC Programming and Applications: PLC I/O addressing, PLC programming instructions: relay type instructions, timer instructions, on delay, off delay, retentive, Counter instructions: Up, down, High speed, logical instructions, data handling instructions, arithmetic instructions.

PLC Programming language: Functional block diagram, instruction list, structured text, sequential function chart (SFC), ladder programming.

Simple Programming Examples using Ladder Logic: language based on relay, timer counter, logical, comparison, arithmetic and data handling instructions.

PLC based applications: Motor sequence control, traffic light control, elevator control, tank level control, conveyor system, stepper motor control, reactor control

UNIT IV

Supervisory Control and Data acquisition System (SCADA): Introduction to SCADA, typical SCADA architecture/ block diagram, benefits of SCADA, Various editors of SCADA.

Interfacing SCADA system with PLC: Typical connection diagram, Object linking and embedding for process control architecture Steps in creating SCADA screen for simple object, Steps for linking SCADA object with PLC ladder diagram using OPC.

Applications of SCADA: Traffic light control, water distribution, pipeline control.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Programmable Logic Controllers, 4 th Edition	Petruzella, F.D.	Tata McGraw Hill India, 2010
2.	Programmable Logic Controllers and Industrial Automation	Mitra Madhuchandra, Sengupta Samarjit	Penram International Publication, New Delhi
3.	Introduction to Programmable Logic Controllers	Dunning, G.	Thomson/ Delmar Learning, New Delhi, 2005
4.	Supervisory Control and Data Acquisition, 4 th Edition	Boyar S.A.	ISA Publication, New Delhi
5.	Practical SCADA for Industry	David, B., Edwin, W.	Newnes (an imprint of Elsevier) International Edition, 2003

CourseCode	CE421
CourseTitle	Metro Systems and Engineering
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	An overview of urban transport policy and characteristics of metro schemes and policies.
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Understanding overview of metro system. 2. Analyze vehicle dynamics and structure. 3. Understand basics of construction planning and management, safety system.

SYLLABUS

UNIT I

General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

UNIT II

Civil Engineering: Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management.

UNIT III

Electronics and Communication Engineering: Signaling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

UNIT IV

Mechanical & TV+AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators Electrical: OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Stand by and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Metro Transit Initiatives	CledanMandariPerott	DhanpatRai and Sons, New Delhi
2.	Track Design Handbook	Transportation Research Board	IRC, New Delhi
3.	Bridge Engineering	Ponnuswamy S	Tata Mcgraw Hill, New Delhi



CourseCode	CE423
CourseTitle	Environmental Systems
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To learn the fundamentals concepts of environmental impact assessment in the field of environmental engineering
Course Outcomes(COs)	1. Apply concepts and methods from ecological sciences in environmental problem solving. 2. Understand the transitional character of environmental problems 3. Understand environment problems and way of addressing them.

SYLLABUS

UNIT I

Introduction to the concepts and applications of environmental systems analysis.

UNIT II

Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy.

UNIT III

Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non- inferior sets, single and multi-objective optimization.

UNIT IV

Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Environmental Impact Assessment	Canter R.L	Mcgraw hill
2.	Concept in Environmental Impact Assessment.	Shukla S.K	Mcgraw hill
3.	Environment Management	Krishanamoorthy P	Hall PTR

CourseCode	SSC008
CourseTitle	Gender Culture and Development
TypeofCourse	HS
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objective (CO)	<ol style="list-style-type: none"> 1. To engage in research nationally and internationally in gender studies at the level of policy and practice, 2. To work as gender experts in the fields of media- print and electronic- and that of information and communication technology 3. To work in the development sector in various capacities 4. To pursue career in the area of Corporate Social Responsibility
CourseOutcomes(CO)	Understand Gender and Women's Studies as an academic field of study, be familiar with its major concepts, history, assumptions, and theories/theorists, and recognize its epistemological and methodological diversity and character.

SYLLABUS

UNIT I

Introduction to Gender: Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender

UNIT II

Gender Roles and Relations : Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labour.

Gender Development Issues: Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender and Mainstreaming

UNIT III

Gender-based Violence: The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective.

UNIT IV

Gender and Culture: Gender and Film, Gender and Electronic Media, Gender and Advertisement
Gender and Popular Literature.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author (s)	Publisher
1.	Gender, culture and honour	Rajesh Gill	ISBN: 9788131610992
2.	Gender in Cross Cultural Perspective	Caroline B Brettell 113821664X US ED	Taylor & Francis Ltd
3.	The Women, Gender & Development Reader	Nalini Visvanathan, Lynn Duggan, Laurie Nisonoff	ZED Books



CourseCode	CSE481
CourseTitle	Basics Of Database Design
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	This subject assesses new developments in database technology. It Interpret and explain the impact of emerging database standards and Evaluate the contribution of database theory to practical implementations of database management systems
Course Outcomes(COs)	The learner will be able to- 1. Understand basic concepts of database 2. Develop and Design ER diagram 3. Develop Relational database management system using constraints and normalization concepts 4. Implement security issues on the developed databases

SYLLABUS

UNIT I

Introduction to Databases and Transactions: Basic concepts of database, Need of database system, File based system, view of data, database architecture, Data Models: The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction. Database Design ER-Diagram: Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas.

UNIT II

Relational database Model: Logical view of data, keys, integrity rules. Relational Database design: features of good relational database design, atomic domain and Normalization. Relational Algebra and Calculus: Relational algebra: introduction, Selection and projection, set operations, renaming, Joins, Division, syntax, semantics. Operators, grouping and ungrouping, relational comparison. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

UNIT III

Constraints, Views and SQL: Database Languages, Constraints and its types, Integrity constraints, Views: Introduction to views, updates on views, comparison between tables and views SQL: data definition, aggregate function, Null Values.

UNIT IV

Transaction management and Concurrency control: Transaction management: ACID properties, serializability and concurrency control, Lock based concurrency control (2PL, Deadlocks), Time stamping methods, optimistic methods, database recovery management Database Security and Authorization: Introduction to Database Security Issues, Discretionary Access Control Based on Granting/Revoking of Privileges.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Fundamentals of Database Systems, Third Edition	Elmasri/Navathe	Addison Wesley
2.	Database Concepts	Korth and Silberschatz Abraham,	McGraw Hall
3.	An introduction to Database Systems	C.J.Date.	Addison Wesley
4.	An introduction to Database Systems	Bipin C. Desai.	West Publishing
5.	SQL,PL/SQL ,The programming language of oracle	Ivan Bayross	BPB Publication

CourseCode	CSE483
CourseTitle	Fuzzy logic
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory 2. Introduce students to artificial neural networks and fuzzy theory from an engineering perspective
Course Outcomes(COs)	<p>The learner will be able to</p> <ol style="list-style-type: none"> 1. Understand concepts of Fuzzy logic and fuzzy set operations. 2. Understand and describe operations on fuzzy relations. 3. Explain features of the membership function 4. Implement conversion of fuzzy to crisp using fuzzy arithmetic

SYLLABUS

UNIT I

Introduction, Classical Sets and Fuzzy Sets

Background, Uncertainty and Imprecision, Statistics and Random Processes, Uncertainty in Information, Fuzzy Sets and Membership, Chance versus Ambiguity. Classical Sets - Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions Fuzzy Sets - Fuzzy Set operations, Properties of Fuzzy Sets. Sets as Points in Hypercubes

UNIT II

Classical Relations and Fuzzy Relations

Cartesian Product, Crisp Relations- Cardinality of Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition. Fuzzy Relations - Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition.

UNIT III

Membership Functions

Features of the Membership Function, Standard Forms and Boundaries, Fuzzification, Membership Value Assignments – Intuition, Inference, Rank Ordering, Angular Fuzzy Sets, Neural Networks, Genetic Algorithms, Inductive Reasoning.

UNIT IV

Fuzzy-to-Crisp Conversions, Fuzzy Arithmetic, Defuzzification Methods Extension Principle - Crisp Functions, Mapping and Relations, Functions of fuzzy Sets.

