CREDIT TABLE
FOR
110 – ELECTRICAL AND ELECTRONICS ENGINEERING

SEMESTER – I

Sl. No.	Course Code	Course Title	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	BSC	Chemistry	30	70	100	3	1	0	4	4
2	BSC	Mathematics –I (Calculus and Differential Equations)	30	70	100	3	1	0	4	4
3	ESC	Programming for Problem Solving	30	70	100	3	0	0	3	3
4	ESC	Workshop Manufacturing Practices	30	70	100	1	0	0	1	1
5	HSMC	English	30	70	100	2	0	0	2	2
Practical										
1	BSC	Chemistry	20	30	50	0	0	3	1.5	3
2	ESC	Programming for Problem Solving	20	30	50	0	0	4	2	4
3	ESC	Workshop Manufacturing Practices	20	30	50	0	0	4	2	4
4	HSMC	English	20	30	50	0	0	2	1	2
	Total				700				20.5	27

TOTAL MARKS: 700 TOTAL CREDITS: 20.5 TOTAL HOURS: 27

BSC	Mathematics –I (Calculus and Differential Equations)	L:3	T:1	P:0	Credit:4

CONTENTS

MODULE 1: CALCULUS (8 LECTURES)

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.

MODULE 2: SEQUENCES AND SERIES (7 LECTURES)

CONVERGENCE OF SEQUENCE AND SERIES, TESTS FOR CONVERGENCE, POWER SERIES, TAYLOR'S SERIES. SERIES FOR EXPONENTIAL, TRIGONOMETRIC AND LOGARITHMIC FUNCTIONS; FOURIER SERIES: HALF RANGE SINE AND COSINE SERIES, PARSEVAL'S THEOREM.

MODULE 3: MULTIVARIABLE CALCULUS: DIFFERENTIATION (6 LECTURES)

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.

MODULE 4: MULTIVARIABLE CALCULUS: INTEGRATION (7 LECTURES)

MULTIPLE INTEGRATION: DOUBLE AND TRIPLE INTEGRALS (CARTESIAN AND POLAR), CHANGE OF ORDER OF INTEGRATION IN DOUBLE INTEGRALS, CHANGE OF VARIABLES (CARTESIAN TO POLAR), APPLICATIONS: AREAS AND VOLUMES BY (DOUBLE INTEGRATION) CENTER OF MASS AND GRAVITY (CONSTANT AND VARIABLE DENSITIES). THEOREMS OF GREEN, GAUSS AND STOKES, ORTHOGONAL CURVILINEAR COORDINATES, SIMPLE APPLICATIONS INVOLVING CUBES, SPHERE AND RECTANGULAR PARALLELEPIPEDS.

MODULE 5: FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS (3 LECTURES)

EXACT, LINEAR AND BERNOULLI'S EQUATIONS, EULER'S EQUATIONS, EQUATIONS NOT OF FIRST DEGREE: EQUATIONS SOLVABLE FOR P, EQUATIONS SOLVABLE FOR Y, EQUATIONS SOLVABLE FOR X AND CLAIRAUT'S TYPE.

MODULE 6: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER (6 LECTURES)

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS WITH VARIABLE COEFFICIENTS, METHOD OF VARIATION OF PARAMETERS, CAUCHY-EULER EQUATION; POWER SERIES SOLUTIONS; LEGENDRE POLYNOMIALS, BESSEL FUNCTIONS OF THE FIRST KIND AND THEIR PROPERTIES.

MODULE 7: PARTIAL DIFFERENTIAL EQUATIONS: FIRST ORDER (3 LECTURES)

FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS, SOLUTIONS OF FIRST ORDER LINEAR AND NON-LINEAR PDES.

TEXT / REFERENCES:

- *G.B. THOMAS AND R.L. FINNEY, "CALCULUS AND ANALYTIC GEOMETRY", PEARSON, 2002.*
- *T. VEERARAJAN, "ENGINEERING MATHEMATICS", MCGRAW-HILL, NEW DELHI, 2008.*
- *B. V. RAMANA, "HIGHER ENGINEERING MATHEMATICS", MCGRAW HILL, NEW DELHI, 2010.*
- *N.P. BALI AND M. GOYAL, "A TEXT BOOK OF ENGINEERING MATHEMATICS", LAXMI PUBLICATIONS, 2010.*
- *B.S. GREWAL, "HIGHER ENGINEERING MATHEMATICS", KHANNA PUBLISHERS, 2000.*
- *E. KREYSZIG, "ADVANCED ENGINEERING MATHEMATICS", JOHN WILEY & SONS, 2006.*
- *W. E. BOYCE AND R. C. DIPRIMA, "ELEMENTARY DIFFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS", WILEY INDIA, 2009.*
- *S. L. ROSS, "DIFFERENTIAL EQUATIONS", WILEY INDIA, 1984.*
- *E. A. CODDINGTON, "AN INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS", PRENTICE HALL INDIA, 1995.*
- *E. L. INCE, "ORDINARY DIFFERENTIAL EQUATIONS", DOVER PUBLICATIONS, 1958.*
- *G.F. SIMMONS AND S.G. KRANTZ, "DIFFERENTIAL EQUATIONS", MCGRAW HILL, 2007.*

BSC	Chemistry	L:3	T:1	P:3	Credit 5.5

MODULE 1: ATOMIC AND MOLECULAR STRUCTURE (10 LECTURES)

FAILURE OF CLASSICAL NEWTONIAN AND MAXWELL WAVE MECHANICS TO EXPLAIN PROPERTIES OF PARTICLES AT ATOMIC AND SUB-ATOMIC LEVEL; ELECTROMAGNETIC RADIATION, DUAL NATURE OF ELECTRON AND ELECTROMAGNETIC RADIATION, PLANK'S THEORY, PHOTOELECTRIC EFFECT AND HEISENBERG UNCERTAINTY PRINCIPLE. FAILURE OF EARLIER THEORIES TO EXPLAIN CERTAIN PROPERTIES OF MOLECULES LIKE PARAMAGNETIC PROPERTIES. PRINCIPLES FOR COMBINATION OF ATOMIC ORBITALS TO FORM MOLECULAR ORBITALS. FORMATION OF HOMO AND HETERO DIATOMIC MOLECULES AND PLOTS OF ENERGY LEVEL DIAGRAM OF MOLECULAR ORBITALS. COORDINATION NUMBERS AND GEOMETRIES, ISOMERISM IN TRANSITIONAL METAL COMPOUNDS, CRYSTAL FIELD THEORY AND THE ENERGY LEVEL DIAGRAMS FOR TRANSITION METAL IONS AND THEIR MAGNETIC PROPERTIES.

MODULE 2: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS (8 LECTURES)

PRINCIPLES OF VIBRATIONAL AND ROTATIONAL SPECTROSCOPY AND SELECTION RULES FOR APPLICATION IN DIATOMIC MOLECULES. ELEMENTARY IDEA OF ELECTRONIC SPECTROSCOPY. UV-VIS SPECTROSCOPY WITH RELATED RULES AND ITS APPLICATIONS. FLUORESCENCE AND ITS APPLICATIONS IN MEDICINE. BASIC PRINCIPLE OF NUCLEAR MAGNETIC RESONANCE AND ITS APPLICATION. BASICS OF MAGNETIC RESONANCE IMAGING.

MODULE 3: INTERMOLECULAR FORCES AND PROPERTIES OF GASES (4 LECTURES)

IONIC, DIPOLAR AND VAN DER WAALS INTERACTIONS. EQUATIONS OF STATE OF IDEAL AND REAL GASES, DEVIATION FROM IDEAL BEHAVIOUR. VANDER WAAL GAS EQUATION.

MODULE 4: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA & WATER CHEMISTRY (8 LECTURES)

THERMODYNAMIC FUNCTIONS: ENERGY, ENTHALPY ENTROPY AND FREE ENERGY. EQUATIONS TO INTERRELATE THERMODYNAMIC PROPERTIES. FREE ENERGY, EMF. AND CELL POTENTIALS, THE NERNST EQUATION AND APPLICATIONS. CORROSION. USE OF FREE ENERGY CONSIDERATIONS IN METALLURGY THROUGH ELLINGHAM DIAGRAMS. SOLUBILITY EQUILIBRIA.

WATER CHEMISTRY, HARD AND SOFT WATER. PARAMETERS OF QUALITY OF WATER TO BE USED IN DIFFERENT INDUSTRIES AS FOR DRINKING WATER. CALCULATION OF HARDNESS OF WATER IN ALL UNITS. ESTIMATION OF HARDNESS USING EDTA AND ALKALINITY METHOD. REMOVAL OF HARDNESS BY SODA LIME AND ION EXCHANGE METHOD INCLUDING ZEOLITE METHOD

MODULE 5: PERIODIC PROPERTIES (4 LECTURES)

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, ACID, BASE, PRINCIPLE OF HSAB THEORY, OXIDATION STATES, HYBRIDIZATION AND MOLECULAR GEOMETRIES.

MODULE 6: STEREOCHEMISTRY (4 LECTURES)

REPRESENTATIONS OF 3-D STRUCTURES, STRUCTURAL ISOMERS AND STEREOISOMERS, CONFIGURATIONS AND SYMMETRY AND CHIRALITY, ENANTIOMERS, DIASTEREOMERS, OPTICAL ACTIVITY, ABSOLUTE CONFIGURATIONS AND CONFORMATIONAL ANALYSIS.

MODULE 7: ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE (4 LECTURES)

INTRODUCTION TO INTERMEDIATES AND REACTIONS INVOLVING SUBSTITUTION, ADDITION, ELIMINATION, OXIDATION- REDUCTION, DIELS ELDER CYCLIZATION AND EPOXIDE RING OPENINGS REACTIONS. SYNTHESIS OF A COMMONLY USED DRUG MOLECULE LIKE ASPIRIN.

SUGGESTED TEXT BOOKS

- *UNIVERSITY CHEMISTRY, BY B. H. MAHAN*
- *CHEMISTRY: PRINCIPLES AND APPLICATIONS, BY M. J. SIENKO AND R. A. PLANE*
- *FUNDAMENTALS OF MOLECULAR SPECTROSCOPY, BY C. N. BANWELL*
- *ENGINEERING CHEMISTRY (NPTEL WEB-BOOK), BY B. L. TEMBE, KAMALUDDIN AND M. S. KRISHNAN*
- *PHYSICAL CHEMISTRY, BY P. W. ATKINS*
- *ORGANIC CHEMISTRY: STRUCTURE AND FUNCTION BY K. P. C. VOLHARDT AND N. E. SCHORE, 5TH EDITION*
- *HTTP://BCS.WHFREEMAN.COM/VOLLHARDTSCHORE5E/DEFAULT.ASP*

COURSE OUTCOMES

THE CONCEPTS DEVELOPED IN THIS COURSE WILL AID IN

QUANTIFICATION OF SEVERAL CONCEPTS IN CHEMISTRY THAT HAVE BEEN INTRODUCED AT THE 10+2 LEVELS IN SCHOOLS. TECHNOLOGY IS BEING INCREASINGLY BASED ON THE ELECTRONIC, ATOMIC AND MOLECULAR LEVEL MODIFICATIONS.

QUANTUM THEORY IS MORE THAN 100 YEARS OLD AND TO UNDERSTAND PHENOMENA AT NANOMETER LEVELS, ONE HAS TO BASE THE DESCRIPTION OF ALL CHEMICAL PROCESSES AT MOLECULAR LEVELS. THE COURSE WILL ENABLE THE STUDENT TO: ANALYSE MICROSCOPIC CHEMISTRY IN TERMS OF ATOMIC AND MOLECULAR ORBITALS AND INTERMOLECULAR FORCES. RATIONALISE BULK PROPERTIES AND PROCESSES USING THERMODYNAMIC CONSIDERATIONS. DISTINGUISH THE RANGES OF THE ELECTROMAGNETIC SPECTRUM USED FOR EXCITING DIFFERENT MOLECULAR ENERGY LEVELS IN VARIOUS SPECTROSCOPIC TECHNIQUES RATIONALISE PERIODIC PROPERTIES SUCH AS IONIZATION POTENTIAL, ELECTRONEGATIVITY, OXIDATION STATES AND ELECTRONEGATIVITY.LIST MAJOR CHEMICAL REACTIONS THAT ARE USED IN THE SYNTHESIS OF MOLECULES.

CHEMISTRY LABORATORY

CHOICE OF 10-12 EXPERIMENTS FROM THE FOLLOWING

- DETERMINATION OF SURFACE TENSION AND VISCOSITY
- THIN LAYER CHROMATOGRAPHY
- ION EXCHANGE COLUMN FOR REMOVAL OF HARDNESS OF WATER
- DETERMINATION OF CHLORIDE CONTENT OF WATER
- COLLIGATIVE PROPERTIES USING FREEZING POINT DEPRESSION
- DETERMINATION OF THE RATE CONSTANT OF A REACTION
- DETERMINATION OF CELL CONSTANT AND CONDUCTANCE OF SOLUTIONS
- POTENTIOMETRY - DETERMINATION OF REDOX POTENTIALS AND EMFS
- SYNTHESIS OF A POLYMER/DRUG
- SAPONIFICATION/ACID VALUE OF AN OIL
- CHEMICAL ANALYSIS OF A SALT
- LATTICE STRUCTURES AND PACKING OF SPHERES
- MODELS OF POTENTIAL ENERGY SURFACES
- CHEMICAL OSCILLATIONS- IODINE CLOCK REACTION
- DETERMINATION OF THE PARTITION COEFFICIENT OF A SUBSTANCE BETWEEN TWO IMMISCIBLE LIQUIDS
- ADSORPTION OF ACETIC ACID BY CHARCOAL
- USE OF THE CAPILLARY VISCOSIMETERS TO THE DEMONSTRATE OF THE ISOELECTRIC POINT AS THE PH OF MINIMUM VISCOSITY FOR GELATIN SOLS AND/OR COAGULATION OF THE WHITE PART OF EGG.

LABORATORY OUTCOMES

THE CHEMISTRY LABORATORY COURSE WILL CONSIST OF EXPERIMENTS ILLUSTRATING THE PRINCIPLES OF CHEMISTRY RELEVANT TO THE STUDY OF SCIENCE AND ENGINEERING. THE STUDENTS WILL LEARN TO: ESTIMATE RATE CONSTANTS OF REACTIONS FROM CONCENTRATION OF REACTANTS/PRODUCTS AS A FUNCTION OF TIME MEASURE

MOLECULAR/SYSTEM PROPERTIES SUCH AS SURFACE TENSION, VISCOSITY, CONDUCTANCE OF SOLUTIONS, REDOX POTENTIALS, CHLORIDE CONTENT OF WATER, ETC SYNTHESIZE A SMALL DRUG MOLECULE AND ANALYSE A SALT SAMPLE

ESC	Programming for Problem Solving	L:3	T:0	P:4	Credit:5

MODULE 1: INTRODUCTION TO PROGRAMMING (6 LECTURES)

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/PSEUDO CODE WITH EXAMPLES. FROM ALGORITHMS TO PROGRAMS; SOURCE CODE, VARIABLES (WITH DATA TYPES) VARIABLES AND MEMORY LOCATIONS, TYPE CASTING/TYPE CONVERSION, RUN TIME ENVIRONMENT (STATIC, DYNAMIC LOCATION), STORAGE CLASSES (AUTO, REGISTER, STATIC, EXTERN), SYNTAX AND LOGICAL ERRORS IN COMPILATION, OBJECT AND EXECUTABLE CODE.

MODULE 2: OPERATORS (3 LECTURES)

ARITHMETIC EXPRESSIONS/ARITHMETIC OPERATORS/RELATIONAL OPERATORS/LOGICAL OPERATORS/BITWISE OPERATORS AND PRECEDENCE

MODULE 3: CONDITIONAL BRANCHING AND LOOPS (5 LECTURES)

WRITING AND EVALUATION OF CONDITIONALS AND CONSEQUENT BRANCHING, ITERATION AND LOOPS

MODULE 4: ARRAYS (4 LECTURES)

ARRAY DECLARATION & INITIALIZATION, BOUND CHECKING ARRAYS (1-D, 2-D), CHARACTER ARRAYS AND STRINGS.