Fuzzy Rule- Based Systems

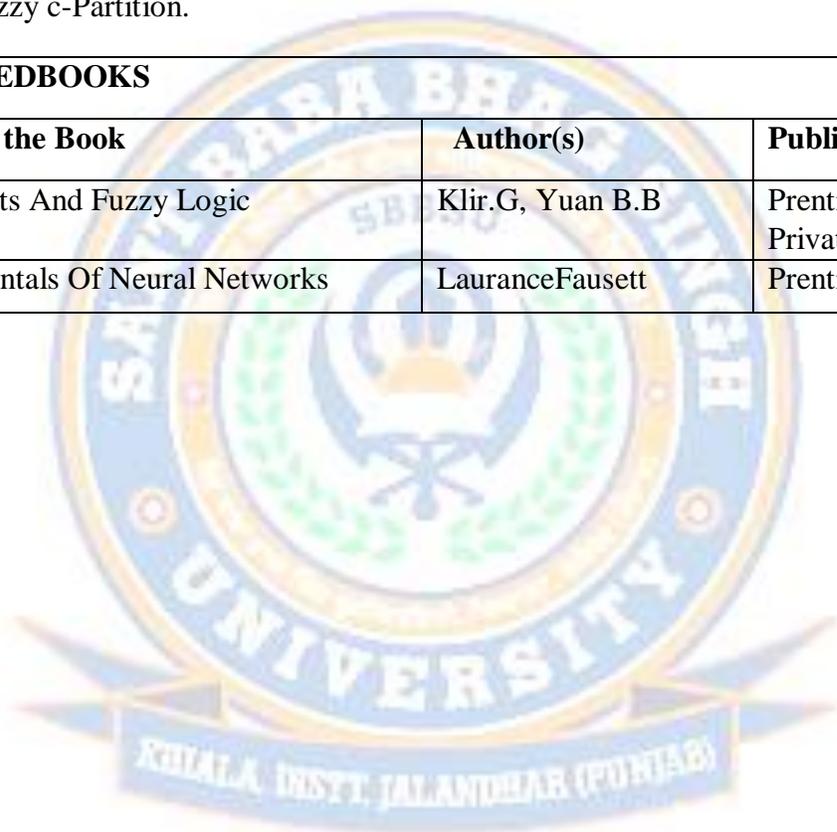
Rule-Based Systems - Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules, Graphical Techniques of Inference

Fuzzy Classification

Classification by Equivalence Relations - Crisp Relations, Fuzzy Relations. Cluster Analysis, Cluster Validity, c-Means Clustering - Hard c-Means (HCM), Fuzzy c-Means (FCM). Classification Metric, Hardening the Fuzzy c-Partition.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Fuzzy Sets And Fuzzy Logic	Klir.G, Yuan B.B	Prentice Hall Of India Private Limited, 1997
2.	Fundamentals Of Neural Networks	LauranceFausett	Prentice Hall



CourseCode	ME471
CourseTitle	Operations Management
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms.
Course Outcomes(COs)	The students will be able to: 1. Apply knowledge of fundamental concepts of operations management. 2. Apply knowledge of approaches to operational performance improvement. 3. Apply decision-support tools to business decision making.

SYLLABUS

UNIT I

Operations management: Concept, Functions. Product Design and development: Product design and its characteristics: Product development process (Technical): Product development techniques. Process selection- Project, job, Batch, Mass, and Process types of Production Systems.

UNIT II

Facility Location: importance, Factors in Location Analysis: Location Analysis Techniques. Facility Layout: Objectives: Advantages: Basic types of layouts. Capacity Planning: Concepts: Factors Affecting Capacity Planning, Capacity Planning Decisions. Production Planning & Control (PPC): Concepts, Objectives, Functions. Work Study: Productivity: Method Study; Work Measurement.

UNIT III

Introduction to modern productivity techniques: just in time, Kanban system. Total Quality Management & six sigma. Functions of Purchasing Management: Objectives, Functions: Methods: Procedure. Value analysis: Concepts. Stock control systems. Virtual factory concept. Production worksheets.

UNIT IV

Inventory Management: Concepts, Classification: Objectives: Factors Affecting Inventory Control Policy: Inventory costs: Re-order Level, Quality Management - Quality Concepts, Difference between Inspections, Quality Control, Quality Assurances, Total Quality Management: Control Charts: acceptance Sampling.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Production & Operations Management	Nair	Tata McGraw hill
2.	Production & Operations Management	Adam and Eben	Prentice Hall



CourseCode	ME473
CourseTitle	Production Planning and Control
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	The objective of this course is to Assist the students to acquire proficiency concept of planning and control of production.
Course Outcomes(COs)	The students will be able to: 1) Understand the role Production Planning and control activities in Manufacturing and Services. 2) Understand and perform various Inventory Management techniques and apply in real manufacturing scenario. 3) Demonstrate various Scheduling procedures

SYLLABUS

UNIT I

Production Planning & Control: Importance, Objectives, and Function Types of Production Systems. Production Procedure: Production Cycle, Planning & Control in the Production Procedure. Production Organization: Organization Structure, Sections of Planning & Control Department. Product Selection, Process Selection, Plant Location, Plant Layout, Operations Capacity Planning.

UNIT II

Production Order: Process Charts, Production Master Programmes, Operation & Route Sheets, Breakdown of the Production Order & preparation of various Cards. Production Planning: Operations Planning and Scheduling Systems, Aggregate Planning Process, Strategies for Aggregate Planning, Disaggregation of Aggregate Plans, Master Production Schedule (MPS), Material Requirement Planning (MRP), Rough Cut Capacity Planning.

UNIT III

Production Control: Machine Loading; Infinite and Finite Loading, Gantt Load Chart, Visual Load Profiles; Detailed Scheduling: Gantt Scheduling Chart, Forward and Backward Scheduling, Forms Schedules, Inputs of Schedule, drawing a Job Schedule, Factors influencing Scheduling, Procedure Scheduling, Reducing Scheduling Problems; Dispatching; Expediting; recording Progress; Input / Output Control.

UNIT IV

Production Control for Mass Production: Design of Production Line, Assembly Line Balancing. Production Control for Batch production: Inventory Control for Single and Multiple Products, Line of Balance. Production control for Job Shop Production: Jumbled Flow in a Job Shop, Job

Sequencing for Machine Limited Scheduling Systems, Job Sequencing for Men and Machine Limited Scheduling Systems.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Production Planning and Control	K C Jain and L N Agarwal	6th edition, Khanna Publishers, 2008
2.	Production Planning and Control	M Mahajan	Dhanpat Rai & Co., 2010
3.	Production & Operations Management	R Paneerselvam	2nd edition, PHI Publications, 2006
4.	Modern Production & Operation Managements	E S Baffa and R K Sarin	8th edition, Wiley Publications, 2009



CourseCode	ME475
CourseTitle	Smart Materials and Devices
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	By the end of this course, student should be able to apply basic principles and mechanisms of smart materials and devices and provides a spring board for further study, demonstrate knowledge and understanding of the physical principles underlying the behavior of smart materials, describe the basic principles and mechanisms of the important smart materials, demonstrate knowledge and understanding of the engineering principles in smart sensors, actuators and transducer technology, propose improvements on the design, analysis, manufacturing and application issues involved in, integrating smart materials and devices with signal processing and control capabilities to engineer smart structures and products.
Course Outcomes(COs)	Course Outcomes: By the end of this course, student will be able to 1 Understand the behavior and applicability of various smart materials. 2Design and conduct experiments, analyze and interpret data related to smart materials and devices. 3Design a system, component, or process based on smart materials to meet desired needs.

SYLLABUS

UNIT-I

Introduction: Overview of Smart Materials and their properties, Classification of Smart Materials, Development of smart materials and devices. Areas of application of devices.

UNIT-II

Piezoelectric and Electrostrictive Materials: Constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezoceramic materials, variation of coupling coefficients in hard and soft piezoceramics, polycrystalline vs single crystal piezoelectric materials, polyvinylidene fluoride, piezoelectric composites

Magnetostrictive and Magnetoelectric Materials: constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials

UNIT-III

Shape Memory Alloys: Synthesis, Types of shape memory alloys, Nickel-Titanium alloy (Nitinol), Cu based alloys, Chiral materials, Applications, Fasteners, Fibers, Reaction vessels, Nuclear reactors, Chemical plants, Satellite antenna, Blood clot filter, Plastics.

Electrorheological (ER) And Magnetorheological (MR) Fluids: Suspensions and ER fluids, ER phenomenon, charge migration mechanism, ER fluid actuators, applications of ER fluids. Composition of MR fluid, applications of MR fluids.

UNIT-IV

Sensor and Actuator: Sensing Technology, Types of Sensors, Physical Measurement using Piezo Electric Strain measurement, Inductively Read Transducers, The LVDT, Fiber Optic Techniques. Chemical and Bio- Chemical sensing in Structural Assessment, Absorptive chemical sensors, Spectroscopes, Fibre Optic Chemical Sensing Systems and Distributed measurement.

Actuator Techniques, Actuator and actuator materials, Piezoelectric and Electrostrictive Material, Magneto structure Material, Shape Memory Alloys, Electrorheological Fluids, Electromagnetic actuation, Role of actuators and Actuator Materials.

Measuring Techniques: Strain Measuring Techniques using Electrical strain gauges, Types, Resistance, Capacitance, Inductance, Wheatstone bridges, Pressure transducers, Load cells, Temperature Compensation, Strain Rosettes.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Piezoelectric Materials and Devices: Applications in Engineering and Medical Sciences	M. S. Vijaya	CRC Press, 2017
2.	Smart Electronic Materials: Fundamentals and Applications	Jaspri Singh	Cambridge University Press, 2005
3.	Smart materials and new technologies	M. Addington, Schodek, L. Daniel	Routledge, 2016
4.	Smart Materials and Structures	M.V. Gandhi, Brian S. Thompson	Springer Netherlands, 1992

CourseCode	EE439
CourseTitle	Electronic Devices
TypeofCourse	OE
L:T:P	300
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To Know the fundamentals of semiconductor physics. 2. To know how to use mathematical models of semiconductor junctions and MOS transistors in circuits and systems.
CourseOutcomes(CO)	<p>At the end of this course students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the principles of semiconductor Physics 2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

SYLLABUS

UNIT I

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors.

UNIT II

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode.

UNIT III

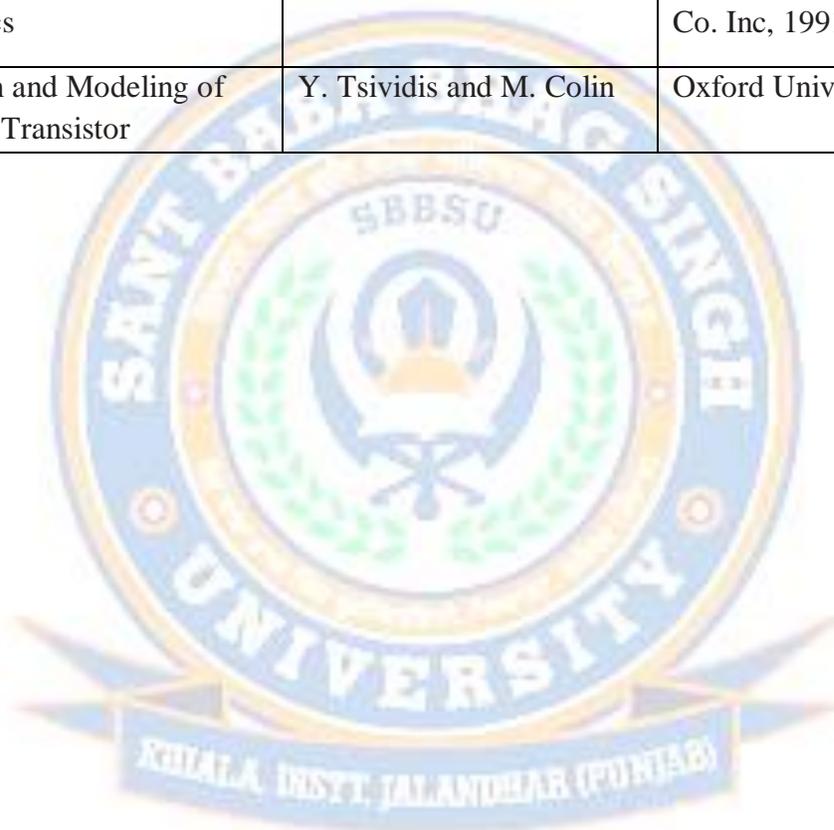
Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell.

UNIT IV

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Solid State Electronic Devices (7th edition)	G. Streetman, and S. K. Banerjee	Pearson,2014
2.	Semiconductor Physics and Devices	D. Neamen , D. Biswas	McGraw-Hill Education
3.	Physics of Semiconductor Devices(3rd edition)	S. M. Sze and K. N. Kwok	John Wiley & Sons, 2006
4.	Fundamentals of solid state electronics	C.T. Sah	World Scientific Publishing Co. Inc, 1991
5.	Operation and Modeling of the MOS Transistor	Y. Tsividis and M. Colin	Oxford Univ. Press,2011



CourseCode	EE441
CourseTitle	Instrumentation in Power System
TypeofCourse	OE
L:T:P	3:0:0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To acquaint the students with the measurement of electrical quantities. 2. To provide information on the components of a data acquisition system. 3. To acquire knowledge of telemetry techniques. 4. To provide students with an understanding of power plant instrumentation.
CourseOutcomes(CO)	<p>At the end of this course students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Learn the measurement of electrical quantities using different electrical instruments. 2. Understand the working of data acquisition system. 3. Understand the working of telemetry techniques. 4. Understand the working of the instruments used in various types of power plants.

SYLLABUS

UNIT I

Measurement of electrical quantities, Active and reactive power in power plants, Energy meters, Instrument transformers and their transient response.

Instrumentation Techniques: Telemetry, Remote Control, remote signaling and supervisory control and data acquisition (SCADA), signal formation, conversion and transmission.

UNIT II

Signal Transmission Techniques: Analog pulse and digital modulation, Amplitude modulation(AM) and Frequency modulation (FM), AM and FM Transmitter and Receiver, Phase Modulation, Pulse modulation, Digital transmission techniques, error detection and correction.

Telemetry: Telemetry errors, DC, pulse and digital telemetry methods and systems.

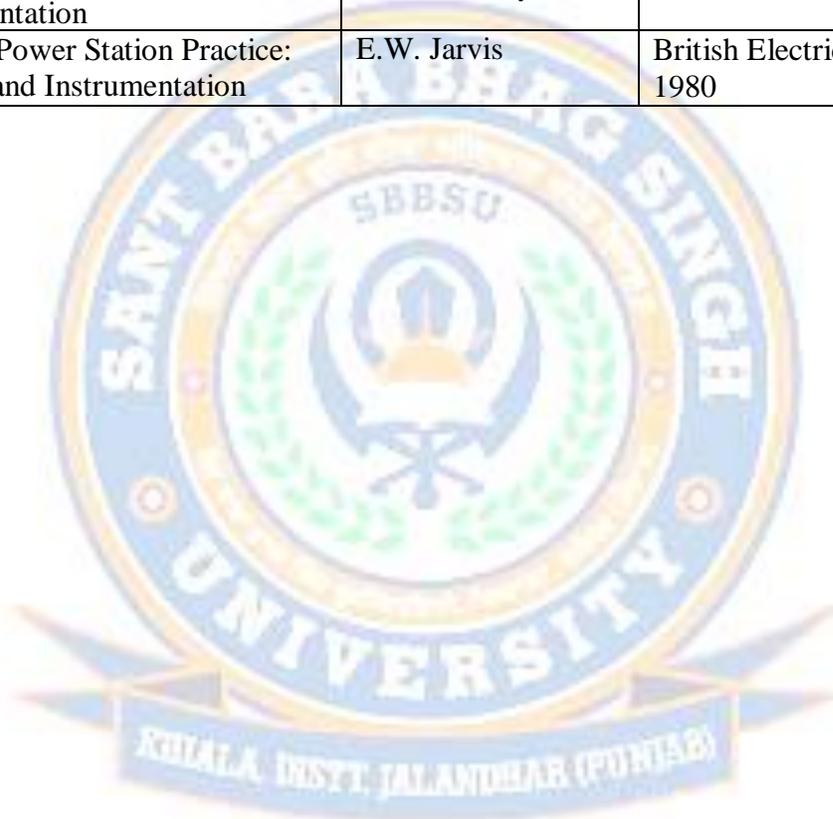
UNIT III

Supervisory Control and Data Acquisition: Function of SCADA system remote terminal unit (RTU) details, Control center details, Communication between control centers, control center and remote terminal unit.