MODULE 5: BASIC ALGORITHMS (6 LECTURES)

SEARCHING (LINEAR SEARCH, BINARY SEARCH ETC.), BASIC SORTING ALGORITHMS (BUBBLE, INSERTION AND SELECTION), FINDING ROOTS OF EQUATIONS, NOTION OF ORDER OF COMPLEXITY THROUGH EXAMPLE PROGRAMS (NO FORMAL DEFINITION REQUIRED)

MODULE 6: FUNCTION (4 LECTURES)

INTRODUCTION & WRITING FUNCTIONS, SCOPE OF VARIABLES FUNCTIONS (INCLUDING USING BUILT IN LIBRARIES), PARAMETER PASSING IN FUNCTIONS, CALL BY VALUE, PASSING ARRAYS TO FUNCTIONS: IDEA OF CALL BY REFERENCE

MODULE 7: RECURSION (5 LECTURES)

RECURSION, AS A DIFFERENT WAY OF SOLVING PROBLEMS. EXAMPLE PROGRAMS, SUCH AS FINDING FACTORIAL, FIBONACCI SERIES, REVERSE A STRING USING RECURSION, AND GCD OF TWO NUMBERS, ACKERMAN FUNCTION ETC. QUICK SORT OR MERGE SORT.

MODULE 8: STRUCTURE/UNION (3 LECTURES)

STRUCTURES, ACCESSING STRUCTURE ELEMENTS, WAY OF STORAGE OF STRUCTURE ELEMENT, DEFINING STRUCTURES AND ARRAY OF STRUCTURES, BASIC DEFINITION OF UNION, COMPARISON B/W STRUCTURE & UNION WITH EXAMPLE

MODULE 9: POINTERS (5 LECTURES)

IDEA OF POINTERS, DEFINING POINTERS, USE OF POINTERS IN SELF-REFERENTIAL STRUCTURES, NOTION OF LINKED LIST (NO IMPLEMENTATION), POINTER TO POINTER, POINTER TO ARRAY, POINTER TO STRINGS, ARRAY OF POINTER, POINTER TO FUNCTION, POINTER TO STRUCTURE.

MODULE 10: FILE HANDLING

(ONLY IF TIME IS AVAILABLE, OTHERWISE SHOULD BE DONE AS PART OF THE LAB)

SUGGESTED TEXT BOOKS

- *BYRON GOTTFRIED, SCHAUM'S OUTLINE OF PROGRAMMING WITH C, MCGRAW-HILL*
- *E. BALAGURUSWAMY, PROGRAMMING IN ANSI C, TATA MCGRAW-HILL*

SUGGESTED REFERENCE BOOKS

- *BRIAN W. KERNIGHAN AND DENNIS M. RITCHIE, THE C PROGRAMMING LANGUAGE, PRENTICE HALL OF INDIA*
- *YASHWANT KANETKAR, LET US C, BPB PUBLICATION*

THE STUDENT WILL LEARN

- TO FORMULATE SIMPLE ALGORITHMS FOR ARITHMETIC AND LOGICAL PROBLEMS.
- TO TRANSLATE THE ALGORITHMS TO PROGRAMS (IN C LANGUAGE).
- TO TEST AND EXECUTE THE PROGRAMS AND CORRECT SYNTAX AND LOGICAL ERRORS.
- TO IMPLEMENT CONDITIONAL BRANCHING, ITERATION AND RECURSION.
- TO DECOMPOSE A PROBLEM INTO FUNCTIONS AND SYNTHESIZE A COMPLETE PROGRAM USING DIVIDE AND CONQUER APPROACH.
- TO USE ARRAYS, POINTERS AND STRUCTURES TO FORMULATE ALGORITHMS AND PROGRAMS.
- TO APPLY PROGRAMMING TO SOLVE MATRIX ADDITION AND MULTIPLICATION PROBLEMS AND SEARCHING AND SORTING PROBLEMS.

- TO APPLY PROGRAMMING TO SOLVE SIMPLE NUMERICAL METHOD PROBLEMS, NAMELY ROT FINDING OF FUNCTION, DIFFERENTIATION OF FUNCTION AND SIMPLE INTEGRATION.

LABORATORY PROGRAMMING FOR PROBLEM SOLVING

[THE LABORATORY SHOULD BE PRECEDED OR FOLLOWED BY A TUTORIAL TO EXPLAIN THE APPROACH OR ALGORITHM TO BE IMPLEMENTED FOR THE PROBLEM GIVEN.]

TUTORIAL 1: PROBLEM SOLVING USING COMPUTERS:
LAB1: FAMILIARIZATION WITH PROGRAMMING ENVIRONMENT

TUTORIAL 2: VARIABLE TYPES AND TYPE CONVERSIONS:
LAB 2: SIMPLE COMPUTATIONAL PROBLEMS USING ARITHMETIC EXPRESSIONS

TUTORIAL 3: BRANCHING AND LOGICAL EXPRESSIONS: LAB 3: PROBLEMS INVOLVING IF-THEN-ELSE STRUCTURES

TUTORIAL 4: LOOPS, WHILE AND FOR LOOPS:
LAB 4: ITERATIVE PROBLEMS E.G., SUM OF SERIES

TUTORIAL 5: 1D ARRAYS: SEARCHING, SORTING: LAB 5: 1D ARRAY MANIPULATION
TUTORIAL 6: 2D ARRAYS AND STRINGS
LAB 6: MATRIX PROBLEMS, STRING OPERATIONS

TUTORIAL 7: FUNCTIONS, CALL BY VALUE:
LAB 7: SIMPLE FUNCTIONS

TUTORIAL 8: NUMERICAL METHODS (ROOT FINDING, NUMERICAL DIFFERENTIATION, NUMERICAL INTEGRATION):
LAB 8: PROGRAMMING FOR SOLVING NUMERICAL METHODS PROBLEMS

TUTORIAL 9: RECURSION, STRUCTURE OF RECURSIVE CALLS LAB 9: RECURSIVE FUNCTIONS

TUTORIAL 10: POINTERS, STRUCTURES AND DYNAMIC MEMORY ALLOCATION LAB 10: POINTERS AND STRUCTURES

TUTORIAL 11: FILE HANDLING:
LAB 11: FILE OPERATIONS

LABORATORY OUTCOMES

- ❖ TO FORMULATE THE ALGORITHMS FOR SIMPLE PROBLEMS
- ❖ TO TRANSLATE GIVEN ALGORITHMS TO A WORKING AND CORRECT PROGRAM
- ❖ TO BE ABLE TO CORRECT SYNTAX ERRORS AS REPORTED BY THE COMPILERS
- ❖ TO BE ABLE TO IDENTIFY AND CORRECT LOGICAL ERRORS ENCOUNTERED AT RUN TIME

- TO BE ABLE TO WRITE ITERATIVE AS WELL AS RECURSIVE PROGRAMS
- TO BE ABLE TO REPRESENT DATA IN ARRAYS, STRINGS AND STRUCTURES AND MANIPULATE THEM THROUGH A PROGRAM
- TO BE ABLE TO DECLARE POINTERS OF DIFFERENT TYPES AND USE THEM IN DEFINING SELF- REFERENTIAL STRUCTURES.
- TO BE ABLE TO CREATE, READ AND WRITE TO AND FROM SIMPLE TEXT FILES.

ESC	Workshop Manufacturing Practices	L:1	T:0	P:4	Credit:3

LECTURES & VIDEOS: (10 HOURS) [L: 1; T: 0; P: 0 (1 CREDIT)]

DETAILED CONTENTS:

1. MANUFACTURING METHODS-CASTING, FORMING, MACHINING, JOINING, ADVANCED MANUFACTURING METHODS (3 LECTURES)
2. CNC MACHINING, ADDITIVE MANUFACTURING (1 LECTURE)
3. FITTING OPERATIONS & POWER TOOLS (1 LECTURE)
4. CARPENTRY (1 LECTURE)
5. PLASTIC MOULDING, GLASS CUTTING (1 LECTURE)
6. METAL CASTING (1 LECTURE)
7. WELDING (ARC WELDING & GAS WELDING), BRAZING, SOLDERING (2 LECTURE)

SUGGESTED TEXT/REFERENCE BOOKS:

- *HAJRA CHOUDHURY S.K., HAJRA CHOUDHURY A.K. AND NIRJHAR ROY S.K., "ELEMENTS OF WORKSHOP TECHNOLOGY", VOL. I 2008 AND VOL. II 2010, MEDIA PROMOTERS AND PUBLISHERS PRIVATE LIMITED, MUMBAI.*
- *KALPAKJIAN S. AND STEVEN S. SCHMID, "MANUFACTURING ENGINEERING AND TECHNOLOGY", 4TH EDITION, PEARSON EDUCATION INDIA EDITION, 2002.*
- *GOWRI P. HARIHARAN AND A. SURESH BABU,"MANUFACTURING TECHNOLOGY – I" PEARSON EDUCATION, 2008.*
- *ROY A. LINDBERG, "PROCESSES AND MATERIALS OF MANUFACTURE", 4TH EDITION, PRENTICE HALL INDIA, 1998.*
- *RAO P.N., "MANUFACTURING TECHNOLOGY", VOL. I AND VOL. II, TATA MCGRAWHILL HOUSE, 2017.*

COURSE OUTCOMES:

- *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.*

WORKSHOP PRACTICE: (60 HOURS) [L: 0; T: 0; P: 4 (2 CREDITS)]

1. MACHINE SHOP (10 HOURS) AND FITTING SHOP (8 HOURS)
2. CARPENTRY (6 HOURS)
3. WELDING SHOP (8 HOURS) (ARC WELDING 4 HRS + GAS WELDING 4 HRS)
4. CASTING (8 HOURS) AND SMITHY (6 HOURS)
5. PLASTIC MOULDING & GLASS CUTTING (6 HOURS)
6. 3-D PRINTING OF DIFFERENT MODELS (8 HOURS)

EXAMINATIONS COULD INVOLVE THE ACTUAL FABRICATION OF SIMPLE COMPONENTS, UTILIZING ONE OR MORE OF THE TECHNIQUES COVERED ABOVE.

LABORATORY OUTCOMES

- UPON COMPLETION OF THIS LABORATORY COURSE, STUDENTS WILL BE ABLE TO FABRICATE COMPONENTS WITH THEIR OWN HANDS.
- THEY WILL ALSO GET PRACTICAL KNOWLEDGE OF THE DIMENSIONAL

ACCURACIES AND DIMENSIONAL TOLERANCES POSSIBLE WITH DIFFERENT MANUFACTURING PROCESSES.

- BY ASSEMBLING DIFFERENT COMPONENTS, THEY WILL BE ABLE TO PRODUCE SMALL DEVICES OF THEIR INTEREST. BY ASSEMBLING DIFFERENT COMPONENTS, THEY WILL BE ABLE TO PRODUCE SMALL DEVICES OF THEIR INTEREST.

HSMC	English	L:2	T:0	P:2	Credit:3

DETAILED CONTENTS

1. **VOCABULARY BUILDING**
   - A. THE CONCEPT OF WORD FORMATION
   - B. ROOT WORDS FROM FOREIGN LANGUAGES AND THEIR USE IN ENGLISH
   - C. ACQUAINTANCE WITH PREFIXES AND SUFFIXES FROM FOREIGN LANGUAGES IN ENGLISH TO FORM DERIVATIVES.
   - D. SYNONYMS, ANTONYMS, AND STANDARD ABBREVIATIONS.
   - E. AFFIXES, ACRONYMS

2. **BASIC WRITING SKILLS**
   - A. SENTENCE STRUCTURES
   - B. USE OF PHRASES AND CLAUSES IN SENTENCES
   - C. IMPORTANCE OF PROPER PUNCTUATION
   - D. KINDS OF SENTENCES
   - E. USE OF TENSE, USE IN CONTEXT AND COHERENCE OF TENSE IN WRITING
   - F. USE OF VOICE – ACTIVE/PASSIVE IN SENTENCES
   - G. USE OF SPEECH – DIRECT AND INDIRECT SPEECH
   - H. FRAMING QUESTIONS- DIRECT, USING MODAL VERBS

3. **IDENTIFYING COMMON ERRORS IN WRITING**
   - A. SUBJECT-VERB AGREEMENT
   - B. NOUN-PRONOUN AGREEMENT
   - C. MISPLACED MODIFIERS
   - D. ARTICLES
   - E. PREPOSITIONS
   - F. REDUNDANCIES
   - G. CLICHÉS
   - H. COMMON ENGLISH ERRORS

4. **NATURE AND STYLE OF SENSIBLE WRITING**
   - A. DESCRIBING
   - B. DEFINING
   - C. CLASSIFYING
   - D. PROVIDING EXAMPLES OR EVIDENCE
   - E. WRITING INTRODUCTION AND CONCLUSION
   - F. ORGANISING PRINCIPLE OF PARAGRAPHS IN DOCUMENTS
   - G. ARGUMENT, DESCRIBING/ NARRATING/ PLANNING, DEFINING,CLASSIFYING
   - H. LEXICAL RESOURCES, USING SUITABLE LANGUAGE REGISTER
   - I. COHERENCE, WRITING INTRODUCTION, BODY AND CONCLUSION, TECHNIQUES FOR WRITING PRECISELY,GRAMMAR AND ACCURACY

5. **WRITING PRACTICES**
   - A. COMPREHENSION
   - B. FORMAL LETTER WRITING/ APPLICATION/ REPORT WRITING/ WRITING MINUTES OF MEETINGS
   - C. ESSAY WRITING
   - D. FORMAL EMAIL WRITING

E. RESUME/ CV WRITING, COVER LETTER,
F. STATEMENT OF PURPOSE

6. ORAL COMMUNICATION

(THIS UNIT INVOLVES INTERACTIVE PRACTICE SESSIONS IN LANGUAGE LAB)

A. LISTENING COMPREHENSION
B. PRONUNCIATION, INTONATION, STRESS AND RHYTHM
C. COMMON EVERYDAY SITUATIONS: CONVERSATIONS AND DIALOGUES
D. COMMUNICATION AT WORKPLACE
E. INTERVIEWS
F. FORMAL PRESENTATIONS
G. ACQUAINTING STUDENTS WITH IPA SYMBOLS
H. PHONETICS (BASIC)
I. SOUNDS – VOWELS, CONSONANTS
J. CLEARING MOTHER TONGUE INFLUENCE
K. CLEARING REDUNDANCIES AND COMMON ERRORS RELATED TO INDIANISMS
L. GROUP DISCUSSION
M. EXPRESSING OPINIONS
N. COHERENCE AND FLUENCY IN SPEECH

7. READING SKILLS

A. READING COMPREHENSION,
B. PARAGRAPH READING BASED ON PHONETIC SOUNDS/ INTONATION

8. PROFESSIONAL SKILLS

A. TEAM BUILDING
B. SOFT SKILLS AND ETIQUETTES

9. ACQUAINTANCE WITH TECHNOLOGY-AIDED LANGUAGE LEARNING

A. USE OF COMPUTER SOFTWARE (GRAMMARLY, GINGER…)
B. USE OF SMARTPHONE APPLICATIONS (DUOLINGO, BUSUU…)

10. ACTIVITIES

A. NARRATIVE CHAIN
B. DESCRIBING/ NARRATING
C. WRITING ESSAYS IN RELAY
D. PEER/ GROUP ACTIVITIES
E. BRAINSTORMING VOCABULARY
F. CUE / FLASH CARDS FOR VOCABULARY
G. DEBATES

SUGGESTED READINGS:

- PRACTICAL ENGLISH USAGE. MICHAEL SWAN. OUP. 1995.
- REMEDIAL ENGLISH GRAMMAR. F.T. WOOD. MACMILLAN.2007
- ON WRITING WELL. WILLIAM ZINSSER. HARPER RESOURCE BOOK. 2001
- STUDY WRITING. LIZ HAMP-LYONS AND BEN HEASLY. CAMBRIDGE UNIVERSITY PRESS. 2006.
- COMMUNICATION SKILLS. SANJAY KUMAR AND PUSHPLATA. OXFORD UNIVERSITY PRESS. 2011.
- EXERCISES IN SPOKEN ENGLISH. PARTS. I-III. CIEFL, HYDERABAD. OXFORD UNIVERSITY PRESS

COURSE OUTCOMES

THE STUDENT WILL ACQUIRE BASIC PROFICIENCY IN ENGLISH INCLUDING READING AND LISTENING COMPREHENSION, WRITING AND SPEAKING SKILLS

CREDIT TABLE
FOR
110–ELECTRICALAND ELECTRONICS ENGINEERING

SEMESTER–II

Sl. No.	Course Code	CourseTitle	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	BSC	Physics(WaveandOptics, Introduction to Quantum Mechanics)	30	70	100	3	1	0	4	4
2	BSC	Mathematics –II (Linear Algebra,TransformCalculus and Numerical Methods)	30	70	100	3	1	0	4	4
3	ESC	BasicElectricalEngineering	30	70	100	3	1	0	4	4
4	ESC	EngineeringGraphics&Design	30	70	100	1	0	0	1	1
Practical										
1	BSC	Physics(WaveandOptics, Introduction to Quantum Mechanics)	20	30	50	0	0	3	1.5	3
2	ESC	BasicElectricalEngineering	20	30	50	0	0	2	1	2
3	ESC	EngineeringGraphics&Design	20	30	50	0	0	4	2	4
	Total				550				17.5	22