UNIT IV

Power Plant Instrumentation: Thermal power plant instrumentation, Nuclear Power plant Instrumentation. Applications of SCADA system to Indian Power Systems.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Power System Control Technology	T. Cegrell	Prentice-Hall of India Private Limited, 2001
2.	Power Plant Control and Instrumentation	D.M. Lindsey	IEEE Press, 2000
3.	Modern Power Station Practice: Control and Instrumentation	E.W. Jarvis	British Electricity International, 1980



CourseCode	CE420
CourseTitle	Environmental Laws and Policy
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To explain the role of law, policy and institutions in the conversation and management of natural resources as well as pollution control.
Course Outcomes(COs)	1. Be familiar with laws and policies in the field of environment. 2.Acquire the skills needed for interpreting the laws and policies. 3.Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources.

SYLLABUS

UNIT I

Overview of environment, nature and ecosystem, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies,

UNIT II

Environment and Governance, sustainable development and environment, understanding climate change, carbon crediting, carbon foot print etc.

UNIT III

Introduction to trade and environment. International environmental laws, Right to Environment as Human Right,

UNIT IV

International Humanitarian Law and Environment, environment and conflicts management, Famous international protocols like Kyoto.

RECOMMENDEDBOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Production & Operations Management	Nair	Tata McGraw hill
2.	Production & Operations Management	Adam and Eben	Prentice Hall

CourseCode	CE422
CourseTitle	Ecological Engineering
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	Chemistry, Life Sciences, Mathematics
Course Objectives	To understand the important physical, chemical and biological processes effecting ecosystem.
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Analyze the impact that designing ecosystem to solve engineering properties 2. Understand concepts involving sustainable use of ecosystem in treatment systems 3. Identify contemporary issues and emerging fields in which ecological engineers called upon.

SYLLABUS

UNIT I

Characteristics of rivers and lakes which affect the management of domestic and industrial wastewaters

UNIT II

Chemical hazards assessment

UNIT III

Surveillance and biomonitoring

UNIT IV

Review of regulations governing effluents.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Ecological Engineering and Ecosystem Restoration	Mitsch WJ and SE Jorjeonson	John Wiley and Sons
2.	Developing an Ecological Engineering	SM Bolton	John Wiley and Sons
3.	A Textbook for Environmental Studies	ErachBharucha	Orient BlackSwan
4.	Environmental Biology,	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner

CourseCode	CSE482
CourseTitle	Software Testing and Quality Management
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	Software Engineering
Course Objectives	The objective of Software Quality Management (SQM) is to manage the quality of software and of its development process. A quality product is one which meets its requirements and satisfies the user.
Course Outcomes(COs)	The student will be able to- 1.Understand Components for Software Quality Components 2. Evaluate and maintain project progress control 3. Identify Need of ISO certifications 4. Explain various software testing techniques

SYLLABUS

UNIT I

Introduction: The Software Quality Challenge, Software Quality Factors, Components of the Software Quality Assurance System. Pre-Project Software Quality Components, Contract Review, Development and Quality Plans.

Software Quality Assurance Components In The Project Life Cycle: Integrating Quality Activities in the Project Life Cycle – Reviews, Software Testing, Strategies, Software Testing –Implementation, Assuring the Quality of Software Maintenance, Assuring The Quality of External Participants' Parts, Case Tools and their Affect on Software Quality.

UNIT II

Software Quality Infrastructure Components: Procedures and Work Instructions, Supporting Quality Devices, Staff Training, Instructing and Certification, Preventive and Corrective Actions, Configuration Management, Documentation and Quality Records Controls.

Software Quality Management Components: Project Progress Control, Components, Internal & External Participants, Progress control regimes, Computerized tools, Software Quality Metrics – Objective, Classification, Process & Product Metrics, Implementation & Limitation of Software Metrics, Software Quality Costs, Objective, Classification Model of cost, Extended Model and Applications.

UNIT III

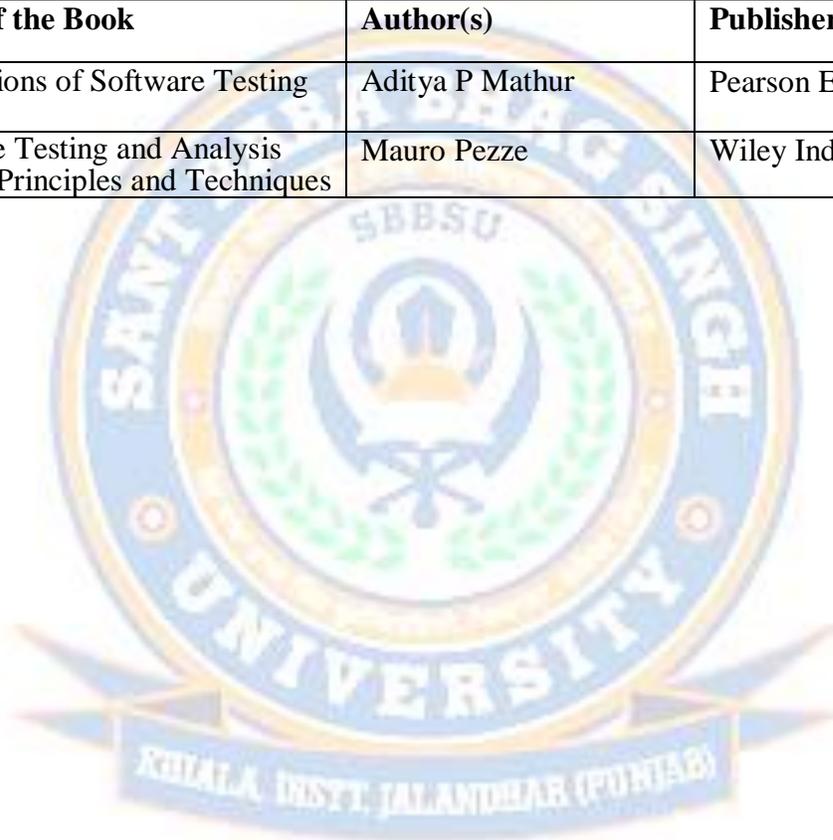
Standards, Certification and Assessment: SQA Standards, ISO9001 Certification, Software Process Assessment. Organizing for Quality Assurance, Management and its Role in Quality Assurance, the Software Quality Assurance Unit, SQA Trustees and Committees

UNIT IV

Testing: Black Box Testing, White Box Testing, Test Case Selection And Adequacy, Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay.

PROCESS: Test and analysis activities within a software process: The quality process; Planning and monitoring; Quality goals; Dependability properties; Analysis; Testing; Improving the process; Organizational factors. Acceptance and Regression Testing.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Foundations of Software Testing	Aditya P Mathur	Pearson Education
2.	Software Testing and Analysis Process Principles and Techniques	Mauro Pezze	Wiley India



CourseCode	CSE484
CourseTitle	Datawarehouse
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	This course introduces advanced aspects of data warehousing and data mining, encompassing the principles, research results and commercial application of the current technologies
Course Outcomes(COs)	The student will be able to- 1. Understand characteristics and functionality of data warehouse 2. Explain architecture of Data warehouse 3. Explain types of OLAP architectures. 4. Explain schemas in data warehouse

SYLLABUS

UNIT I

Data Warehouse Fundamentals: Introduction to Data Warehouse, OLTP Systems; Differences between OLTP Systems and Data Warehouse: Characteristics of Data Warehouse; Functionality of Data Warehouse: Advantages and Applications of Data Warehouse; Advantages, Applications: Top-Down and Bottom-Up Development Methodology: Tools for Data warehouse development: Data Warehouse Types:

UNIT II

Planning and Requirements: Introduction: Planning Data Warehouse and Key Issues: Planning and Project Management in constructing Datawarehouse: Data Warehouse Project; Data Warehouse development Life Cycle, Kimball Lifecycle Diagram, Requirements Gathering Approaches: Team organization, Roles, and Responsibilities:

UNIT III

Data Warehouse Architecture: Introductions, Components of Data warehouse Architecture: Technical Architectures; Data warehouse architectures. OLAP Architectures; MOLAP, ROLAP, HOLAP: Data Warehouse and OLAP: Hypercube & Multicubes.

UNIT IV

Dimensional Modeling: Introduction: E-R Modeling: Dimensional Modeling: E-R Modeling VS Dimensional Modeling: Data Warehouse Schemas; Star Schema, Inside Dimensional Table, Inside Fact Table, Fact Less Fact Table, Granularity, Star Schema Keys: Snowflake Schema: Fact and Constellation Schema

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Data Warehousing, Data Mining & OLAP	A. Berson, S.J. Smith	Tata McGraw-Hill
2.	Data Mining – Concepts and Techniques	Jiawei Han & Micheline Kamber	Elsevier India



CourseCode	ME472
CourseTitle	Industrial Safety and Environment
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	To aware the students with potential Risks in operations and their Management.
Course Outcomes(COs)	The students will able to: 1)Enumerate the importance of industrial safety. 2)Indicate unsafe acts and conditions causing accidents. 3)Outline accident investigation and analysis

SYLLABUS

UNIT I

Introduction, growing concern for safety and health, Safety terminology. Health and safety regulations: International and National scenario: National policy: Product and system liability, Safety cost and losses: Cost of accidents and hidden costs, growing awakening and concern for environment: Environment protection Act 1986 (amended 1991): Global warming. Principles of total safety and environment management: Goal, synergy and differences between safety and environment, Synergy of quality with safety, health and environment, Safety. Safety and health hazards, Types of hazards, Measuring performance of safety and health systems: Indices, and their computation. Safety hazards: Safety in construction, Machine guards & machine tools safety, Safety in material handling.

UNIT II

Fire safety and industrial security, Principles of fire safety: Occupational injuries and precaution, Characteristics, and nature of fire: Fire hazards. Types of fires and ways of extinguishing: Automatic sprinklers: Portable extinguisher: Extinguishing agents. Fire prevention techniques: Building codes & regulation: Building materials and internal finishes. Electrical fire safety: Problems and facts: Electrical distribution and earthing: FRLS wiring : Portable genset and appliances : Electrical processes like welding & cutting . Fire regulations: Standards: Occupancy & egress: Escape plans & displays: Protective clothing: Protective strategies: Emergency preparedness. Fire losses and assessment: After effect & plan of action

UNIT III

Health, Industrial hygiene, Loss control and productivity, Application of occupational hygiene, Health hazard agents: Chemical agents like toxic compounds and materials: Physical agents like noise, vibration & radiation: Biological hazards . Exposure risk assessment: Routes of exposure Measurement of exposure: Exposure factors. Pulmonary diseases due to environment pollution. Respiratory and personal protective equipment, Development and administering medical surveillance

system, Environmental management. Sustainable development planning: National policy Environmental damage and costs: Deteriorating impact on environment. Environmental factors and safety. Environmental design of workplace: Location: Work direction walkways: Area allocation and sitting/working plan. Illumination: Types of lighting (natural vs artificial): Luminous level: Glare. Ventilation: Types (natural and mechanical): Heat calculation: Measurements. Noise: Types: Protection: Effects & productivity. Drinking water: Contamination: Causes: Precaution: Preventive maintenance Industrial pollution hazards. Air pollution: Types: Causes: Prevention and control Water pollution: Categories: Causes: Prevention and control. Soil and ground pollution: Categories: Causes: Prevention and control. Noise pollution: Causes: Prevention: Acoustic design: Monitor and controls. Industrial waste: Types: Control: Reuse. Environmental impact assessment: Objective: Environment impact in India: Other efforts in conserving nature

UNIT IV

Compliance of environmental laws: Guidelines for location of industries: Compliance of water & air pollution acts, and other environmental laws, Imperative for sustainable development. Greenhouse gases: Composition: Effect. Carbon emission: Kyoto protocol: Carbon credits: Emission trading: Carbon credit scenario in India: Corporate social responsibility. Carbon footprint: Measures to reduce Initial investment. Ozone layer depletion. Mutual agreements: Member states: Scope: Responsibilities Rainwater harvesting: India's tradition in water harvesting: Rainfall data: Catch water practice and policy: Basic design: Making a mass movement. Wasteland reclamation and reforestation: Restoration of ecology: Restoration of water logged soil: Mine rehabilitation: Managed reforestation: Tree plantation: Climatic change mitigation EHS regulations and disaster management . Introduction to disaster management.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Industrial Safety Management	<u>LMDeshmukh</u>	McGrawHill, 2010
2.	Principles of Fire Safety Engineering: Understanding Fire and Fire Protection	A.K.DAS	PHI
3.	Safety Management	R.K.Mishra	AITBS Publishers India

CourseCode	EE443
CourseTitle	VLSI Design
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. Study the fundamentals of CMOS circuits and its characteristics. 2. Learn the design and realization of combinational & sequential digital circuits. 3. To discuss architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology. 4. Learn the different FPGA architectures and testability of VLSI circuits.
Course Outcomes(COs)	<p>At the end of this course students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 1. Understand the foundations and features of CMOS circuits. 2. Design and implement sequential and combinational digital circuits. 3. Describe the architectural decisions and performance tradeoffs associated in developing and implementing circuits. 4. Become familiar with the various FPGA architectures and the testability of VLSI circuits.

SYLLABUS

UNIT I

Introduction to MOS Transistors: MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II

Combinational MOS Logic Circuits: Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III

Sequential Circuit Design: Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential

Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design.

UNIT IV

Design of Arithmetic Building Blocks and Subsystem: Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a trade off. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

Implementation Strategies and Testing: FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	AVHDLPrimmer	Bhasker	PrenticeHall
2.	Digital System Design usingVHDL	Charles.H.Roth	PWS
3.	VDHL-Analysis &Modellingof DigitalSystems	Navabi Z	McGrawHill
4.	FundamentalsofDigitalLogicwithVHDLDesign	BrownandVranesic	TMH

CourseCode	EE445
CourseTitle	Computational Intelligence
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. Fundamentals of key intelligent systems technologies including knowledge based systems, neural networks, fuzzy systems, and evolutionary computation. 2. Practice in integration of intelligent systems technologies for engineering applications.
CourseOutcomes(CO)	<p>After the completion of the course, the students will be able to:</p> <ol style="list-style-type: none"> 1. Gain a working knowledge of knowledge-based systems. 2. Apply intelligent systems technologies in a variety of engineering applications. 3. Implement typical computational intelligence algorithms in MATLAB.

SYLLABUS

UNIT I

Artificial Intelligence – a brief review – Pitfalls of traditional AI – Why Computational Intelligence?
 – Computational intelligence concept - Importance of tolerance of imprecision and uncertainty -
 Constituent techniques – Overview of Artificial Neural Networks, Fuzzy Logic, Evolutionary
 Computation.

UNIT II

Neural Network: Biological and artificial neuron, neural networks, supervised and unsupervised
 learning. Single layer Perceptron, Multilayer Perceptron – Back propagation learning. Neural
 networks as associative memories - Hopfield networks, Bidirectional Associative Memory.
 Topologically organized neural networks – competitive learning, kohonen maps.

UNIT III

Fuzzy Logic: Fuzzy sets, properties, membership functions, fuzzy operations. Fuzzy logic and fuzzy
 inference and applications, Evolutionary Computation - constituent algorithms, Swarm intelligence
 algorithms - Overview of other bio-inspired algorithms - Hybrid approaches (neural networks, fuzzy
 logic, genetic algorithms etc.)

UNIT IV

Optimization: Derivative-based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing, Random Search, Downhill Simplex Search.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Neural Networks - A Classroom Approach	Kumar S	Tata McGraw Hill, 2004
2.	Computational Intelligence: Principles, Techniques and Applications	Konar A	Springer Verlag, 2005
3.	Fuzzy Logic with Engineering Applications	Timothy J. Ross.	McGraw-Hill



CourseCode	CE424
CourseTitle	Air and Noise Pollution Control
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	The course provides an overview of air and noise quality and technology associated with the monitoring and control.
Course Outcomes(COs)	1. Identify the source of air and noise pollution. 2. Monitor the ambient air quality. 3. Understand the concepts involved in control technologies.

SYLLABUS

UNIT I

Air pollutants, Sources, classification, Combustion Processes and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects - Smoke, smog and ozone layer disturbance, Greenhouse effect.

UNIT II

Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by absorption, adsorption, reaction and other methods.

UNIT III

Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators and other removal methods like absorption, adsorption, precipitation etc. Biological air pollution control technologies, Indoor air quality.