TOTAL MARKS: 550 TOTAL CREDITS: 17.5

TOTALHOURS:22 IA (INTERNAL ASSESMENT), ESE (END SEMESTER EXAMINATION)

BSC	**Physics(WavesandOptics,and Introduction toQuantumMechanics)**	**L:3**	**T:1**	**P:3**	**Credit:5.5**

CONTENTS

MODULE1:WAVES(3LECTURES)

MECHANICAL AND ELECTRICAL SIMPLE HARMONIC OSCILLATORS, DAMPED HARMONIC OSCILLATOR, FORCED MECHANICAL AND ELECTRICAL OSCILLATORS, IMPEDANCE, STEADY STATE MOTION OF FORCED DAMPED HARMONIC OSCILLATOR

MODULE2:NON-DISPERSIVETRANSVERSEANDLONGITUDINALWAVES(4LECTURES)

TRANSVERSE WAVE ON A STRING, THE WAVE EQUATION ON A STRING, HARMONIC WAVES,REFLECTIONANDTRANSMISSIONOFWAVESATABOUNDARY,IMPEDANCEMATCHING, STANDING WAVES AND THEIR EIGEN FREQUENCIES, LONGITUDINAL WAVES AND THE WAVE EQUATION FOR THEM, ACOUSTICS WAVES

MODULE3:LIGHTANDOPTICS(3LECTURES)

LIGHT AS AN ELECTROMAGNETIC WAVE AND FRESNEL EQUATIONS, REFLECTANCE AND TRANSMITTANCE,BREWSTER'SANGLE,TOTALINTERNALREFLECTION,ANDEVANESCENT WAVE. MIRRORS AND LENSES AND OPTICAL INSTRUMENTS BASED ON THEM

MODULE4:WAVEOPTICS(5LECTURES)

HUYGENS' PRINCIPLE, SUPERPOSITION OF WAVES AND INTERFERENCE OF LIGHT BY WAVEFRONT SPLITTING AND AMPLITUDE SPLITTING; YOUNG'S DOUBLE SLIT EXPERIMENT, NEWTON'S RINGS, MICHELSON INTERFEROMETER, MACH ZEHNDER INTERFEROMETER. FARUNHOFERDIFFRACTIONFROMASINGLESLITANDACIRCULARAPERTURE,THERAYLEIGH CRITERION FOR LIMIT OF RESOLUTION AND ITS APPLICATION TO VISION; DIFFRACTION GRATINGS AND THEIR RESOLVING POWER

MODULE5:LASERS(5LECTURES)

EINSTEIN'S THEORY OF MATTER RADIATION INTERACTION AND A AND B COEFFICIENTS; AMPLIFICATION OF LIGHT BY POPULATION INVERSION,

DIFFERENT TYPES OF LASERS: GAS LASERS (HE-NE, CO2), SOLID-STATE LASERS (RUBY, NEODYMIUM), DYE LASERS; PROPERTIES OF LASER BEAMS: MONO-CHROMATICITY

MODULE6:INTRODUCTIONTOQUANTUMMECHANICS(5LECTURES)

WAVENATUREOFPARTICLES,TIME-DEPENDENTANDTIME-INDEPENDENTSCHRODINGER EQUATION FOR WAVE FUNCTION, BORN INTERPRETATION, PROBABILITY CURRENT, EXPECTATIONVALUES,FREE-PARTICLEWAVEFUNCTIONANDWAVE-PACKETS,UNCERTAINTY PRINCIPLE.

MODULE7:SOLUTIONOFWAVEEQUATION(6LECTURES)

SOLUTION OF STATIONARY-STATE SCHRODINGER EQUATION FOR ONE DIMENSIONAL PROBLEMS–PARTICLE IN A BOX, PARTICLE IN ATTRACTIVE DELTA-FUNCTION POTENTIAL, SQUARE-WELLPOTENTIAL,LINEARHARMONICOSCILLATOR.SCATTERINGFROMAPOTENTIAL BARRIERANDTUNNELING;RELATEDEXAMPLESLIKEALPHA-DECAY,FIELD-IONIZATIONAND SCANNING TUNNELING MICROSCOPE, TUNNELING IN SEMICONDUCTOR STRUCTURES. THREE- DIMENSIONAL PROBLEMS: PARTICLE IN THREE DIMENSIONAL BOX AND RELATED EXAMPLES.

MODULE8:INTRODUCTIONTOSOLIDSANDSEMICONDUCTORS(9LECTURES)

FREE ELECTRON THEORY OF METALS, FERMI LEVEL, DENSITY OF STATES IN 1, 2 AND3DIMENSIONS,BLOCH'STHEOREMFORPARTICLESINAPERIODICPOTENTIAL,KRONIG- PENNEY MODEL AND ORIGIN OF ENERGY BANDS.

TYPES OF ELECTRONIC MATERIALS: METALS, SEMICONDUCTORS, AND INSULATORS. INTRINSIC AND EXTRINSIC SEMICONDUCTORS, DEPENDENCE OF FERMI LEVEL ON CARRIER- CONCENTRATION AND TEMPERATURE (EQUILIBRIUM CARRIER STATISTICS), CARRIER GENERATION AND RECOMBINATION, CARRIER TRANSPORT: DIFFUSION AND DRIFT, P -N JUNCTION.

TEXT/REFERENCES:

- *G. MAIN, "VIBRATIONS AND WAVES IN PHYSICS", CAMBRIDGE UNIVERSITY PRESS, 1993.*
- *H.J.PAIN,"THEPHYSICSOFVIBRATIONSANDWAVES",WILEY,2006.*
- *E.HECHT,"OPTICS",PEARSONEDUCATION,2008.*
- *A.GHATAK,"OPTICS",MCGRAWHILLEDUCATION,2012.*
- *O.SVELTO,"PRINCIPLESOFLASERS",SPRINGERSCIENCE&BUSINESSMEDIA, 2010.*

- *D.J.GRIFFITHS,"QUANTUMMECHANICS",PEARSONEDUCATION,2014.*
- *R.ROBINETT,"QUANTUMMECHANICS",OUPOXFORD,2006.*
- *D.MCQUARRIE,"UANTUMCHEMISTRY",UNIVERSITYSCIENCEBOOKS,2007.*
- *D.A.NEAMEN,"SEMICONDUCTORPHYSICSANDDEVICES",TIMESMIRRORHIGH EDUCATION GROUP, CHICAGO, 1997.*
- *E.S.YANG,"MICROELECTRONICDEVICES",MCGRAWHILL,SINGAPORE,1988.*
- *B.G.STREETMAN,"SOLIDSTATEELECTRONICDEVICES",PRENTICEHALLOFINDIA, 1995*

BSC	**Mathematics–II(LinearAlgebra,Transform CalculusandNumericalMethods)**	**L:3**	**T:1**	**P:0**	**Credit:4**

MODULE1:MATRICES(10LECTURES)

ALGEBRAOFMATRICES,INVERSEANDRANKOFAMATRIX,RANK-NULLITYTHEOREM; SYSTEMOFLINEAREQUATIONS;SYMMETRIC,SKEW-SYMMETRICANDORTHOGONALMATRICES; DETERMINANTS; EIGENVALUES AND EIGENVECTORS; DIAGONALIZATION OF MATRICES; CAYLEY-HAMILTON THEOREM, ORTHOGONAL TRANSFORMATION AND QUADRATIC TO CANONICAL FORMS.

MODULE2:NUMERICALMETHODS-I(10LECTURES)

SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS – BISECTION METHOD, NEWTON-RAPHSON METHOD AND REGULA-FALSI METHOD. FINITE DIFFERENCES, INTERPOLATIONUSINGNEWTON'SFORWARDANDBACKWARDDIFFERENCEFORMULAE.CENTRAL DIFFERENCE INTERPOLATION: GAUSS'S FORWARD AND BACKWARD FORMULAE. NUMERICAL INTEGRATION: TRAPEZOIDAL RULE AND SIMPSON'S 1/3RD AND 3/8 RULES.

MODULE3:NUMERICALMETHODS-II(10LECTURES)

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 PREDICATOR-CORRECTOR METHODS. PARTIAL DIFFERENTIAL EQUATIONS: FINITE DIFFERENCE SOLUTION TWO DIMENSIONAL LAPLACE EQUATION AND POISSON EQUATION, IMPLICIT AND EXPLICIT METHODS FOR ONE DIMENSIONALHEATEQUATION(BENDER-SCHMIDTANDCRANK-NICHOLSONMETHODS),FINITE DIFFERENCE EXPLICIT METHOD FOR WAVE EQUATION.

MODULE4:TRANSFORMCALCULUS(10LECTURES)

LAPLACETRANSFORM,PROPERTIESOFLAPLACETRANSFORM,LAPLACETRANSFORMOF PERIODIC FUNCTIONS. FINDING INVERSE LAPLACE TRANSFORM BY DIFFERENT METHODS,

CONVOLUTIONTHEOREM.EVALUATIONOFINTEGRALSBYLAPLACETRANSFORM,SOLVINGODES AND PDES BY LAPLACE TRANSFORM METHOD. FOURIER TRANSFORMS.

TEXT/REFERENCES:

. D.POOLE,"LINEARALGEBRA:AMODERNINTRODUCTION",BROOKS/COLE,2005.
. N.P. BALI AND M. GOYAL, "A TEXT BOOK OF ENGINEERING MATHEMATICS", LAXMI PUBLICATIONS, 2008.
. B.S.GREWAL,"HIGHERENGINEERINGMATHEMATICS",KHANNAPUBLISHERS,2010.
. V.KRISHNAMURTHY,V.P.MAINRAANDJ.L.ARORA,"ANINTRODUCTIONTOLINEAR ALGEBRA", AFFILIATED EAST-WEST PRESS, 2005.

ESC	BasicElectricalEngineering	L:3	T:1	P:2	Credit:5

MODULE1:DCCIRCUITS(8LECTURES)

ELECTRICAL CIRCUIT ELEMENTS (R, L AND C), VOLTAGE AND CURRENT SOURCES, KIRCHHOFF CURRENT AND VOLTAGE LAWS, ANALYSIS OF SIMPLE CIRCUITS WITH DC EXCITATION. STAR-DELTA CONVERSION, NETWORK THEOREMS (SUPERPOSITION, THEVENIN, NORTON AND MAXIMUM POWER TRANSFER THEOREMS). TIME-DOMAIN ANALYSIS OF FIRST- ORDER RL AND RC CIRCUITS

MODULE2:ACCIRCUITS(8LECTURES)

REPRESENTATIONOFSINUSOIDALWAVEFORMS,PEAK,RMSANDAVERAGEVALUES(FORM FACTOR AND PEAK FACTOR), IMPEDANCE OF SERIES AND PARALLEL CIRCUIT, PHASOR REPRESENTATION,REALPOWER,REACTIVEPOWER,APPARENTPOWER,POWERFACTOR,POWER TRIANGLE. 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.

MODULE3:MAGNETICCIRCUITS:(4LECTURES)

INTRODUCTION, SERIES AND PARALLEL MAGNETIC CIRCUITS, ANALYSIS OF SERIES AND PARALLEL MAGNETIC CIRCUITS.

MODULE4:TRANSFORMERS(6LECTURES)

MAGNETICMATERIALS,BHCHARACTERISTICS,IDEALANDPRACTICALTRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT, LOSSES IN TRANSFORMERS, REGULATION AND EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.

MODULE5:ELECTRICALMACHINES(10LECTURES)

CONSTRUCTION, WORKING, TORQUE-SPEED CHARACTERISTIC AND SPEED CONTROL OF SEPARATELY EXCITED DC MOTOR. GENERATION OF ROTATING

MAGNETIC FIELDS, CONSTRUCTION AND WORKING OF A THREE-PHASE INDUCTION MOTOR, SIGNIFICANCE OF TORQUE-SLIPCHARACTERISTIC.LOSSCOMPONENTSANDEFFICIENCY,STARTINGANDSPEED CONTROLOFINDUCTIONMOTOR.CONSTRUCTIONANDWORKINGOFSYNCHRONOUS GENERATORS.

MODULE6:ELECTRICALINSTALLATIONS(6LECTURES)

COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING. TYPES OF BATTERIES, IMPORTANT CHARACTERISTICSFORBATTERIES.ELEMENTARYCALCULATIONSFORENERGYCONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.

SUGGESTEDTEXT/REFERENCEBOOKS

- *D.P.KOTHARIANDI.J.NAGRATH,"BASICELECTRICALENGINEERING",TATA MCGRAW HILL, 2010.*
- *D.C.KULSHRESHTHA,"BASICELECTRICALENGINEERING",MCGRAWHILL,2009.*
- *L. S. BOBROW,"FUNDAMENTALSOFELECTRICALENGINEERING",OXFORD UNIVERSITY PRESS, 2011.*
- *E.HUGHES,"ELECTRICALANDELECTRONICSTECHNOLOGY",PEARSON,2010.*
- *V. D. TORO, "ELECTRICAL ENGINEERING FUNDAMENTALS", PRENTICE HALL INDIA, 1989.*
- *BASICELECTRICALENGINEERINGBYFITZERALD,ETAL,TATAMCGRAWHILL*
- *FUNDAMENTALSOFELECTRICALENGG.BYR.PRASAD,PHIPUBLICATION*
- *BASICELECTRICALENGINEERINGBYV.K.MEHTAANDROHITMEHTA,S.CHAND PUBLICATION*

COURSEOUTCOMES

- TOUNDERSTANDANDANALYZEBASICELECTRICANDMAGNETICCIRCUITS
- TOSTUDYTHEWORKINGPRINCIPLESOFELECTRICALMACHINESANDPOWER CONVERTERS.
- TOINTRODUCETHECOMPONENTSOFLOWVOLTAGEELECTRICALINSTALLATIONS

LABORATORY

LISTOFEXPERIMENTS/DEMONSTRATIONS

- BASICSAFETYPRECAUTIONS.INTRODUCTIONANDUSEOFMEASURINGINSTRUMENTS
  – VOLTMETER, AMMETER, MULTI-METER, OSCILLOSCOPE. REAL-LIFE RESISTORS, CAPACITORS AND INDUCTORS.
- MEASURING THE STEADY-STATE AND TRANSIENT TIME-RESPONSE OF R-L, R-C, AND R-L-CCIRCUITSTOASTEPCHANGEINVOLTAGE(TRANSIENTMAYBEOBSERVEDONASTORAGEOSCILLOSCOPE).SINUSOIDALSTEADYSTATERESPONSEOFR-

L,ANDR- CCIRCUITS– IMPEDANCECALCULATIONANDVERIFICATION.OBSERVATIONOFPHASE DIFFERENCES BETWEEN CURRENT AND VOLTAGE. RESONANCE IN R-L-C CIRCUITS.

- 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:MEASUREMENTOFPRIMARYANDSECONDARYVOLTAGESA NDCURRENTS, AND POWER.
- THREE-PHASETRANSFORMERS:STARANDDELTACONNECTIONS.VOLTAGE ANDCURRENTRELATIONSHIPS(LINE-LINEVOLTAGE,PHASE-TO-NEUTRALVOLTAGE, LINEANDPHASECURRENTS).PHASE-SHIFTSBETWEENTHEPRIMARYANDSECONDARY SIDE. CUMULATIVE THREE-PHASE POWER IN BALANCED THREE-PHASE CIRCUITS.
- DEMONSTRATION OF CUT-OUT SECTIONS OF MACHINES:DC MACHINE (COMMUTATOR-BRUSHARRANGEMENT),INDUCTIONMACHINE(SQUIRRELCAGEROTOR),SYN CHRONOUS MACHINE(FIELDWINGING-SLIPRINGARRANGEMENT)ANDSINGLE-PHASEINDUCTION MACHINE.
- TORQUESPEEDCHARACTERISTICOFSEPARATELYEXCITEDDCMOTOR.
- 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.
- SYNCHRONOUSMACHINEOPERATINGASAGENERATOR:STAND-ALONEOPERATIONWITH A LOAD. CONTROL OF VOLTAGE THROUGH FIELD EXCITATION.
- DEMONSTRATIONOF(A)DC-DCCONVERTERS(B)DC-ACCONVERTERS– PWMWAVEFORM
  (C) THE USE OF DC-AC CONVERTER FOR SPEED CONTROL OF AN INDUCTION MOTOR AND (D) COMPONENTS OF LT SWITCHGEAR.