UNIT IV

Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise control methods.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Environmental Pollution Control Engineering	CS Rao	Wiley Eastern Ltd., New Delhi
2.	Environmental Noise Pollution	PE Cunniff	McGraw Hill, New York
3.	Air Pollution: It's Origin and Control	Wark, Kenneth, Addison	Wesley, New York



CourseCode	CE426
CourseTitle	Engineering Materials for Sustainability
TypeofCourse	OE
L:T:P	3 0 0
Credits	3
CoursePrerequisites	NIL
Course Objectives	The course provides instruction on civil and construction engineering materials used in construction.
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Students will be able to sustainability context of new construction. 2. Identify key material properties to a variety of civil works. 3. Specify building material for construction applications including the use of appropriate standards.

SYLLABUS

UNIT I

Environmental impact of materials; life-cycleassessment.

UNIT II

Material selection to optimize performance.

UNIT III

Design, evaluation ofgreenconstructionmaterials.

UNIT IV

Production of greenconstructionmaterials.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Design and Control of Concrete Mixtures	Kosmatka SH and Wilson ML	Portland Cement Association
2.	Sustainability Issues in Infrastructure Engineering	HanyShehata, Sherif El-Badwy	Springer International Publishing
3.	Urban Engineering for Sustainability	Sybil Derrible	The MIT Press

Course Code	CSE486
Course Title	Image Analysis
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	To make students familiar with the various fundamentals & and processes involved in the processing of an image.
Course Outcomes(COs)	The learner will be able to- 1. Understand basic concepts of digital image processing 2. Describe image enhancement techniques 3. Explain image restoration and compression using degradation models

SYLLABUS

UNIT I

Digital Image Fundamentals & Transforms: Introduction, Background, Digital Image Representation, Fundamental Steps in Image Processing, Elements of a Digital Image Processing System. Elements of Visual Perception, Sampling and Quantization, Basic Relationships between Pixels, Imaging Geometry. Introduction to the Fourier Transform, The Discrete Fourier Transform, Some Properties of the Two-Dimensional Fourier Transform.

UNIT II

Image Enhancement: Spatial Domain Methods, Frequency Domain Methods, Some Simple Intensity Transformations, Histogram Processing, Image Subtraction, Image Averaging, Smoothing Filters, Sharpening Filters, Low pass Filtering, High pass Filtering.

UNIT III

Image Restoration & Compression: Degradations Model - Definitions, Degradation Model for Continuous, Restoration in the Spatial Domain, Geometric Transformation. Error free compression, Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression – Lossy Predictive Coding, Transform Coding.

UNIT IV

Image Segmentation & Representation: Edge Detection, Thresholding, Region-Based Segmentation. Image Representation, Boundary and Regional Descriptors, Relational Descriptors. Object Recognition: Pattern and pattern classes, recognition based on Decision Theoretic Methods, Structural Methods.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Digital Image Processing	Rafael. C. Gonzalez & Richard E. Woods	Pearson Education
2.	Digital Image Processing	W.K.Pratt.	John Wiley & sons
3.	Image Processing Analysis and Machine Vision	M. Sonka	Thomson Learning



Course Code	CSE488
Course Title	Grid Computing
Type of Course	PE
L:T:P	3 0 0
Credits	3
Course Prerequisites	NIL
Course Objectives	To get an overview about system infrastructure of grid. Also to learn about the current architecture, services and instantiations of the Grid.
Course Outcomes(COs)	The student will be able to 1. Understand parallel and distributed computing 2. Explain grid monitoring systems 3. Explain data management and grid security

SYLLABUS

UNIT I

Concepts and Architecture: Introduction, Parallel and Distributed Computing, Cluster Computing, Grid Computing, Anatomy and Physiology of Grid, Review of Web Services, OGSA, WSRF

UNIT II

Grid Monitoring: Grid Monitoring Architecture (GMA), An Overview of Grid Monitoring Systems- Grid ICE, JAMM, MDS, Network Weather Service, R-GMA, Other Monitoring Systems, Ganglia and GridMon

UNIT III

Grid security and resource management: Grid Security, Brief Security Primer, PKI, X509 Certificates, Grid Security, Grid Scheduling and Resource Management, Scheduling Paradigms, Working principles of Scheduling, A Review of Condor, SGE, PBS and LSF - Grid Scheduling with QoS.

UNIT IV

Data Management and Grid portals: Data Management, Categories and Origins of Structured Data, Data Management Challenges, Architectural Approaches, Collective Data Management Services, Federation Services, Grid Portals, First-Generation Grid Portals, Second-Generation Grid Portals
Grid middleware: List of globally available Middle wares, Case Studies, Recent version of Globus Toolkit and gLite - Architecture, Components and Features.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	The Grid Core Technologies	Maozhen Li, Mark Baker	John Wiley & Sons
2.	The Grid 2 – Blueprint for a New Computing Infrastructure	Ian Foster & Carl Kesselman	Morgan Kaufman
3.	Grid Computing	Joshy Joseph & Craig Fellenstein	Pearson Education
4.	Grid Computing: Making the Global Infrastructure a reality	Fran Berman, Geoffrey Fox, Anthony J.G. Hey	John Wiley and sons



Course Code	ME474
Course Title	Group Technology and Flexible Manufacturing systems
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	The objective of this course is to Assist the students to acquire proficiency concept of planning and control of production.
Course Outcomes(COs)	The students will be able to: 1. Apply the concepts of PPC and GT to the development of FMS. 2. Discuss the planning and scheduling methods used in manufacturing systems. 3. Identify various workstations, system support equipment. 4. Identify hardware and software components of FMS.

SYLLABUS

UNIT I

Group Technology: Introduction, Types of Production and Layouts, Product Layout, Process Layout, Fixed Position Layout, Group Technology Layout along with its scope of application .Part families, Parts classification and coding, Types of classification and coding systems, Machine cell design, determining the best machine arrangement, Benefits of Group Technology.

UNIT II

Flexible Manufacturing Systems: Automation, Types of Automation, flexibility, its needs and benefits, Types of flexibility, Introduction to Flexible Manufacturing System taking into account problems of conventional batch manufacturing systems, Definition, Industrial relevance, Need for FMS, Evolution of FMS from Group Technology.

UNIT III

Role of Information Technology for flexibility, integration and automation, Role of integrated and automated material handling systems, Overview of Multi model and mixed model flexible lines.

UNIT IV

Typical FMS operation, Computer simulation and AI for FMS, Design, Planning, scheduling and control issues in FMS, Various FMS configurations, FMS as mini CIM, Benefits and justification for FMS ,Future challenges. Robotic technology, Joints and links, Robot programming and applications.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Automation, Production Systems and Computer Integrated Manufacturing	M. P. Groover	Prentice- Hall
2.	Handbook of Flexible Manufacturing Systems	Jha, N.K	Academic Press Inc., 1991



Course Code	EE434
Course Title	Analog and Digital Communication
Type of Course	OE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	NIL
Course Objective	<ol style="list-style-type: none"> 1. To familiarize students with different analog modulation schemes and their efficiency and bandwidth. 2. To familiarize students with how a communication system behaves in the presence of noise. 3. To familiarize students with pulse modulation systems and how they work. 4. To familiarize students with computation of the bit error performance of various digital modulation techniques.
Course Outcomes(COs)	<p>At the end of this course students will demonstrate the ability to:</p> <ol style="list-style-type: none"> 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.

SYLLABUS

UNIT I

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

UNIT II

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 III

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 IV

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Base band Pulse 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.

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.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Communications Systems	Haykin S	John Wiley and Sons, 2001
2.	Communication Systems Engineering	Proakis J. G. and Salehi M	Tata McGraw Hill 2001
3.	Principles of Communication Systems	Taub H. and Schilling D.L	Tata McGraw Hill 2001
4.	Principles of Communication Engineering	Wozencraft J. M. and Jacobs I. M	John Wiley, 1965
5.	Digital Communication	Barry J. R., Lee E. A. and Messerschmitt D. G	Kluwer Academic Publishers, 2004
6.	Digital Communications	Proakis J.G	McGraw Hill, 2000

Course Code	EE436
Course Title	Biomedical Instrumentation
Type of Course	OE
L:T:P	3:0:0
Credits	3
Course Pre-requisites	NIL
Course Objective	<ol style="list-style-type: none"> 1. To introduce fundamentals of transducers as applicable to physiology. 2. To explore the human body parameter measurements set ups. 3. To acquaint the students with various types of assistive devices. 4. To develop an understanding of biotelemetry and its working.
Course Outcomes(COs)	<p>After successful completion of the course the students will demonstrate:</p> <ol style="list-style-type: none"> 1. An understanding of physiological parameters and their measurement. 2. An understanding of the bio-electric signals and their measurements. 3. An understanding of the various types of assistive devices. 4. An understanding of the biotelemetry and its working.