LABORATORYOUTCOMES

- GETANEXPOSURETOCOMMONELECTRICALCOMPONENTSANDTHEIRRATINGS.
- MAKEELECTRICALCONNECTIONSBYWIRESOFAPPROPRIATERATINGS.
- UNDERSTANDTHEUSAGEOFCOMMONELECTRICALMEASURINGINSTRUMENTS.
- UNDERSTANDTHEBASICCHARACTERISTICSOFTRANSFORMERSANDELECTR ICALMACHINES.
- GETANEXPOSURETOTHEWORKINGOFPOWERELECTRONICCONVERTERS

ESC	EngineeringGraphics&Design	L:1	T:0	P:4	Credit:3

TRADITIONALENGINEERINGGRAPHICS:

PRINCIPLESOFENGINEERINGGRAPHICS;ORTHOGRAPHICPROJECTION;DESCRIPTIVE GEOMETRY; DRAWING PRINCIPLES; ISOMETRIC PROJECTION; SURFACE DEVELOPMENT; PERSPECTIVE; READING A DRAWING; SECTIONAL VIEWS; DIMENSIONING & TOLERANCES; TRUE LENGTH, ANGLE; INTERSECTION, SHORTEST DISTANCE.

COMPUTERGRAPHICS:

ENGINEERING GRAPHICS SOFTWARE; -SPATIAL TRANSFORMATIONS; ORTHOGRAPHIC PROJECTIONS; MODEL VIEWING; CO-ORDINATE SYSTEMS; MULTI-VIEW PROJECTION; EXPLODED ASSEMBLY; MODEL VIEWING; ANIMATION; SPATIAL MANIPULATION; SURFACE MODELLING; SOLID MODELLING, INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM).

(EXCEPTTHEBASICESSENTIALCONCEPTS,MOSTOFTHETEACHINGPARTCANHAPPEN CONCURRENTLY IN THE LABORATORY)

MODULE1:INTRODUCTIONTOENGINEERINGDRAWING

PRINCIPLES OF ENGINEERING GRAPHICS AND THEIR SIGNIFICANCE, USAGE OF DRAWING INSTRUMENTS, LETTERING, CONIC SECTIONS INCLUDING THE RECTANGULAR HYPERBOLA(GENERALMETHODONLY);CYCLOID,EPICYCLOID,HYPOCYCLOIDAND INVOLUTE; SCALES – PLAIN, DIAGONAL AND VERNIER SCALES

MODULE2:ORTHOGRAPHICPROJECTIONS

PRINCIPLESOFORTHOGRAPHICPROJECTIONS-CONVENTIONS-PROJECTIONSOFPOINTS AND LINES INCLINED TO BOTH PLANES; PROJECTIONS OF PLANES INCLINED PLANES - AUXILIARY PLANES

MODULE3:PROJECTIONSOFREGULARSOLIDS

THOSEINCLINEDTOBOTHTHEPLANES-AUXILIARYVIEWS;DRAWSIMPLEANNOTATION, DIMENSIONING AND SCALE. FLOOR PLANS THAT INCLUDE: WINDOWS, DOORS, AND FIXTURES SUCH AS WC, BATH, SINK, SHOWER, ETC.

MODULE4:SECTIONSANDSECTIONALVIEWSOFRIGHTANGULARSOLIDS

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)

MODULE5:ISOMETRICPROJECTIONS

PRINCIPLES OF ISOMETRIC PROJECTION – ISOMETRIC SCALE, ISOMETRIC VIEWS, CONVENTIONS; ISOMETRIC VIEWS OF LINES, PLANES, SIMPLE AND COMPOUND SOLIDS; CONVERSIONOFISOMETRICVIEWSTOORTHOGRAPHICVIEWSANDVICE-VERSA,CONVENTIONS

MODULE6:OVERVIEWOFCOMPUTERGRAPHICS

LISTINGTHECOMPUTERTECHNOLOGIESTHATIMPACTONGRAPHICALCOMMUNICATION, DEMONSTRATINGKNOWLEDGEOFTHETHEORYOFCADSOFTWARE[SUCHAS:THEMENUSYSTEM, 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]

MODULE7:CUSTOMISATION&CADDRAWING

CONSISTINGOFSETUPOFTHEDRAWINGPAGEANDTHEPRINTER,INCLUDINGSCALE 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 COORDINATEINPUTENTRYMETHODSTODRAWSTRAIGHTLINES,APPLYINGVARIOUSWAYSOF DRAWING CIRCLES.

MODULE8:ANNOTATIONS,LAYERING&OTHERFUNCTIONS

COVERING APPLYING DIMENSIONS TO OBJECTS, APPLYING ANNOTATIONS TO DRAWINGS;SETTINGUPANDUSEOFLAYERS,LAYERSTOCREATEDRAWINGS,CREAT

E,EDIT AND USE CUSTOMIZED LAYERS; CHANGING LINE LENGTHS THROUGH MODIFYING EXISTING LINES (EXTEND/LENGTHEN); PRINTING DOCUMENTS TO PAPER USING THE PRINT COMMAND; ORTHOGRAPHICPROJECTIONTECHNIQUES;DRAWINGSECTIONALVIEWSOFCOMPOSITERIGHT REGULAR GEOMETRIC SOLIDS AND PROJECT THE TRUE SHAPE OF THE SECTIONED SURFACE; DRAWINGANNOTATION,COMPUTER-AIDEDDESIGN(CAD)SOFTWAREMODELINGOFPARTSAND ASSEMBLIES.PARAMETRICANDNON-PARAMETRICSOLID,SURFACE,ANDWIREFRAMEMODELS. 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.

MODULE9:DEMONSTRATIONOFASIMPLETEAMDESIGNPROJECTTHATILLUSTRATES

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;USEOFSOLID-MODELINGSOFTWAREFORCREATINGASSOCIATIVEMODELSAT 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).

SUGGESTEDTEXT/REFERENCEBOOKS:

- *BHATTN.D.,PANCHALV.M.&INGLEP.R.,(2014),ENGINEERINGDRAWING, CHAROTAR PUBLISHING HOUSE*
- *SHAH,M.B.&RANAB.C.(2008),ENGINEERINGDRAWINGANDCOMPUTERGRAPHICS, PEARSON EDUCATION*
- *AGRAWALB.&AGRAWALC.M.(2012),ENGINEERINGGRAPHICS,TMHPUBLICATION*
- *NARAYANA,K.L.&PKANNAIAH(2008),TEXTBOOKONENGINEERINGDRAWING, SCITECHPUBLISHERS*
- *(CORRESPONDINGSETOF)CADSOFTWARETHEORYANDUSERMANUALS*

COURSEOUTCOMES

ALLPHASESOFMANUFACTURINGORCONSTRUCTIONREQUIRETHECONVERSIONOFNEW IDEASANDDESIGNCONCEPTSINTOTHEBASICLINELANGUAGEOFGRAPHICS.THERE

FORE, THERE ARE MANY AREAS (CIVIL, MECHANICAL, ELECTRICAL, ARCHITECTURAL AND INDUSTRIAL)INWHICHTHESKILLSOFTHECADTECHNICIANSPLAYMAJORROLESINTHE DESIGN AND DEVELOPMENT OF NEW PRODUCTS OR CONSTRUCTION. STUDENTS PREPARE FOR ACTUAL WORK SITUATIONS THROUGH PRACTICAL TRAINING IN A NEW STATE-OF-THE-ART COMPUTER DESIGNED CAD LABORATORY USING ENGINEERING SOFTWARE

THISCOURSEISDESIGNEDTOADDRESS:

- TOPREPAREYOUTODESIGNASYSTEM,COMPONENT,ORPROCESSTOMEETDESIRED NEEDS WITHIN REALISTIC CONSTRAINTS SUCH AS ECONOMIC, ENVIRONMENTAL, SOCIAL, POLITICAL, ETHICAL, HEALTH AND SAFETY, MANUFACTURABILITY, AND SUSTAINABILITY
- TOPREPAREYOUTOCOMMUNICATEEFFECTIVELY
- TOPREPAREYOUTOUSETHETECHNIQUES,SKILLS,ANDMODERNENGINEERINGTOOLS NECESSARY FOR ENGINEERING PRACTICE

THESTUDENTWILLLEARN:

- INTRODUCTIONTOENGINEERINGDESIGNANDITSPLACEINSOCIETY
- EXPOSURETOTHEVISUALASPECTSOFENGINEERINGDESIGN
- EXPOSURETOENGINEERINGGRAPHICSSTANDARDS
- EXPOSURETOSOLIDMODELLING
- EXPOSURETOCOMPUTER-AIDEDGEOMETRICDESIGN
- EXPOSURETOCREATINGWORKINGDRAWINGS
- EXPOSURETOENGINEERINGCOMMUNICATION

110 EEE

SEMESTER III [Second year]

Branch/Course: Electrical & Electronics Engineering

Sl. No	Course Code	Course Title	Hours per week			Total contact hours	Credits
			Lecture	Tutorial	Practical		
1	PCC-EEE01	Electrical Circuit Analysis	3	1	0	4	4
2	PCC-EEE02	Digital Electronics	3	0	0	3	3
3	PCC-EEE03	Electrical Machines – I	3	0	0	3	3
4	PCC-EEE04	Electrical Machines Laboratory - I	0	0	2	2	1
5	PCC-EEE05	Electromagnetic Fields	3	1	0	4	4
7	ESC 301	Engineering Mechanics	3	1	0	4	4
8	MOOC-EEE 01	MOOCs / SWAYAM / NPTEL Courses - 1	2	0	0	2	2
9	INT-EEE011	Internship	4 weeks				4
		TOTAL CREDITS					**25**
10	MC 401	Human Values & Ethics	3	0	0	3	0
11	MC 402	Capstone Design Project	3	0	0	3	0
12	MC 403	NCC/ NSS/ other Clubs & Society Activity/ Sports	3	0	0	3	0
		TOTAL CONTACT HOURS				**31**	

110 – EEE

PCC-EEE01	Electrical Circuit Analysis	3L:1T:0P	4 credits

Course Outcomes:

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

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

Module 1: Network Theorems (9 Hours)

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.

Module 2: Solution of First and Second order networks (8 Hours)

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

Module 3: Sinusoidal steady state analysis (8 Hours)

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

Module 4: Electrical Circuit Analysis Using Laplace Transforms (8 Hours)

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

Module 5: Two Port Network and Network Functions (6 Hours)

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

Module 6: Network Topology and Graph Theory (3 Hours)

Introductory concepts of network graphs, cut sets, loops, cut set and loop analysis.

Text / References:

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

PCC-EEE02	Digital Electronics	3L:0T:0P	3 credits

Course Outcomes:

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

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.
- Be able to use PLDs to implement the given logical problem.

Module 1: Fundamentals of Digital Systems and logic families (7Hours)

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 lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational Digital Circuits (7Hours)

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 ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, paritychecker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (7Hours)

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.

Module 4: A/D and D/A Converters (7Hours)

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

Module 5: Semiconductor memories and Programmable logic devices. (7Hours)

Memory organization and operation, expanding memory size, classification and characteristics of

memories, sequential memory, read only memory (ROM), read and write memory (RAM), content
addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Text/References:

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

PCC-EEE03	Electrical Machines-I	3L:0T:0P	3 credits

Course Outcomes:

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

- Understand the concepts of magnetic circuits.
- Understand the operation of dc machines.
- Analyse the differences in operation of different dc machine configurations.
- Analyse single phase and three phase transformers circuits.

Magnetic fields and magnetic circuits (6 Hours)

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

Module 2: Electromagnetic force and torque (9 Hours)

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

Module 3: DC machines (8 Hours)

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

Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module 4: DC machine - motoring and generation (7 Hours)

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

Module 5: Transformers (12 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests,
polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of 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.

Text /References

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

PCC-EE04: Electrical Machines Laboratory– I (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of PCC-EEE03.

PCC-EEE05	Electromagnetic Fields	3L:1T:0P	4 credits

Course Outcomes:

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

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell's equation in different forms and different media.
- To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1**:** Review of Vector Calculus (6 hours)

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus-differentiation, partial differentiation, integration, vector operator del, gradient, divergence a n d curl; integral theorems of vectors. Conversion of a vector from one coordinate system to an other.

Module 2: Static Electric Field (6 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential
difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Module 3: Conductors, Dielectrics and Capacitance (6 Hours)

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of
perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module 4: Static Magnetic Fields (5 Hours)

Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector
Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

Module 5: Magnetic Forces, Materials and Inductance (6 Hours)

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.

Module 6: Time Varying Fields and Maxwell's Equations (5 Hours)

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

Module 7: Electromagnetic Waves (6 Hours)

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.

Module 8: Transmission line (4 Hours)

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.

Text/References:

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

ESC 301	Engineering Mechanics	3L:1T:0P	3 credits

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

- Understand the concepts of co-ordinate systems.
- Analyse the three-dimensional motion.
- Understand the concepts of rigid bodies.
- Analyse the free-body diagrams of different arrangements.
- Analyse torsional motion and bending moment.

Module 1: Introduction to vectors and tensors and co-ordinate systems (5 hours)

Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Module 2: Three-dimensional Rotation (4 hours)

Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectorsandtensors.

Module 3: Kinematics of Rigid Body (6 hours)

Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two-and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 4: Kinetics of Rigid Bodies (5 hours)

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass

moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module 5: Free Body Diagram (1 hour)

Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 6: General Motion (9 hours)

Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

Module 7: Bending Moment (5 hours)

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, shear force and bending moment diagrams.

Module 8: Torsional Motion (2 hours)

Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Module 9: Friction (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

110–Electrical&ElectronicsEngineering

SemesterIV[Secondyear]Branch/Course:Electrical&ElectronicsEngineering

sr. no.	CODE	CourseTitle	L	T	P	H	Credit
1		AnalogElectronics	3	0	0	3	3
2		AnalogElectronicsLaboratory	0	0	2	2	1
3		ElectricalMachines–II	3	0	0	3	3
4		ElectricalMachinesLaboratory-II	0	0	2	2	1
5		Microprocessors	3	0	0	3	3
6		DigitalElectronicsandMicroprocessorLaboratory	0	0	2	2	1
7		SignalsandSystems	2	1	0	3	3
8		Mathematics–III(ProbabilityandStatistics)	3	1	0	4	4
9		Biology-I	2	1	0	3	3
10		HSMCElectiveCourses	3	0	0	3	3
11		EnvironmentalScience	3	0	0	3	0
12		CapstoneDesignProject	3	0	0	3	0
13		NCC/NSS/ otherClubs&SocietyActivity/ Sports	3	0	0	3	0
			TOTAL				25

Electrical&ElectronicsEngineeringIVSemester

BranchCode–110

PCC-EEE06	**AnalogElectronicCircuits**	**3L:0T:0P**	**3credits**

CourseOutcomes:

Attheend ofthiscourse, studentswilldemonstratetheabilityto

- Understandthecharacteristicsoftransistors.
- Design andanalyze variousrectifierandamplifiercircuits.
- Designsinusoidalandnon-sinusoidaloscillators.
- UnderstandthefunctioningofOP-AMPanddesignOP-AMPbasedcircuits.

Module1:Diodecircuits(4Hours)

P-N junctiondiode,I-Vcharacteristicsofadiode;reviewofhalf-waveandfull-waverectifiers,Zenerdiodes,clampingand clippingcircuits.

Module 2:BJTcircuits (8Hours)

Structure and I-Vcharacteristics of a BJT;BJT as aswitch.BJT as an amplifier: small-signalmodel,biasingcircuits,currentmirror;common-emitter,common-baseandcommon-collectoramplifiers;Smallsignalequivalentcircuits,high-frequencyequivalentcircuits

Module3:MOSFETcircuits(8Hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasingcircuits, common-source, common-gate and common-drain amplifiers;small signal equivalent circuits - gain, input and output impedances, trans-conductance, highfrequencyequivalentcircuit.

Module4:Differential, multi-stageandoperationalamplifiers(8 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structureof an operationalamplifier,idealop-amp,non-idealitiesinanop-amp(Outputoffsetvoltage,inputbias current, input offset current, slew rate, gain bandwidth product), FrequencyResponseoftheamplifier.

Module5:Linearapplicationsofop-amp(8Hours)

Idealizedanalysisofop-ampcircuits.Invertinga n dnon-invertingamplifier,differentialamplifier, +instrumentationamplifier,integrator,active filter,P,PIandPIDcontrollersandlead/lagcompensator usinganop-amp,voltageregulator,Feedback amplifiers and Oscillatorsdesign(Weinbridgeandphaseshift).AnalogtoDigitalConversion.

Module6:Nonlinearapplicationsofop-amp(6Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators.Precisionrectifier,peakdetector.Monoshot.

Text/References:

1. A.S.SedraandK.C.Smith,"MicroelectronicCircuits",NewYork,OxfordUniversityPress,1998.
2. J.V.Wait,L.P.HuelsmanandG.A.Korn,"IntroductiontoOperationalAmplifiertheoryandapplications",McGrawHillU.S.,1992.
3. J.MillmanandA.Grabel,"Microelectronics",McGrawHillEducation,1988.
4. P.HorowitzandW.Hill,"TheArtofElectronics",CambridgeUniversityPress,1989.
5. P.R.Gray,R.G.MeyerandS.Lewis,"AnalysisandDesignofAnalogIntegratedCircuits",JohnWiley&Sons,2001.

PCC-EEE07:AnalogElectronicCircuitsLaboratory(0:0:2–1credit)

Hands-onexperimentsrelatedtothecoursecontentsofPCC-EEE06.

PCC-EEE08	ElectricalMachines–II	3L:0T:0P	3credits

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understandtheconceptsofrotatingmagneticfields.
- Understandtheoperation ofacmachines.
- Analyseperformancecharacteristics ofacmachines.

Module1:FundamentalsofACmachinewindings(8Hours)

Physicalarrangementofwindingsinstatorandcylindricalrotor;slotsforwindings;single-turncoil - active portion and overhang; full-pitch coils,concentrated winding,distributedwinding,windingaxis,3D visualization of the above winding types, Air-gap MMF distribution with fixed current throughwinding-concentratedanddistributed,Sinusoidallydistributedwinding,windingdistributionfactor

Module2:Pulsatingandrevolvingmagneticfields (4Hours)

Constantmagneticfield,pulsatingmagneticfield-alternatingcurrentin windingswithspatial displacement, Magnetic field produced by a single winding - fixed current and alternatingcurrent Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90degrees,Additionofpulsatingmagneticfields,Threewindingsspatiallyshiftedby120degrees(carryingthree-phasebalancedcurrents),revolvingmagneticfield.

Module3:InductionMachines(12Hours)

Construction,Types(squirrelcage andslip-ring), TorqueSlip Characteristics, Startingand Maximum Torque. Equivalentcircuit. PhasorDiagram, Losses and Efficiency. Effectofparameter variationontorquespeedcharacteristics(variationofrotorandstatorresistances,statorvoltage,frequency).Methodsofstarting,brakingandspeedcontrolforinductionmotors. Generatoroperation.Self-excitation.Doubly-FedInductionMachines.

Module4:Single-phaseinductionmotors(6Hours)

Constructionalfeatures,doublerevolvingfieldtheory,equivalentcircuit,determinationofparameters.Split-phasestartingmethodsandapplications

Module5:Synchronousmachines (10Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalentcircuit andphasordiagram,armaturereaction,synchronousimpedance,voltageregulation.Operating characteristicsofsynchronous machines, V-curves. Salientpole machine- tworeaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation ofalternators-synchronizationandloaddivision.

Text/References:

1. A.E.FitzgeraldandC.Kingsley,"ElectricMachinery",McGrawHillEducation,2013.
2. M. G. Say,"Performanceanddesignof AC machines",CBSPublishers,2002.
3. P.S.Bimbhra,"ElectricalMachinery",KhannaPublishers,2011.
4. I.J.NagrathandD.P.Kothari,"ElectricMachines",McGrawHillEducation,2010.
5. A.S.Langsdorf,"Alternatingcurrentmachines",McGrawHillEducation,1984.
6. P.C.Sen,"PrinciplesofElectricMachinesandPowerElectronics",JohnWiley&Sons, 2007.

PCC-EEE09:ElectricalMachinesLaboratory–II(0:0:2–1credit)

Hands-onexperimentsrelatedtothecoursecontentsofPCC-EEE08.

PCC-EEE10	Microprocessors	3L:0T:0P	3credits

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Doassemblylanguageprogramming.
- Dointerfacingdesignofperipheralslike I/O,A/D,D/A,timeretc.
- Developsystemsusingdifferentmicrocontrollers.

Module1:FundamentalsofMicroprocessors: (7 Hours) FundamentalsofMicroprocessorArchitecture.8-bitMicroprocessor and

Microcontrollerarchitecture,Comparisonof8-bitmicrocontrollers,16-bitand32-bitmicrocontrollers.
Definition of embedded system and its

characteristics,RoleofmicrocontrollersinembeddedSystems.Overviewofthe8051family.

Module2:The8051Architecture(8Hours)

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers,SFRs,ClockandRESETcircuits,StackandStackPointer, Program Counter, I/Oports, Memory Structures, Data and Program Memory, Timing diagrams and ExecutionCycles.

Module3:InstructionSetandProgramming(8Hours)

Addressingmodes:Introduction,Instructionsyntax,Datatypes,SubroutinesImmediateaddressing, Registeraddressing,Direct addressing,Indirect addressing,Relativeaddressing,Indexedaddressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings.Datatransfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutineinstructions,Bitmanipulationinstruction.
Assemblylanguageprograms,Clanguageprograms.Assemblersandcompilers.Programminganddebuggingtools.

Module4:MemoryandI/OInterfacing(6Hours):

Memoryand I/O expansion buses, control signals, memory wait states. Interfacingof peripheraldevicessuchasGeneralPurposeI/O, ADC,DAC,timers,counters,memorydevices.

Module5:ExternalCommunicationInterface(6Hours)

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacingtoprotocolslikeBlue-tooth andZig-bee.

Module6:Applications(6Hours)

LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensorinterfacing.

Text/References:

1. M.

   A.Mazidi,J.G.MazidiandR.D.McKinlay,“The8051MicrocontrollerandEmbeddedSystems:UsingAssemblyandC”,PearsonEducation,2007.
2. K.J.Ayala,“8051Microcontroller”,DelmarCengageLearning,2004.
3. R.Kamal,“EmbeddedSystem”,McGrawHillEducation,2009.
4. R.S.Gaonkar,“,MicroprocessorArchitecture:ProgrammingandApplicationswiththe8085”,PenramInternationalPublishing,1996
5. D.A.Patterson and J.H. Hennessy, "Computer Organization and Design:The Hardware/Softwareinterface”,MorganKaufmanPublishers,2013.
6. D.V. Hall, “Microprocessors&Interfacing”,McGrawHillHigherEducation,1991.

PCC-EEE11:Digital&MicroprocessorLaboratory(0:0:2–1credit)

Hands-onexperimentsrelatedtothecoursecontentsofPCC-EEE02&PCC-EEE10.

PCC-EEE12	**SignalsandSystems**	**2L:1T:0P**	**3credits**

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understandtheconceptsofcontinuoustime anddiscretetime systems.
- Analysesystemsincomplexfrequencydomain.
- Understandsamplingtheoremanditsimplications.

Module1:IntroductiontoSignalsandSystems(3hours):

Signals andsystems as seen in everyday life, and in various branches of engineeringandscience.Signalproperties:periodicity,absoluteintegrability,determinismandstochasticcharacter. Some special signals of importance: the unit step, the unit impulse, the sinusoid, thecomplex exponential, some special time-limited signals; continuous and discrete time signals,continuousanddiscreteamplitudesignals.Systemproperties:linearity:additivityandhomogeneity,shift-invariance,causality,stability,realizability.Examples.

Module2:Behaviorofcontinuousanddiscrete-timeLTIsystems(8hours)

Impulse responseandstepresponse,convolution,input-outputbehaviorwithaperiodicconvergent inputs,cascadeinterconnections.Characterizationofcausalityandstability of LTIsystems. System representation through differential equationsanddifferenceequations.State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation.StateTransitionMatrix and its Role. Periodic inputs to an LTI system, the notion of a frequencyresponseanditsrelationtotheimpulseresponse.

Module3:Fourier,Laplaceandz-Transforms(10hours)

Fourier seriesrepresentationofperiodicsignals,WaveformSymmetries,CalculationofFourierCoefficients.FourierTransform,convolution/multiplicationandtheireffectinthefrequencydomain, magnitudeandphaseresponse,Fourierdomainduality.TheDiscrete-TimeFourierTransform(DTFT)andtheDiscreteFourierTransform(DFT).Parseval'sTheorem.Reviewofthe Laplace Transform for continuous time signals and systems,system functions,polesand zeros of system functions and signals, Laplace domain analysis, solution to differentialequations and system behavior. The z-Transform for discrete time signals and systems, systemfunctions,polesandzerosofsystemsandsequences,z-domainanalysis.

Module4:SamplingandReconstruction(4 hours)

The Sampling Theorem and its implications.Spectra of sampled signals.Reconstruction:idealinterpolator,zero-orderhold,first-orderhold.Aliasinganditseffects.Relationbetweencontinuous and discrete time systems. Introduction to the applications of signal and systemtheory:modulationforcommunication,filtering,feedbackcontrolsystems.

Text/References:

1. A.V.Oppenheim,A.S.WillskyandS.H.Nawab,"Signalsandsystems",PrenticeHallIndia,1997.
2. J. G. Proakisand D. G. Manolakis, "DigitalSignalProcessing:Principles,Algorithms,andApplications",Pearson,2006.
3. H.P.Hsu,"Signalsandsystems",Schaum'sseries,McGrawHillEducation,2010.
4. S.HaykinandB.V.Veen,"SignalsandSystems",JohnWileyandSons,2007.
5. A.V.OppenheimandR.W.Schafer,"Discrete-TimeSignalProcessing",PrenticeHall,2009.
6. M.J.Robert"FundamentalsofSignalsandSystems",McGrawHill Education,2007.
7. B.P.Lathi,"LinearSystemsandSignals",OxfordUniversityPress,2009.

BSC401	**Mathematics-III(ProbabilityandStatistics)**	**3L:1T:0P**	**4credits**

Module1:BasicProbability(12hours)

Probabilityspaces,conditionalprobability,independence;Discreterandomvariables,Independent randomvariables,themultinomialdistribution,Poissonapproximationtothebinomialdistribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation ofDiscrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev'sInequality.

Module2:ContinuousProbabilityDistributions(4hours)

Continuousrandomvariablesandtheirproperties, distributionfunctionsanddensities,normal,exponentialandgammadensities.

Module3:BivariateDistributions (4 hours)

Bivariatedistributionsandtheirproperties,distributionofsumsandquotients,conditionaldensities ,Bayes'rule.

Module4:BasicStatistics(8hours)

MeasuresofCentraltendency:Moments,skewnessandKurtosis- Probabilitydistributions: Binomial,PoissonandNormal-
evaluationofstatisticalparametersforthesethreedistributions,Correlationandregression– Rankcorrelation.

Module 5:AppliedStatistics(8hours)

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolasand
moregeneralcurves.Testofsignificance:Largesampletestforsingleproportion,differenceofproportions,singlemean,differenceofmeans,anddifferenceofstandarddeviations.

Module6:Small samples(4hours)

Testforsinglemean,differenceofmeansandcorrelationcoefficients,testforratioofvariances-Chi-squaretestforgoodnessoffitandindependenceof attributes.

Text/References:

1. E.Kreyszig,"Advanced EngineeringMathematics",John Wiley&Sons,2006.
2. P.G.Hoel,S.C.PortandC.J.Stone,"IntroductiontoProbabilityTheory",UniversalBookStall,2003.
3. S.Ross,"AFirstCourseinProbability",PearsonEducationIndia,2002.
4. W.Feller,"AnIntroductiontoProbabilityTheoryanditsApplications",Vol.1,Wiley,1968.
5. N.P.BaliandM.Goyal,"AtextbookofEngineeringMathematics",LaxmiPublications, 2010.
6. B.S.Grewal,"HigherEngineeringMathematics",KhannaPublishers,2000.
7. T.Veerarajan,"EngineeringMathematics",TataMcGraw-Hill,NewDelhi,2010.

	Biology-I	**2L:1T:0P**	**3credits**

Module1:Introduction(2hours)

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics
andChemistry.Bringoutthefundamentaldifferencesbetweenscienceandengineeringbydrawinga
comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect ofbiology asanindependentscientificdiscipline. Whywe needtostudybiology? Discusshowbiological observations of 18^{th}Century that lead to major discoveries.ExamplesfromBrownianmotionandtheoriginofthermodynamics
byreferringtotheoriginalobservationofRobertBrown
andJuliusMayor.Theseexampleswillhighlightthefundamentalimportanceofobservationsin anyscientificinquiry.

Module2:Classification(3hours)

Purpose: To convey that classification *per se* is not what biology is all about. The underlyingcriterion,such as morphological,biochemical orecological behighlighted. Hierarchy of lifeformsat phenomenologicallevel.Acommonthreadweaves this hierarchy Classification.Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure-prokaryotesoreucaryotes.(c)energyandCarbonutilization-Autotrophs,heterotrophs,lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic orterrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can comeunder different category based onclassification.Model organisms forthestudyof biologycome from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M.musculus

Module3:Genetics(4hours)

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences".Mendel'slaws,Conceptofsegregationandindependentassortment.Conceptofallele.

Gene mapping, Gene interaction, Epistasis. Meiosis andMitosis be taught as a part of genetics.Emphasis tobegivenottothemechanics of cell divisionnor thephasesbuthow geneticmaterialpassesfrom parent tooffspring.Conceptsofrecessivenessand dominance.Concept ofmappingofphenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept ofcomplementationusinghumangenetics.

Module4:Biomolecules(4hours)

Purpose:Toconveythatallformsoflifehasthesamebuildingblocksandyetthemanifestationsare asdiverseasonecan imagine.Moleculesoflife.Inthiscontext discussmonomericunitsand polymeric structures. Discuss about sugars, starch and cellulose.Amino acids and proteins.NucleotidesandDNA/RNA.Twocarbonunitsandlipids.

Module5:Enzymes(4 Hours)

Purpose:Toconveythatwithoutcatalysislifewouldnothaveexistedonearth.

Enzymology:

Howtomonitorenzymecatalysedreactions.Howdoesanenzymecatalysereactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples.Enzymekineticsandkineticparameters.Whyshouldweknowtheseparameterstounderstandbiology?RNAcatalysis.

Module6:InformationTransfer(4hours)

Purpose:Themolecularbasisofcodinganddecodinggeneticinformationisuniversal.Molecular basis of informationtransfer. DNAas a genetic material. HierarchyofDNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality anddegeneracyofgeneticcode.Definegeneintermsofcomplementationandrecombination.

Module7:Macromolecularanalysis(5hours)

Purpose:Toanalysebiologicalprocessesatthereductionisticlevel.Proteins-structureandfunction.Hierarchinproteinstructure.Primary secondary, tertiaryandquaternarystructure.Proteinsasenzymes,transporters,receptorsandstructuralelements.

Module8:Metabolism(4hours)

Purpose: The fundamental principles of energy transactions are thesameinphysical andbiological world. Thermodynamics as applied to biological systems. Exothermic and endothermicversus endergonicandexergonicreactions.Concept ofK_{eq} and itsrelationto

standardfree energy.Spontaneity.ATPasanenergycurrency.ThisshouldincludethebreakdownofglucosetoCO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 andH2O(Photosynthesis).Energyyieldingandenergyconsumingreactions.ConceptofEnergy charge.

Module9.Microbiology(3 hours)

Conceptofsinglecelledorganisms.Conceptofspeciesandstrains.Identificationandclassification of microorganisms. Microscopy. Ecologicalaspects of single celled organisms.Sterilizationandmediacompositions.Growthkinetics.

Text/References:

1. N.A.Campbell,J.B.Reece,L.Urry,M.L.CainandS.A.Wasserman,"Biology:Aglobalapproach",PearsonEducationLtd,2014.
2. E.E.Conn,P.K.Stumpf,G.BrueningandR.H.Doi,"OutlinesofBiochemistry",JohnWileyandSons,2009.
3. D.L.NelsonandM.M.Cox,"PrinciplesofBiochemistry",W.H.FreemanandCompany, 2012.
4. G.S.StentandR.Calendar,"MolecularGenetics",Freemanandcompany,1978.
5. L.M.Prescott,J.P.HarleyandC.A.Klein,"Microbiology",McGrawHillHigherEducation,2005.

CourseOutcomes

Afterstudyingthecourse,thestudentwillbeableto:

- Describe how biologicalobservationsof18thCenturythatleadtomajordiscoveries.
- Conveythatclassification*per se*isnotwhatbiologyisallaboutbuthighlighttheunderlyingcriteria,suchasmorphological,biochemicalandecological
- Highlighttheconceptsofrecessivenessanddominanceduringthepassageofgeneticmaterialfromparenttooffspring
- Conveythatallformsoflifehavethesamebuildingblocksandyetthemanifestationsareasdiverseasonecanimagine
- Classifyenzymesanddistinguishbetweendifferentmechanismsof enzymeaction.
- IdentifyDNAasageneticmaterialinthemolecularbasisofinformationtransfer.
- Analysebiologicalprocessesatthereductionisticlevel
- Applythermodynamicprinciplestobiologicalsystems.
- Identify andclassifymicroorganisms.

HSMEC703	**OrganizationalBehavior&IndustrialPsychology[14]**	**2L:0T:0P**	**2credits**

CourseOutcome:

At theendofthiscourse,students will demonstratetheabilityto

- Understanding of organisationalbehaviour and industrial psychology is a must for an engineersinceitdirectlyaffects the industryin the largersense.
- The functioning of an organisation right from the floor to the top management level has to beunderstood well from the OBIP perspective in order to make a positive contribution to the growthof the organisation.