SYLLABUS

UNIT I

Physiological Transducers: Introduction to physiological systems, Pressure transducers, Transducer for body temperature measurement. Pulse sensors, Respiration sensors.

UNIT-II

Bio-Electric Signals and Electrodes:Origin of bio-electric signals (ECG, EEG, EMG), Recording electrodes, Electrical conductivity of electrode jellies and creams.

UNIT III

Assistive Devices for Human Body:Stimulator, defibrillator, pacemaker, diathermy. Prosthetics: Upper and lower extremity prostheses, harness control, EMG-controlled externally powered prosthesis, basic concept of mono functional and multifunctional devices.

UNIT IV

Biotelemetry:Physiological parameters adaptable to bio-telemetry, Components of a biotelemetry system, Implantable units, Application of telemetry in patient care.

RECOMMENDED BOOKS			
S. No	Name	Author(S)	Publisher
1.	Biomedical Instrumentation and Measurements	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer	PHI, 2nd Edition, 2004
2.	Hand book of Biomedical Instrumentation	Khandpur R.S	Tata McGraw Hill, 2004
3.	Principles of Applied Biomedical Instrumentation	L.A. Geddes and L.E. Baker	John Wiley



Course Code	CE428
Course Title	Solid and Hazardous Waste Management
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	To know the sources and types of solid waste and to learn the importance of methods of collection and selection of location for solid waste.
Course Outcomes(COs)	1. Students will be able to characterize the industrial waste. 2. Assess the degree of treatment required for the wastewater. 3. Understand concepts behind industrial waste.

SYLLABUS

UNIT I

Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal.

UNIT II

Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem

UNIT III

Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal

UNIT IV

Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and sub-surface characterization, Containment, remedial alternatives.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Integrated solid waste management	Thiesen & Vigil	Mcgraw Hill
2.	Hazardous waste management	Lagrega Buckingham and Evans	Mcgraw Hill

CourseCode	CE430		
CourseTitle	Rural Water Supply and Onsite Sanitation Systems		
TypeofCourse	OE		
L:T:P	3 0 0		
Credits	3		
CoursePrerequisites	NIL		
Course Objectives	The sustainable provision of safe and drinking water remains as the major challenges facing both the developing and industrialized regions in the world.		
Course Outcomes(COs)	1 To assess the water demand of area under consideration. 2.To plan and design water supply system. 3.To understand various processes involved in sewage treatment.		
3.	Solid waste management in developing countries	AD Bhide	Nagpur publications

SYLLABUS

UNIT I

Attributes of water supply systems, drinking water quality. Relationships between diseases and water quality, hygiene and sanitation.

UNIT II

Need for water treatment. Point of use water treatment systems, filters, bio-sand filters, disinfection systems for rural areas, chlorination, Solar disinfection systems, removal of arsenic, fluoride and iron.

UNIT III

Onsite sanitation systems: Nexus between water quality and sanitation. Importance of hydrogeology on selection of onsite sanitation systems, Design of Septic tanks, single pit and double pit toilets.

UNIT IV

Small bore systems, bio digesters, reed beds, constructed wetlands, sludge/septage management systems.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Water Supply Engineering, Vol. II	Garg S K	Khanna Publishers, New Delhi, 2003
2.	Environmental Engg. - A design Approach	Arcadio P. Sincero and Gregoria P. Sincero	Prentice Hall of India, New Delhi
3.	Water Supply Engineering	Punmia B C	Laxmi Publication, New Delhi

Course Code	CSE490
Course Title	E-COMMERCE AND ERP
Type of Course	PE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	Basics of Internet
Course Objectives	This course examines the evolution of enterprise resource planning (ERP) systems - from internally focused client/server systems to externally focused e-business. This class studies the types of issues that managers will need to consider in implementing cross-functional integrated ERP systems. The objective of this course is to make students aware of the potential and limitations of ERP systems. This objective will be reached through hands-on experience, case studies, lectures, guest speakers and a group project.
Course Outcomes(COs)	The course would equip students with the basics of E-Commerce, technologies involved with it and various issues associated with.

SYLLABUS

UNIT I

Introduction and Concepts Networks and commercial transactions - Internet and other novelties; Networks and electronic transactions today, Model for commercial transactions; Internet environment - internet advantage, world wide web and other internet sales venues; Online commerce solutions. Security Technologies: Why is internet insecure? A brief introduction to Cryptography; Public key solution. Digital payment systems; First virtual internet payment system; cyber cash model Operational process of Digicash, Ecash Trail; Using Ecash; Smart cards; Electronic Data Interchange: Its basics; EDI versus Internet and EDI over Internet.

UNIT II

Introduction ERP An Overview, Enterprise-An Overview, Benefits of ERP, ERP and Related Technologies, Business Process Reengineering (BPR), Data Warehousing, Data Mining, On-line Analytical Processing (OLAP), Supply Chain Management, Management Information systems (MIS), Decision support system (DSS), Executive Information systems (EIS). ERP – A Manufacturing Perspective Materials Requirement Planning (MRP), Bill of Material (Bom), Distribution Requirements Planning (DRP), JIT & Kanban, CAD/CAM.

UNIT III

ERP Implementation - ERP Implementation Lifecycle, Implementation Methodology, Not all Packages are Created Equal!, ERP Implementation-The Hidden Costs, Organizing the

Implementation, Vendors, Consultants and Users, Contracts with Vendors, Consultants and Employees, Project Management and Monitoring, After ERP Implementation.

UNIT IV

The Business Modules- Business Modules in an ERP Package, Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales and Distribution

UNIT V

The ERP Market and Benefits of ERP- ERP Market Place, SAP AG, PeopleSoft, Baan Company, JD Edwards World Solutions Company, Oracle Corporation, QAD, System Software Associates, Inc. (SSA) ERP Present and Future Turbo Charge the ERP System, Enterprise Integration Applications (EIA), ERP and E-Commerce, ERP and Internet, Future Directions in ERP, Appendices" , Benefits of ERP Time Reduction, Resource Utilization, Performance, Customer Satisfaction, Flexibility, Quality, Accuracy.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Enterprise Resource Planning	S. Sadagopan	Tata McGraw Hill 2000
2.	E-Commerce: The Cutting Edge of Business	Bajaj, Kamlesh K. and Nag, Debjani	Tata McGraw-Hill Publishing Company
3.	Enterprise Resource Planning	Alexis Leon	Tata McGraw Hill 2001
4.	Electronic Commerce	Loshin, Pete and Murphy, Paul	Second edition, 1990, Jaico Publishing House, Mumbai

Course Code	CSE492
Course Title	Network Security
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	It aims to introduce students to the fundamental techniques used in implementing secure network communications, and to give them an understanding of common threats and attacks.
Course Outcomes(COs)	The student will be able to- <ol style="list-style-type: none"> 1. Understand basic concepts and security in network technology 2. Explain IPv6 3. Explain classical encryption techniques 4. Illustrate applications of Network Security

SYLLABUS

UNIT I

Introduction to Network Technology: SLIP/PPP Dedicated lines, BOOTP, DHCP, Domain management (DNS), Transport Layer issues, TCP/IP, Gateway, Dial-up, Internet networking TCP/IP protocols, IP addressing.

UNIT II

Basics of Network security- Fundamentals of network security, Basics of IPv6, IPsec: overview of IPsec, IP and IPv6, Authentication header (AH), Encapsulating Security Payload (ESP).

Security Trends – Attacks and services, Classical crypto systems, Different types of ciphers, LFSR sequences, Basic Number theory, Congruences, Chinese Remainder theorem, Modular exponentiation, Fermat and Euler's theorem, Legendre and Jacobi symbols, Finite fields, continued fractions.

UNIT III

Model of Network security- Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Block Cipher and the Data Encryption Standard - Modes of operation, Triple DES, AES, RC4, RSA, Attacks, Primality test, Factoring.

Discrete Logarithms –Digital signatures, RSA, ElGamal, DSA, Unwanted traffic: denial of service attacks.

UNIT IV

Authentication applications – Kerberos, X.509, PKI, Electronic Mail security, PGP, S/MIME, IP security, Web Security, SSL, TLS, SET.

System Security – Intruders, Malicious software, viruses, Firewalls and filters, Security Standards.