ModuleI:Introduction 4Lectures

Conceptoforganization&organizational behaviour.

ModuleII:Personality 11Lectures

Meaning,concept,determinants,personalitytheories(psychoanalytictheory,traittheoryandself-theory)

(a) Perception:Meaning,concept,processofperception,significanceofperception.

(b) Leaning:meaning,concept,nature,componentoflearningprocess.

(c) Attitude:Meaning,concept,factorsinattitudeformation,methodoffindingemployee'sattitude.

(d) Value:Meaningandtypes,valueandattitude–similarityanddifference.

(e) Motivation:Meaning,theoriesofmotivation(Maslow'stheory&Herzberg'stheory),Hawthorneexperiment

ModuleIII:Group& Team 4Lectures

Group: Concept,importance,classificationofgroups,reasonforgroupformation,groupdynamics,group cohesiveness.

Team: Meaning,concept,types,creatinganeffectiveteamwork.

ModuleIV:Communication 8Lectures

(a) Concept,process,importance,barrier

(b) Organizationalconflict:Meaning,concept,types,stagesofconflict,resolutionofconflict.

(c) Power&Politics:Natureandconcept,ethicsofpowerandpolitics,typesofpower.

(d) Leadership:Concept,Qualitiesandfunctionsof aleader,approachestotheanalysisofleadership

ModuleV:ConceptofOrganizationtheory 8

LecturesConceptofOrganizationstructure,formsofOrganizationalStructure,ConceptofOrganizational culture.

ModuleVI:Genderattheworkplace 2Lectures

Womenattheworkplacerulesandregulations,hygieneandsafetyregulations,Problemsandsolutions.

ModuleVII:Organizationaleffectiveness 6Lectures

(a) Concept,approaches,criteriaofeffectiveness.

(b) OrganizationalChange:Meaning,factorsinorganizationalchange,processofplannedChange.

(c) Organizationaldevelopment:Concept,Needoforganizationaldevelopment,differencebetweenorganizationsdevelopment&managementdevelopment

Text/References:

- StephenP.Robbin&SeemaSanghi,'OrganizationalBehaviour',Pearson.
- L.M.Prasad,'Organizational Behaviour',S.Chand&so

SemesterV(Thirdyear]
Branch/CourseElectricalElectronics&Engineering

Sl. No.	Code	CourseTitle	Hoursper week			Credit
			L	T	P	
1		Analog&DigitalCommunicationSystem	3	0	2	4
2		CapstoneDesignProject	3	0	0	0
3		ConstitutionofIndia/EssenceofIndian KnowledgeTraditional	3	0	0	0
4		ControlSystems	3	0	2	4
5		MOOCs/SWAYAM/ NPTEL Courses-2	2	0	0	2
6		PowerElectronics	3	0	2	4
7		PowerSystems–I(ApparatusandModelling)	3	0	2	4
8		ProfessionalElectiveLaboratory-1	0	0	2	1
9		SummerEntrepreneurship-II	0	0	12	6

110– ElectricalElectronicsEngineering

VSemester

PCC-EEE13	PowerSystems-I	3L:0T:2P	4credits

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understandtheconceptsofpowersystems.
- Understandthevariouspowersystemcomponents.
- Evaluatefaultcurrentsfordifferenttypesoffaults.
- Understandthegenerationofover-voltagesandinsulationcoordination.
- Understandbasicprotectionschemes.
- Understand conceptsofHVDC powertransmissionand renewableenergygeneration.

Module1:BasicConcepts(4hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: BulkPower
GridsandMicro-grids.
Generation:ConventionalandRenewableEnergySources.Distributed Energy Resources.Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distributionvoltagelevelsandtopologies(meshedandradialsystems).SynchronousGridsandAsynchronous (DC) interconnections. Review ofThree-phase systems. Analysis ofsimple three-phasecircuits.PowerTransferinACcircuitsandReactivePower.

Module2: PowerSystemComponents(15hours)

OverheadTransmissionLinesandCables:ElectricalandMagneticFieldsaroundconductors,Corona.Parametersoflines and cables.Capacitanceand Inductance calculations forsimpleconfigurations.Travelling-waveEquations.SinusoidalSteadystaterepresentationofLines:Short,mediumandlonglines.PowerTransfer,VoltageprofileandReactivePower.
Characteristics of transmission lines.Surge Impedance Loading.Series and ShuntCompensationoftransmissionlines.

Transformers:Three-phaseconnectionsandPhase-shifts.Three-windingtransformers,auto-transformers,NeutralGroundingtransformers.Tap-Changingintransformers.
TransformerParameters.Singlephaseequivalentofthree-phasetransformers.

SynchronousMachines:Steady-stateperformancecharacteristics.Operationwhenconnected toinfinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform underbalancedterminalshortcircuitconditions–steadystate,transientandsub-transientequivalentcircuits.
Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unitcalculations.

Module3:Over-voltagesandInsulationRequirements(4hours)

Generation ofOver-voltages: Lightning and Switching Surges. Protection against Over-voltages,Insulation Coordination.Propagation of Surges. Voltages produced by traveling surges. BewleyDiagrams.

Module 4:FaultAnalysisandProtectionSystems(10hours)

Method of Symmetrical Components (positive,negativeand zerosequences).BalancedandUnbalancedFaults.Representationofgenerators, linesandtransformers insequence networks.ComputationofFaultCurrents.NeutralGrounding.

Switchgear: Types of CircuitBreakers.Attributes of Protection schemes, Back-up Protection.Protection schemes (Over-current, directional, distance protection, differential protection) andtheirapplication.

Module5:IntroductiontoDCTransmission&RenewableEnergySystems(9hours)

DCTransmissionSystems:Line-CommutatedConverters(LCC)andVoltageSourceConverters(VSC).LCCandVSCbaseddclink, RealPowerFlowcontrolinadclink.

Comparisonofacanddc

transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronicinterface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed andvariable speed turbines. Permanent Magnetic Synchronous Generators and Induction Generators.PowerElectronicsinterfacesofwindgeneratorstothegrid.

Text/References:

1. J.GraingerandW.D.Stevenson,"PowerSystemAnalysis",McGrawHillEducation,1994.
2. O.I.Elgerd,"ElectricEnergySystemsTheory",McGrawHillEducation,1995.
3. A.R.BergenandV.Vittal,"PowerSystemAnalysis",PearsonEducationInc.,1999.
4. D.P.KothariandI.J.Nagrath,"ModernPowerSystemAnalysis",McGrawHillEducation,2003.
5. B.M.Weedy,B.J.Cory,N.Jenkins,J.EkanayakeandG.Strbac,"ElectricPowerSystems", Wiley,2012.

PCC-EEE14:PowerSystems–ILaboratory(0:0:2–1credit)

Hands-on experiments related to the course contents ofPCC-EEE13. Visits topower systeminstallations (generation stations, EHV substations etc.) are suggested. Exposure to fault analysis andElectro-magnetictransientprogram(EMTP)andNumericalRelaysaresuggested.

PCC-EEE15	ControlSystems	3L:0T:2P	4credits

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understandthemodellingoflinear-time-invariantsystemsusingtransferfunctionandstate-spacerepresentations.
- Understandtheconceptofstabilityanditsassessmentforlinear-timeinvariantsystems.
- Designsimplefeedbackcontrollers.

Module1:Introductiontocontrolproblem(4hours)

IndustrialControlexamples.Mathematicalmodelsofphysicalsystems.Controlhardwareandtheirmodels.Transferfunctionmodelsoflineartime-invariantsystems.
FeedbackControl:Open-LoopandClosed-loopsystems.BenefitsofFeedback.Blockdiagramalgebra.

Module2:TimeResponseAnalysis(10hours)

Standardtestsignals.Timeresponseoffirstandsecondordersystemsforstandardtestinputs.
Applicationofinitialandfinalvaluetheorem.Designspecificationsforsecond-ordersystemsbasedonthetime-response.
ConceptofStability.Routh-HurwitzCriteria.RelativeStabilityanalysis.Root-Locustechnique.ConstructionofRoot-loci.

Module3:Frequency-responseanalysis(6hours)

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

Module4:IntroductiontoControllerDesign(10hours)

Stability,steady-stateaccuracy,transientaccuracy,disturbancerejection,insensitivityandrobustnessofcontrolsystems.
Root-locimethodoffeedbackcontrollerdesign.
Designspecifications infrequency-domain.Frequency-domainmethodsofdesign.
ApplicationofProportional, IntegralandDerivativeControllers, LeadandLagcompensationindesigns.AnalogandDigitalimplementationofcontrollers.

Module5:StatevariableAnalysis(6hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution ofstateequations.EigenvaluesandStabilityAnalysis.Conceptofcontrollabilityandobservability.
Pole-placementbystatefeedback.
Discrete-timesystems.DifferenceEquations. State-spacemodelsoflineardiscrete-timesystems.
Stabilityoflineardiscrete-timesystems.

Module6:IntroductiontoOptimalControlandNonlinearControl(5hours)

Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic conceptsandanalysis.

Text/References:

1. M.Gopal,“ControlSystems:PrinciplesandDesign”,McGrawHillEducation,1997.
2. B.C.Kuo, “AutomaticControlSystem”,PrenticeHall,1995.

3. K.Ogata,“ModernControlEngineering”,PrenticeHall,1991.
4. I.J.NagrathandM.Gopal,“ControlSystemsEngineering”,NewAgeInternational,2009

PCC-EEE16:ControlSystemsLaboratory(0:0:2–1credit)

Hands-on/Computerexperimentsrelatedtothecoursecontentsof PCC-EEE15.

PCC-EEE17	PowerElectronics	3L:0T:2P	4credits

CourseOutcomes:

Attheendofthiscoursestudentswilldemonstratetheabilityto

- Understandthedifferencesbetweensignallevelandpowerleveldevices.
- Analysecontrolledrectifiercircuits.
- AnalysetheoperationofDC-DCchoppers.
- Analysetheoperationofvoltagesourceinverters.

Module1:Powerswitchingdevices(8Hours)

Diode,Thyristor,MOSFET,IGBT:I-VCharacteristics;Firingcircuitforthyristor;Voltageandcurrentcommutationof athyristor;GatedrivecircuitsforMOSFETandIGBT.

Module2:Thyristorrectifiers(7Hours)

Single-phasehalf-wave andfull-wave rectifiers,Single-phasefull-bridge thyristor rectifierwithR-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load andhighly inductiveload;Inputcurrentwaveshapeandpowerfactor.

Module3:DC-DCbuckconverter(5Hours)

Elementarychopperwithanactiveswitchanddiode,conceptsofdutyratioandaveragevoltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control ofoutputvoltage.

Module4:DC-DCboostconverter(5Hours)

Power circuit of aboost converter, analysis andwaveforms at steady state, relation betweendutyratioandaverageoutputvoltage.

Module5:Single-phasevoltagesourceinverter(10Hours)

Powercircuitofsingle-phasevoltagesourceinverter,switchstatesandinstantaneousoutputvoltage, square wave operation of the inverter, concept of average voltage over a switching cycle,bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and outputvoltage

Module6:Three-phasevoltagesourceinverter(8Hours)

Powercircuit ofathree-phase voltagesourceinverter, switchstates, instantaneousoutputvoltages,averageoutputvoltagesoverasub-cycle,three-phasesinusoidalmodulation

Module7:A.C.toA.C.Converter(8Hours)[14]

Classification, principle of operation of step up and step down cyclo-converter, single phase to singlephase cyclo-converter with resistive and inductive load, three phase to single phase cyclo-converter,half wave and full wave, cosine wave crossing technique. three phase to three phase cyclo-converter.outputvoltageequationofcyclo-converter.

Text/References:

1. M.H.Rashid,"Powerelectronics:circuits,devices,andapplications",PearsonEducationIndia ,2009.
2. N.Mohan and T.M. Undeland,"PowerElectronics: Converters,Applications and Design",JohnWiley&Sons,2007.
3. R.W.EricksonandD. Maksimovic, "FundamentalsofPowerElectronics", Springer

Science&BusinessMedia,2007.
4. L.Umanand,“PowerElectronics:EssentialsandApplications”,WileyIndia,2009.

PCC-EEE18:PowerElectronicsLaboratory(0:0:2–1credit)

Hands-onexperimentsrelatedtothecoursecontentsofPCC-EEE17.

PCC-EEE19	**Analog&DigitalCommunicationSystem[2]**	**3L:0T:2P**	**4credits**

CourseOutcome:

Attheend ofthiscourse,studentswilldemonstratetheabilityto

- Understandthebasicsofcommunicationsystem,analoganddigitalmodulationtechniques.
- Applytheknowledgeofdigitalelectronicsandunderstandtheerrorcontrolcodingtechniques.
- Summarizedifferenttypesofcommunicationsystemsanditsrequirements.

Module1:BasicblocksofCommunicationSystem.AnalogModulation-PrinciplesofAmplitudeModulation,DSBSC,SSB-SCandVSB-SC.AM transmittersand receivers.

Module2: AngleModulation-FrequencyandPhaseModulation.TransmissionBandwidthof FM signals,Methodsof generationand detection.FMTransmittersandReceivers.

Module3: Samplingtheorem-PulseModulationTechniques-PAM,PWMandPPMconcepts-PCM system –Datatransmissionusinganalogcarriers(ASK,FSK,BPSK,QPSK).

Module4: Errorcontrolcodingtechniques–Linearblockcodes-Encoderanddecoder.Cycliccodes–Encoder,SyndromeCalculator.Convolutioncodes.

Module5: ModernCommunicationSystems–Microwavecommunicationsystems-Opticalcommunicationsystem-Satellitecommunicationsystem-Mobilecommunicationsystem.

Text/References:

1. SimonHaykins,‘CommunicationSystems’,JohnWiley,3rdEdition,1995.
2. D.Roddy&J.Coolen,‘ElectronicCommunications’,PrenticeHallofIndia,4thEdition,1999.
3. KennedyG,‘ElectronicCommunicationSystem’,McGrawHill,1987.

PCC-EEE20:Analog&DigitalCommunicationSystemLaboratory(0:0:2–1credit)

Hands-on/ComputerexperimentsrelatedtothecoursecontentsofPCC-EEE19.

MC 501	**Constitution of India – Basicfeatures and fundamentalprinciples**	**3L :0T:0P**	**0Credits** **(Mandatory non-creditcourse)**

The Constitution of India is the supreme law of India. Parliament of India cannot makeany lawwhichviolatestheFundamentalRightsenumeratedunderthePartIIIoftheConstitution.The ParliamentofIndiahasbeenempoweredtoamendtheConstitution under Article368,however,itcannotusethispowertochangethe"basicstructure"ofthe constitution,whichhasbeenruledandexplainedbytheSupremeCourtofIndiainits historical judgments. The Constitution of India reflectstheideaof"Constitutionalism"– amodernandprogressiveconcepthistoricallydeveloped by the thinkers of "liberalism" – an ideology which has been recognized asoneofthemostpopularpoliticalideologyandresultofhistoricalstrugglesagainstarbitrary use of sovereign power by state.The historic revolutions in France, England,America and particularly European Renaissance andReformationmovementhaveresultedintoprogressivelegalreformsintheformof "constitutionalism"inmanycountries.The Constitution of India was made by borrowing models and principles frommanycountriesincluding United KingdomandAmerica.

TheConstitutionofIndiaisnotonlya legal documentbutit alsoreflectssocial,political and economic perspectivesoftheIndianSociety. It reflects India's legacy of"diversity".IthasbeensaidthatIndianconstitutionreflectsidealsofitsfreedommovement, however, few criticshavearguedthatitdoesnottrulyincorporateourownancientlegalheritageand cultural values. No law can be "static" and thereforethe Constitution of India has also been amended more than one hundred times.Theseamendmentsreflectpolitical,socialand economicdevelopmentssincetheyear1950.The Indian judiciary and particularly the Supreme Court of India has played anhistoric role as the guardian of people. It has been protecting not only basic ideals of theConstitution but also strengthened the same through progressive interpretations of thetext of the Constitution. The judicial activism of the Supreme Court of India and itshistoriccontributionshasbeenrecognizedthroughouttheworldanditgraduallymadeit "asoneof thestrongestcourtintheworld".

Coursecontent:

1. Meaningoftheconstitutionlawandconstitutionalism
2. HistoricalperspectiveoftheConstitutionofIndia
3. SalientfeaturesandcharacteristicsoftheConstitutionofIndia
4. Schemeofthefundamentalrights
5. TheschemeoftheFundamentalDutiesanditslegalstatus

6. TheDirectivePrinciplesof StatePolicy –Itsimportanceandimplementation
7. FederalstructureanddistributionoflegislativeandfinancialpowersbetweentheUnionan dtheStates
8. ParliamentaryFormofGovernmentinIndia– Theconstitutionpowersandstatusofthe PresidentofIndia
9. AmendmentoftheConstitutionalPowersandProcedure
10. Thehistoricalperspectivesoftheconstitutionalamendmentsin India
11. EmergencyProvisions:NationalEmergency,PresidentRule,FinancialEmergency
12. LocalSelfGovernment–ConstitutionalSchemeinIndia
13. SchemeoftheFundamentalRighttoEquality
14. SchemeoftheFundamentalRighttocertainFreedomunderArticle19
15. ScopeoftheRighttoLifeandPersonalLibertyunder Article21.

Semester VI (Third year]
Branch/CourseElectricalElectronicsEngineering

Course Code	Paper Title	L	T	P	Credits	branch
	DigitalSignal Processing	3	0	2	4	110
	ElectronicsDesignLaboratory	1	0	4	3	110
	GraduateEmployabilitySkillsandCompetitiveCourses(GATE,IES, etc.)	3	0	0	0	110
	IntroductiontoVLSIDesign	3	0	2	4	110
	MeasurementsandInstrumentation	3	0	2	4	110
	ProfessionalSkillDevelopment	3	0	0	3	110
	ProgramElective-I	3	0	0	3	110

Semester VI (Third year]
Branch/CourseElectricalElectronicsEngineering

PEC-EEE23	DigitalSignalProcessing	3L:0T:0P	3credits

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Representsignalsmathematicallyincontinuousanddiscrete-time,andinthefrequencydomain.
- Analysediscrete-timesystemsusingz-transform.
- UnderstandtheDiscrete-FourierTransform(DFT)andtheFFTalgorithms.
- Designdigitalfilters forvariousapplications.
- Applydigitalsignalprocessingfortheanalysisofreal-lifesignals.

Module1:Discrete-timesignalsandsystems(6hours)

Discretetimesignalsandsystems:Sequences;representationofsignalsonorthogonalbasis; Representationofdiscretesystemsusingdifferenceequations,Samplingandreconstructionofsignals -aliasing;SamplingtheoremandNyquistrate.

Module2:Z-transform(6hours)

z- Transform,RegionofConvergence,AnalysisofLinearShiftInvariantsystemsusingz-transform, Propertiesofz-transformforcausalsignals,Interpretationofstabilityinz-domain,Inversez- transforms.

Module2:DiscreteFourierTransform(10hours)

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

Module3:DesignofDigitalfilters(12hours)

Designof FIR Digital filters: Window method,Park-McClellan's method. Design of IIR Digital Filters: Butterworth,Chebyshev and EllipticApproximations;Low-pass,Band-pass,Band-stop and Highpassfilters.

Effectof finite register length in FIRfilterdesign.Parametric andnon-parametric spectral

estimation.Introductiontomulti-ratesignal processing.

Module4:ApplicationsofDigitalSignalProcessing(6hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model,LinearMean-SquareEstimation,WienerFilter.

Text/ReferenceBooks:

1. S.K.Mitra,"DigitalSignalProcessing:Acomputer basedapproach",McGrawHill, 2011.
2. A.V.OppenheimandR.W.Schafer,"DiscreteTimeSignalProcessing",PrenticeHall,1989.
3. J.G.ProakisandD.G.Manolakis,"DigitalSignalProcessing:Principles,AlgorithmsAndApplications", Prentice Hall, 1997.
4. L.R.RabinerandB.Gold,"TheoryandApplicationofDigitalSignalProcessing",PrenticeHall, 1992.
5. J.R.Johnson,"IntroductiontoDigitalSignalProcessing",PrenticeHall,1992.
6. D. J. DeFatta, J. G.LucasandW. S. Hodgkiss, "DigitalSignalProcessing", John Wiley& Sons, 1988.

PCC-EEE24:DigitalSignalProcessingLaboratory(0:0:2–1credit)

Hands-on/ComputerexperimentsrelatedtothecoursecontentsofPCC-EEE23.

PCC-EEE25	**MeasurementsandInstrumentation**	**3L:0T:0P**	**3credits**

CourseOutcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- DesignandvalidateDCandACbridges.
- Analyzethedynamicresponseandthecalibrationoffewinstruments.
- Learnaboutvariousmeasurementdevices,theircharacteristics,theiroperationandtheirlimitations.
- Understandstatisticaldataanalysis.
- Understandcomputerizeddataacquisition.

Lectures/Demonstrations:

1. ConceptsrelatingtoMeasurements:Truevalue,Accuracy,Precision,Resolution,Drift, Hysteresis,Dead-band,Sensitivity.
2. Errors in Measurements. Basic statistical analysisapplied tomeasurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. SensorsandTransducersforphysicalparameters:temperature,pressure,torque,flow.Speed andPositionSensors.
4. CurrentandVoltageMeasurements.Shunts,PotentialDividers.InstrumentTransformers, Hall Sensors.
5. MeasurementsofR, LandC.
6. DigitalMulti-meter,TrueRMS meters,Clamp-onmeters,Meggers,
7. DigitalStorageOscilloscope.
8. Basic components of bio-medical instruments, bio-electric signals & recording electrodes, transducers, recording and display devices. Patient care and monitoring systems, cardiovascular measurements-blood pressure, blood flow, cardiac output, heart sounds etc.; instrumentation for respiratory and nervous systems, analysis of EEG, ECG, EMG, EOG and

action potentials, non- invasive diagnostic measurements - temperature, ultrasonic diagnosis, CAT scan techniques, sensory measurements-motor response.

PCC-EEE26:MeasurementsandInstrumentationLaboratory(0:0:2–1credit)
ListofExperiments

1. Measurementofabatchofresistorsandestimatingstatisticalparameters.
2. MeasurementofLusingabridgetechniqueaswellasLCRmeter.
3. MeasurementofCusingabridgetechniqueaswellasLCRmeter.
4. MeasurementofLowResistanceusingKelvin'sdoublebridge.
5. MeasurementofHighresistanceandInsulationresistanceusingMegger.
6. UsageofDSOforsteadystateperiodicwaveformsproducedbyafunctiongenerator.
    a. Selectionoftriggersourceandtriggerlevel,selectionoftime-scaleandvoltage scale.
    b. Bandwidthofmeasurementandsamplingrate.
7. Downloadofone-cycledataofaperiodicwaveformfromaDSOand use valuesto computethe RMS values using a C program.
8. UsageofDSOtocapturetransientslikeastep changeinR-L-Ccircuit.
9. CurrentMeasurementusingShunt,CT,andHallSensor.

PCC-EEE27	ElectronicsDesignLaboratory	1L:0T:4P	3credits

Course Outcomes :

Attheendofthecourse,studentswilldemonstratetheabilityto

- Understandthepracticalissuesrelatedtopracticalimplementationofapplicationsusing electroniccircuits.
- Chooseappropriatecomponents,softwareandhardwareplatforms.
- DesignaPrintedCircuitBoard,getitmadeandpopulate/solderitwithcomponents.
- Workasateamwithotherstudentstoimplementanapplication.

Basicconceptsonmeasurements; Noisein electronic systems; Sensors andsignalconditioningcircuits; IntroductiontoelectronicinstrumentationandPCbaseddataacquisition;Electronicsystemdesign, Analogsystemdesign,Interfacingofanaloganddigitalsystems,Embeddedsystems,Electronicsystem design employing microcontrollers, CPLDs, and FPGAs, PCB design and layout; System assembly considerations.Groupprojectsinvolvingelectronichardware(Analog,Digital,mixedsignal)leadingto implementationof anapplication.

Text/ReferenceBooks

1. A.S.SedraandK.C.Smith,"Microelectroniccircuits",OxfordUniversityPress,2007.
2. P.HorowitzandW.Hill,"TheArtofElectronics",CambridgeUniversity Press,1997.
3. H.W.Ott,"NoiseReduction TechniquesinElectronicSystems",Wiley,1989.
4. W.C.Bosshart,"PrintedCircuitBoards:DesignandTechnology",TataMcGrawHill,1983.
5. G.L.Ginsberg,"PrintedCircuitDesign",McGrawHill,1991.

EC15	ComputerArchitecture	3L:0T:0P	3credits

BasicStructureofComputers,Functional units, software,performanceissues software,machine instructions andprograms,Typesof instructions,Instructionsets:Instructionformats,Assembly language,Stacks,Ques,Subroutines.

Processororganization,Informationrepresentation,numberformats.

Multiplication&division,ALUdesign,FloatingPointarithmetic,IEEE754floatingpointformats ControlDesign,Instructionsequencing,Interpretation, Hardwiredcontrol-Designmethods, and CPUcontrolunit.MicroprogrammedControl -Basicconcepts,minimizingmicroinstructionsize, multipliercontrolunit.Microprogrammedcomputers-CPU controlunit

Memoryorganization,devicecharacteristics,RAM,ROM, Memorymanagement,ConceptofCache &associativememories,Virtualmemory.
Systemorganization,Input-Outputsystems,Interrupt,DMA,StandardI/Ointerfaces

Conceptofparallelprocessing,Pipelining,Formsofparallelprocessing,interconnectnetwork

Text/Reference Books:

1. V.CarlHammacher,"Computer Organisation",FifthEdition.
2. A.S.Tanenbum,"StructuredComputerOrganisation",PHI,Thirdedition
3. Y.Chu,"Computer Organizationand Microprogramming",II,EnglewoodChiffs, N.J.,PrenticeHallEdition
4. M.M.Mano,"Computer SystemArchitecture",Edition
5. C.W.Gear, "ComputerOrganizationandProgramming",McGrawHill, N.V. Edition
6. HayesJ.P,"Computer ArchitectureandOrganization",PHI,Secondedition

Course Outcomes

Attheendofthiscoursestudentswilldemonstratetheabilityto
1. learnhowcomputerswork
2. knowbasicprinciplesofcomputer'sworking
3. analyzetheperformance ofcomputers
4. knowhowcomputersaredesignedandbuilt
5. Understandissuesaffectingmodernprocessors(caches,pipelinesetc.).

PEC-EE13	DigitalControlSystems	3L:0T:0P	3credits

Course Outcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto
- ObtaindiscreterepresentationofLTIsystems.
- Analysestabilityofopenloopandclosedloopdiscrete-timesystems.
- Designandanalysedigitalcontrollers.
- Designstatefeedbackandoutputfeedbackcontrollers.

Module1:Discrete RepresentationofContinuousSystems(6 hours)

BasicsofDigitalControlSystems.Discreterepresentationofcontinuoussystems.
Sampleandholdcircuit.MathematicalModellingofsampleandholdcircuit.EffectsofSamplingandQuantization.
Choiceofsamplingfrequency. ZOHequivalent.

Module2:Discrete SystemAnalysis(6 hours)

Z-TransformandInverseZ Transformforanalyzingdiscretetimesystems.PulseTransferfunction.
Pulsetransferfunctionofclosedloopsystems.Mappingfroms-planetozplane.SolutionofDiscrete

timesystems.Timeresponseofdiscretetimesystem.

Module 3:Stability ofDiscreteTimeSystem(4 hours)

StabilityanalysisbyJurytest.Stabilityanalysis usingbilineartransformation.Designofdigitalcontrolsystemwithdeadbeatresponse.Practicalissueswithdeadbeatresponsedesign.

Module 4:StateSpaceApproachfordiscrete timesystems(10 hours)

Statespacemodels ofdiscretesystems,Statespaceanalysis.LyapunovStability.Controllability,reach-ability, Reconstructibilityandobservabilityanalysis.Effect ofpolezerocancellationonthe controllability&observability.

Module5:DesignofDigitalControlSystem(8hours)

DesignofDiscretePIDController,Designofdiscretestatefeedbackcontroller.Designofsetpoint tracker.DesignofDiscreteObserverforLTISystem. DesignofDiscretecompensator.

Module6:Discrete outputfeedbackcontrol(8hours)

Design of discreteoutputfeedback control. Fast outputsampling(FOS)and periodicoutput feedbackcontrollerdesignfordiscretetimesystems.

TextBooks:

1. K.Ogata,"DigitalControlEngineering",PrenticeHall,EnglewoodCliffs,1995.
2. M.Gopal,"DigitalControlEngineering",WileyEastern,1988.
3. G. F. Franklin, J. D. PowellandM. L.Workman, "DigitalControlofDynamicSystems", Addison-Wesley,1998.
4. B.C. Kuo,"DigitalControlSystem",Holt,RinehartandWinston,1980.

PCC-EEE21 Introduction to VLSI Design 3L:0T:0P 3 credits

Course Outcomes:

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

1. Understand the mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnect. .
2. Understand the CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects
3. Understand the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI).

Module 1: Introduction MOSFET, threshold voltage, current, Channel length modulation, body bias effect and short channel effects, MOS switch, MOSFET capacitances, MOSFET models for calculation- Transistors and Layout, CMOS layout elements, parasitics, wires and vias-design rules-layout design SPICE simulation of MOSFET I-V characteristics and parameter extraction (10 hours)

Module 2: CMOS inverter, static characteristics, noise margin, effect of process variation, supply scaling, dynamic characteristics, inverter design for a given VTC and speed, effect of input rise time and fall time, static and dynamic power dissipation, energy & power delay product, sizing chain of inverters, latch up effect-Simulation of static and dynamic characteristics, layout, post layout simulation (10 hours)

Module 3: Static CMOS design, Complementary CMOS, static properties, propagation delay, Elmore delay model, power consumption, low power design techniques, logical effort for transistor sizing, ratioed logic, pseudo NMOS inverter, DCVSL, PTL, DPTL & Transmission gate logic, dynamic CMOS design, speed and power considerations, Domino logic and its derivatives, C2MOS, TSPC registers, NORA CMOS – Course project (10 hours)

Module 4: Circuit design considerations of Arithmetic circuits, shifter, CMOS memory design - SRAM and DRAM, BiCMOS logic - static and dynamic behaviour -Delay and power consumption in BiCMOS Logic. (10 hours)

Text / References:

1. David A. Hodges, Horace G. Jackson, and Resve A. Saleh, "Analysis and Design of Digital Integrated Circuits", McGraw-Hill, Third edition, 2004..
2. R. J. Baker, H. W. Li, and D. E. Boyce, "MOS circuit design, layout, and simulation", Wiley-IEEE Press, 2007.

3. Sung-Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits - Analysis & Design", Tata McGraw Hill, Third edition, 2003.
4. Wayne Wolf, "Modern VLSI design", Pearson Education, 2003
5. Christopher Saint and Judy Saint, "IC layout basics: A practical guide", Tata McGraw Hill Professional, 2001.

PCC-EEE22: Introduction to VLSI Design Laboratory (0:0:2 – 1 credit)

Hands-on/Computer experiments related to the course contents of PCC-EEE21

HSMC 501	**Professional Skill Development**	**3L:0T: 0P**	**3 credits**
Pre-requisites	HSMC 301		

Objectives of the course:

1. To learn various interpersonal skills
2. To help in developing various professionals skills.
3. To cover the facets of verbal and non-verbal languages, public speech, reading gestures and body languages, preparing for group discussion and enhancing presentations skills.
4. To enable learners to speak fluently and flawlessly in all kinds of communicative Contexts with speakers of all nationalities.

Detail contents:

Module 1 **Lecture 10 hrs.**

Communication skills: Public speaking, Group discussion, Gestures and body language & professional presentation skills

Module 2 **Lecture 10 hrs.**

Interpersonal skills: Group dynamics, Negotiation skills, Leadership, Emotional intelligence

Module 3 **Lecture 10 hrs.**

Employability and Corporate Skills: Time management and effective planning, Stress management, People skills, Team work, development of leadership qualities, Decision making and Negotiation skills, Positive attitude, Self-motivation, Professional ethics, Business etiquettes, balancing board room.

Module 4 **Lecture 10 hrs.**

Business writing skills, Resume Writing. Interview Skills, Technical Presentation, Guest Lecture, Professional Ethics, Project Management, Entrepreneurship.

Suggested reference books:

1. "Personality Development and Soft Skills", BarunMitra, Oxford University Press.
2. "Managing Soft Skills for Personality Development", B.N. Ghosh, McGraw Hill.
3. "Communication Skills and Soft Skills: An Integrated Approach", E. Suresh Kumar, Pearson
4. "Communication to Win", Richard Denny, Kogan Page India Pvt. Ltd.

Course outcomes

1. Student can able to write their resume and can prepare for presentation, group discussion and interview.
2. Student can develop interpersonal skills like negotiation and leadership skills.
3. Students can develop Employability and Corporate Skills with proper time management and stress management.

Students learn to practice the professional ethics, project management and Entrepreneurship.

PEC-EE19	Advanced Electric Drives	3L:0T:0P	3 credits

Course Outcomes:

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

- Understand the operation of power electronic converters and their control strategies.
- Understand the vector control strategies for ac motor drives
- Understand the implementation of the control strategies using digital signal processors.