RECOMMENDED BOOKS

S. No	Name of the Book	Author(s)	Publisher
1.	Network Security and Ethical Hacking	RajatKhare	Luniver Press
2.	Cryptography and Network Security	AtulKahate	Tata Mc-Graw Hill
3.	Computer Networks	A.S Tanenbaum	Pearson



Course Code	ME476
Course Title	Work Study and Ergonomics Engineering
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	This course introduces the role of Work Study in the industry and how productivity issues in the industry can be addressed by the application of Work Study, while stimulating critical thinking on the techniques of Method Study and Work Measurement. The course also introduces the concept of conducting time studies and production studies to assess time standards and production standards for fulfilling production goals in an organization. The course further introduces the scope of ergonomics and the application of ergonomic principles to workplace design and work organisation and culminates with the concept of evaluating the impact of various human factors to design of safe workplace environment.
Course Outcomes(COs)	<ol style="list-style-type: none"> 1. Develop a case for productivity improvement in any manufacturing or service industry scenario. 2. Independently conduct a method study in any organization with the objective of improving a process, material movement system or design of a work place 3. Develop time standards for operations, identify production bottlenecks and improvise operations

SYLLABUS

UNIT I

Introduction: Definition, Scope, Historical review and areas of application of work study in industries, Inter- relation between method study and work measurement, Reaction of management and labor, Role in improving plant productivity.

UNIT II

Method Study: Objectives and step-wise procedure for method analysis, Recording & evaluation techniques, Micro-motion and macro motion study, Therbligs and simo-charts, Principle of motion economy, Normal work areas and design of work places, Principles of work design, Multiple activity chart, Flow process chart, String diagram, Travel charts.

UNIT III

Work Measurement: Work measurement objectives, Techniques & criteria for selection of technique, Stop watch time study, Systems of performance ratings, Calculation of standard time, Introduction to

allowances, Production study, Work sampling, Standard data usage, Engineered time standard, Predetermined motion time system (PMTS).

Ergonomics Engineering

Anthropometry: Significance of human body measurement in design of equipment, Facilities, Work place and operation, Static and dynamic anthropometry, Anthropometric data.

UNIT IV

Task Analysis: Task description, Posture measurement, RULA & REBA analysis and evaluation, Lifting & lowering tasks, Lifting index, Lifting & carrying tasks, NIOSH lifting equation. Biomechanics: Introduction to levers of Human Body, Ligaments & Tendons, Joints. Kinetics to include forces producing motion.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Motion & Time Study	Niebel, B.W	9th Edition McGraw Hill Higher education, 1992
2.	Work Study	Kanawaty, G	ILO, Geneva, 4th revised edition, 1992
3.	Motion & Time Study	Barnes, R. M.	7th edition, John Wiley & Sons, 1980
4.	Introduction to Ergonomics	Bridger, R.S	McGraw Hill, 2008

Course Code	EE438
Course Title	Power Plant Engineering
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To introduce students to different aspects of power plant engineering. 2. To familiarize the students to the working of power plants based on different fuels. 3. To expose the students to the principles of energy, economic and environmental issues.
Course Outcomes(COs)	<p>After successful completion of the course the students will demonstrate:</p> <ol style="list-style-type: none"> 1. Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation. 2. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts. 3. Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.

SYLLABUS

UNIT I

Thermal Power Plants: Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT II

Nuclear Power Plants: Basics of nuclear energy conversion: 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 III

Hydroelectric Power Plants: Classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.t

UNIT IV

Energy, economic and environmental issues: 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.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	PowerPlantTechnology	EIWakilM.M	McGrawHill,2010
2.	PowerPlantEngineering	ElliotT.C&ChenK	McGrawHill,1998
3.	PowerPlantEngineering	Nag P.K	TataMcGrawHill,2008



Course Code	EE440
Course Title	Embedded Systems
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	<ol style="list-style-type: none"> 1. To know the fundamentals of embedded systems. 2. To connect the PIC Microcontroller to the rest of the system. 3. To know about designing of real-time operating system
Course Outcomes(COs)	<p>After successful completion of the course the students will demonstrate:</p> <ol style="list-style-type: none"> 1. Understand the key concepts of embedded systems. 2. Interface PIC Micro controller with peripherals. 3. Design real time operating system

SYLLABUS

UNIT I

Introduction: Review of Embedded Hardware: Terminology, Gates, Timing Diagram, Memory, Microprocessor Buses, Direct Memory Access, Interrupts, Built instructions on the Microprocessor. Conventions used on Schematic, Interrupts, Microprocessor Architecture, Interrupt Basic, Shared Data Problem, Interrupt Latency.

UNIT II

PIC Micro controller and Interfacing: Introduction, CPU Architecture, Registers, Instruction, Sets, Addressing Modes, Programs, Interfacing Methods, Parallel I/O Interface, Parallel Port Interface, Memory Interfacing, High Speed I/O Interfacing, Interrupt, Interrupt Service Routine features of Interrupts, Interrupt vector and Priority, Timing Generation and Measurements, Input Capture, Output Compare, Frequency Measurement, Serial I/O Device RS232, RS485, Analog Interfacing, Applications.

UNIT III

Software Development and Tools: Embedded System Evolution Trends, Round – Robin, Robin, with Interrupts, Function Scheduling architecture, Algorithms, Introduction to assembler, Compiler and Cross compilers and Integrated Development Environment (IDE), Object Oriented Interfacing, Recursion, Debugging Strategies, Simulators.

UNIT IV

Real Time Operating Systems (RTOS): Task And Task States, Tasks and Data, Semaphores and shared data, operating system services, Message queues, Timer Function, Events, Memory Management, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Specification and Design of Embedded Systems	Gajski D.D., Vahid F., Gong J., Narayan S	Prentice Hall
2.	Embedded systems Design	Steve Heath	Prentice Hall
3.	Hardware Software Co-design of Embedded System	Balarin F., Chiodo	Academic Publishers



Course Code	CE432
Course Title	Transport of Water and Wastewater
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	It is the branch of environmental engineering in which the basic principles of science and engineering are applied to the problems of water pollution control.
Course Outcomes(COs)	1. This wastewater engineering includes wastewater treatment. 2. Sludge disposal and reuse, wastewater reclamation and reuse. 3. Effluent disposal and the role of engineer.

SYLLABUS

UNIT I

The objective of the course is to make students gain insight into how the water and wastewater get transported through conduits and open channels, and use the same for the design, operation and maintenance of these systems.

UNIT II

Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance and operation.

UNIT III

Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer layout, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety.

UNIT IV

Storm water Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in storm water drains, materials, cross sections, design of storm water drainage systems, inlets, storm water pumping, operation and maintenance.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Waste Water Engineering - Treatment and Reuse	Metcalf & Eddy	McGraw Hill, New Delhi, 2003
2.	Waste Water Engg. (Environmental Engg.-II)	Punmia B C	Laxmi Publication, New Delhi, 2002
3.	Water Supply Engineering, Vol. II	Garg S K	Khanna Publishers, New Delhi, 2003

Course Code	CE434
Course Title	Groundwater Engineering
Type of Course	OE
L:T:P	3 0 0
Credits	3
Course Pre-requisites	NIL
Course Objectives	Provide information needed to work in water management and environmental consulting fields or to conduct research.
Course Outcomes(COs)	1. Ability to conduct ground water survey work. 2. Apply methods to recharge ground water. 3. Design the wells.

SYLLABUS

UNIT I

The main objective is to provide sufficient knowledge to the students about the groundwater hydrology, well hydraulics and well construction, geophysical explorations, groundwater quality and management of groundwater resources; Problems and perspectives regarding groundwater in India

UNIT II

Hydrogeology: Darcy's Equation; flow characteristics; general flow equations; unsaturated flow

UNIT III

Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple wells systems; characteristic well losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction)

UNIT IV

Water Wells: Construction; completion, development, protection and rehabilitation of wells; Groundwater quality; Groundwater Management: Basin management, investigations, conjunctive use, modeling, artificial recharge; Saline water intrusion.

RECOMMENDED BOOKS			
S. No	Name of the Book	Author(s)	Publisher
1.	Groundwater Hydrology	Raghunath HM	Wiley Eastern Ltd
2.	Groundwater Hydrology	Todd DK	John Wiley and Sons
3.	Groundwater Engineering	Abdel Aziz	McGraw Hills
4.	Groundwater Assessment, Development and Management	KR Karanth	Tata Mcgraw Hills, New Delhi