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

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

Module 2: Induction motor drives (10 hours)

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

Module 3: Synchronous motor drives (6 hours)

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

Module 4: Permanent magnet motor drives (6 hours)

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

Module 5: Switched reluctance motor drives (6 hours)

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

Module 6: DSP based motion control (6 hours)

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

Text / References:

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

PEC-EE17	Computational Electromagnetics	3L:0T:0P	3 credits

Course Outcomes:

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

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

Module 1: Introduction (6 hours)

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

Module 2: Analytical Methods (6 hours)

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

Module 3: Finite Difference Method (FDM) (7 hours)

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

Module 4: Finite Element Method (FEM) (7 hours)

Overview of FEM, Variational and Galerkin Methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Module 5: Special Topics (7 hours)

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

Module 6: Applications (7 hours)

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

Text/Reference Books

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

PEC-EE03	Electrical Drives	3L:0T:0P	3 credits

Course Outcomes:

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

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

Module 1: DC motor characteristics (5 hours)

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

Module 2: Chopper fed DC drive (5 hours)

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

Module 3: Multi-quadrant DC drive (6 hours)
Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive, regenerative braking.

Module 4: Closed-loop control of DC Drive (6 hours)
Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Module 5: Induction motor characteristics (6 hours)
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.

Module 6: Scalar control or constant V/f control of induction motor (6 hours)
Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Module 7: Control of slip ring induction motor (6 hours)
Impact of rotor resistance of the induction motor torque-speed curve, operation of slip-ring induction motor with external rotor resistance, starting torque, power electronic based rotor side control of slip ring motor, slip power recovery.

Text / References:

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

PEC-EE09	**Electrical Energy Conservation and Auditing**	**3L:0T:0P**	**3 credits**

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

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

Module 1: Energy Scenario (6 Hours)
Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module 2: Basics of Energy and its various forms (7 Hours)
Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat

capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Module 3: Energy Management & Audit (6 Hours)

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.

Module 4: Energy Efficiency in Electrical Systems (7Hours)

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

Module 5: Energy Efficiency in Industrial Systems (8 Hours)

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

Module 6: Energy Efficient Technologies in Electrical Systems (8Hours)

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.

Text/Reference Books

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

PEC-EE05	Electrical Machine Design	3L:0T:0P	3 credits

Course Outcomes:

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

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

- Use software tools to do design calculations.

Module 1: Introduction

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

Module 2: 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.

Module 3: 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.

Module 4: Synchronous Machines

Sizing of asynchronous 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.

Module 5: 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 **c**omplex structures of modern machines- PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

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

Semester VII (Fourth Year]
Branch/Course ELECTRICAL ELECTRONICS ENGINEERING

Course Code	Course Title	L	T	P	Credits	Branch			
1107xx	Open Elective- I	3	0	0	3	110	TH	70	30
1107xx	Open Elective- II	3	0	0	3	110	TH	70	30
1107xx	Program Elective - III	3	0	0	3	110	TH	70	30
1107xx	Program Elective- IV	3	0	0	3	110	TH	70	30
100709	Project-I	0	0	12	6	110	PR	30	20
100706	Seminar	0	0	2	1	110	PR	30	20
100702	Summer Entrepreneurship-III	0	0	16	8	110	PR	30	20

100704	**Electromagnetic waves**	**3L:0T:0P**	**3 credits**

Course Outcomes:

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

- Analyse transmission lines and estimate voltage and current at any point on transmission line for different loadconditions.
- Provide solution to real life plane wave problems for various boundaryconditions.
- Analyse the field equations for the wave propagation in special cases such as lossy and low loss dielectricmedia.
- Visualize TE and TM mode patterns of field distributions in a rectangularwave-guide.
- Understand and analyse radiation byantennas.

Module 1: Transmission Lines (6 hours)

Introduction, Concept of distributed elements, Equations of voltage andcurrent, Standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on atransmission 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 transmissionlines.

Module 2: Maxwell's Equations (6 hours)

BasicquantitiesofElectromagnetics,BasiclawsofElectromagnetics:Gauss'slaw,Ampere'sCircuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at mediainterface.

Module 3: Uniform Plane Wave (7 hours)
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.

Module 4: Plane Waves at Media Interface (7 hours)
Planewaveinarbitrarydirection,Planewaveatdielectricinterface,Reflectionandrefractionofwaves 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.

Module 5: Waveguides (7 hours)
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.

Module 6: Antennas (7 hours)
Radiationparametersofantenna,Potentialfunctions,Solutionforpotentialfunctions,Radiationsfrom Hertzdipole,Nearfield,Farfield,Totalpowerradiatedbyadipole,Radiationresistanceandradiation pattern of Hertz dipole, Hertz dipole in receivingmode.

Text/Reference Books

1. R. K. Shevgaonkar, **"**Electromagnetic Waves**"**, Tata McGraw Hill,2005.
2. D. K. Cheng, "Field and Wave Electromagnetics**"**, Addison-Wesley,1989.
3. M. N.O. Sadiku, "Elements of Electromagnetics**"**, Oxford University Press,2007.
4. C. A. Balanis, "Advanced Engineering Electromagnetics", John Wiley & Sons,2012.
5. C. A. Balanis, "Antenna Theory: Analysis and Design**"**, John Wiley & Sons,2005.

110703	**High Voltage Engineering**	**3L:0T:0P**	**3 credits**

Course outcomes:

At the end of the course, the student will demonstrate

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

Module 1: Breakdown in Gases (8 Hours)
Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Module 2: Breakdown in liquid and solid Insulating materials (7 Hours)
Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic

breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Module 3: Generation of High Voltages (7 Hours)

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

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

Peakvoltage,impulsevoltageandhighdirectcurrentmeasurementmethod, cathode erayoscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial dischargemeasurements.

Module 5: Lightning and Switching Over-Voltages (7 Hours)

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

Module 6: High Voltage Testing of Electrical Apparatus and High Voltage Laboratories (7 Hours)

Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulators and

bushings,testingofisolatorsandcircuitbreakers,testingofcables,powertransformersandsomehigh voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V.Labs.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, “High Voltage Engineering”, McGraw Hill Education,2013.
2. C. L. Wadhwa, “High Voltage Engineering”, New Age International Publishers,2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers,1993.
4. E. Kuffel, W. S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”,Newnes Publication,2000.
5. R. Arora and W. Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley& Sons,2011.
6. Various IS standards for HV Laboratory Techniques andTesting

110704	Industrial Electrical Systems	3L:0T:0P	3 credits

Course Outcomes:

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

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

Module 1: Electrical System Components (8 Hours)

LTsystemwiringcomponents,selectionofcables,wires,switches,distributionbox,meteringsystem, 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 safetypractices

Module 2: Residential and Commercial Electrical Systems (8 Hours)

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

Module 3: Illumination Systems (6 Hours)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy savinginilluminationsystems,designofalightingschemeforaresidentialandcommercialpremises, floodlighting.

Module 4: Industrial Electrical Systems I (8 Hours)

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

Module 5: Industrial Electrical Systems II (6 Hours)

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

Module 6: Industrial Electrical System Automation (6 Hours)

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

Text/Reference Books

1. S.L. Uppal and G.C. Garg, “Electrical Wiring, Estimating &Costing”, Khanna publishers,2008.

2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International,2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, DhanpatRai and Co.,1997.
4. Web site for ISStandards.
5. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education,2008.

110705	**Line Commutated and Active PWM Rectifiers**	**3L:0T:0P**	**3 credits**

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

- Analyse controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factormode.1

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

Half-wavedioderectifierwithRLandRCloads;1-phasefull-wavedioderectifierwithL,CandLCfilter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current wave shape, effect of source inductance; commutation overlap.

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

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

Module 3: Multi-Pulse converter (6 Hours)

Review of transformer phase shifting, generation of 6-phaseacvoltagefrom3-phaseac, 6-pulseconverter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

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

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

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

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

Module 6: Isolated single-phase ac-dc fly back converter (10 Hours)

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

Text/ References:

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

110707	Digital Control Systems	3L:0T:0P	3 credits

Course Outcomes:

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

- Obtain discrete representation of LTIsystems.
- Analyse stability of open loop and closed loop discrete-timesystems.
- Design and analyse digitalcontrollers.
- Design state feedback and output feedbackcontrollers.

Module 1: Discrete Representation of Continuous Systems (6 hours)

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

Module 2: Discrete System Analysis (6 hours)

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.

Module 3: Stability of Discrete Time System (4 hours)

StabilityanalysisbyJurytest.Stabilityanalysisusingbilineartransformation.Designofdigitalcontrol system with dead beat response. Practical issues with dead beat responsedesign.

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

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.

Module 5: Design of Digital Control System(8 hours)

Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

Module 6: Discrete output feedback control (8 hours)

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

Text Books:

1. K. Ogata, “Digital Control Engineering”, Prentice Hall, Englewood Cliffs,1995.
2. M. Gopal, “Digital Control Engineering”, Wiley Eastern,1988.
3. G. F. Franklin, J. D. Powell and M. L. Workman, “Digital Control of Dynamic Systems”, Addison-Wesley,1998.
4. B.C. Kuo, “Digital Control System”, Holt, Rinehart and Winston,1980.

110709	Electrical and Hybrid Vehicles	3L:0T:0P	3 credits

Course Outcomes:

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

- Understand the models to describe hybrid vehicles and theirperformance.
- Understand the different possible ways of energystorage.
- Understand the different strategies related to energy storagesystems.

Module 1: Introduction (10 hours)

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

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.

Module 3: Electric Trains (10 hours)

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

Electric Propulsionunit:Introductiontoelectriccomponentsusedinhybridandelectricvehicles,Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration andcontrolofPermanentMagnetMotordrives,ConfigurationandcontrolofSwitchReluctanceMotor drives, drive systemefficiency.

Module 4: Energy Storage (10 hours)

EnergyStorage:IntroductiontoEnergyStorageRequirementsinHybridandElectricVehicles,Battery basedenergystorageanditsanalysis,FuelCellbasedenergystorageanditsanalysis,SuperCapacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching theelectricmachine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Module 5: Energy Management Strategies (9 hours)

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

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

Text / References:

1. C. Mi, M. A. Masrur and D. W.Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons,2011.

2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer,2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and FuelCell Vehicles: Fundamentals, Theory, and Design”, CRC Press,2004.
4. T. Denton, “Electric and Hybrid Vehicles”, Routledge,2016.

110715	**Computer Networks**	**3L:0T: 0P**	**3 Credits**

Objectives of the course

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

Module 1: **Lecture 8**

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

Module 2: **Lecture 8**

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

Module 3: **Lecture 8**

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

Module 4: **Lecture 8**

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

Module 5: **Lecture 8**

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

Suggested books

1. Data Communication and Networking, 4th Edition, BehrouzA. Forouzan, McGraw- Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice HallIndia.

Suggested reference books

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall ofIndia.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States ofAmerica.

Course Outcomes

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

110716	Strength of Materials	3L:0T:0P	3Credits

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Contents:

Module:1 *(8 lectures)*

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle, theories of failure,

Module:2 **(8 lectures)**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Module: 3 *(8 lectures)*

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Module: 4 *(8 lectures)*

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Module: 5 *(8 lectures)*

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi,2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr. and John J. Dewole, Mechanics of Materials, Tata GrawHill Publishing Co. Ltd., New Delhi2005.

Practical:

1. Hooke's Law
2. Hardness Test: Rockwell, Brinell, Vicker
3. Izod&Charpy Impact Test

4. Bending Test
5. Torsion Test
6. Shear test
7. Compressive strength test
8. Fatigue Test
9. Verification of Maxwell's reciprocal theorem
10. Continuous beam deflection test
11. Strain Measurement

Atleast 8 experiments should be performed from above list

Course Outcomes:

1. After completing this course, the students should be able to recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

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110717	Fluid Machinery	3L:0T:3P	4.5 Credits

Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behavior of solids.

Contents:

Module: 1

Introduction – Classification of fluid machinery. **(Lectures: 2)**

Module: 2

Dynamic action of fluid jet – Impact of fluid jet on fixed and moving flat places, impact of jet on fixed and moving curved vanes, flow over radial vanes, jet propulsions. **(Lectures: 4)**

Module: 3

Euler's fundamental equation, degree of reaction. **(Lectures:2)**

Module: 4

Hydraulic turbines, introduction, classification, impulse turbine, construction details, velocity triangles, power and efficiency calculations, reaction turbines; constructional details, working principle, velocity triangles, power and efficiency calculations, draft tube, cavitation, governing. **(Lectures: 10)**

Module: 5

Principle of similarity in fluid machinery; unit and specific quantities, testing models and selection of hydraulic turbines. **(Lectures: 3)**

Module: 6

Positive displacement pumps: Reciprocating pump; working principle, classification, slip, indicator diagram, effect of friction and acceleration, theory of air vessel, performance characteristics gas gear oil pump and screw pump. **(Lectures: 4)**

Module: 7

Rotodynamicpumps: Introduction, classification, centrifugal pump; main components, working principle velocity triangle, effect of shape of blade specific speed, heats, power and efficiency, calculations minimum steering speed, multi stage pumps, performance characteristic, comparison with reciprocating pump. **(Lectures: 7)**

Course Outcomes:

Upon completion of this course, students will be able understand the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.

Text Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third

Edition, CRC Press,2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International,1965.
3. Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international,1969.
4. Hydrantic Machine by JagdishLal
5. Hydraulics & Hydraulic Machines by Vasandari
6. Hydrantic Machine by RD Purohit

Practical:

1. Performance on hydraulic turbines:
    a. Pelton wheel
    b. Francis turbine
    c. Kaplan turbine.
2. Performance on hydraulic pumps:
    a. Single stage and multi stage centrifugal pumps
    b. Reciprocating pump.
3. Performance test of a two stage reciprocating air compressor
4. Performance test on an air blower

OPTIONAL

1. Visit to hydraulic power station/Municipal water pump house and case studies.
2. Demonstration of cut section models of hydraulic turbines and pumps.

110719	Internet of Things	3L:0T:0P	3 Credits

Objectives of the Course:

The objective of this course is to impart necessary and practical knowledge of components of

Internet of Things and develop skills required to build real-life IoT based projects.

Detailed contents

Module 1 **Lectures 8 hrs.**

Introduction to IoT: Architectural Overview, Designprinciplesandneededcapabilities,IoTApplications,Sensing,Actuation,BasicsofNetworking, M2M andIoTTechnologyFundamentals- Devicesandgateways,Data management,BusinessprocessesinIoT,Everythingasa Service(XaaS),Role ofCloud in IoT, Security aspects in IoT.

Module 2 **Lectures 9 hrs.**

Elements of IoT: HardwareComponents – Computing (Arduino,Raspberry Pi),Communication,Sensing,Actuation, I/O interfaces.Software Components- Programming API's (using Python/Node.js/Arduino) for Communication. Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

Module 3 **Lectures 18 hrs.**

IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisitionand integration, Device data storage- Unstructured data storage on cloud/local server,Authentication, authorization of devices.

Module 4 **Lectures 10 hrs.**

IoT Case Studies: IoT case studies and mini projects based on Industrial automation,Transportation, Agriculture,Healthcare, Home Automation.

List of Suggested Books:

1. Vijay Madisetti, ArshdeepBahga, İnternet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

4. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
5. Adrian McEwen, “Designing the Internet of Things”, Wiley
6. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
7. CunoPfister, “Getting Started with the Internet of Things”, O Reilly Media

Learning Outcomes:

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

1. Understand internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices
4. Develop real life IoT based projects

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110725	**Cloud Computing**	**3L:0T:0P**	**3 Credits**

Objective: This course will cover the study of various cloud services, deployment model, resource provisioning and scheduling algorithms involved in better implementing the cloud-based systems.

Detailed contents

Module 1 **Lecture 4 hrs.**

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, deployment models, and service models.

Module 2 **Lecture 5 hrs.**

Virtualization: Issues with virtualization, virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, virtualization of data centers, and Issues with Multi-tenancy.

Module 3 **Lecture 6 hrs.**

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine, and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, SLA management.

Module 4 **Lecture 12 hrs.**

Resource Management: Cloud resource provisioning plan (advance reservation, on demand plan, spot instances), various scheduling and load balancing techniques to improve QoS parameters, Resource Optimization algorithms, task migration and VM migration technique.

Module 5 **Lecture 7 hrs.**

Security: Vulnerability Issues and Security Threats, Application-level Security, Data level Security, and Virtual Machine level Security, Infrastructure Security, and Multi-tenancy Issues.

Module 6 **Lecture 6 hrs.**

Advances: Green Cloud, Mobile Cloud Computing, Fog Computing, Internet of Things

Suggested Books:

1. Cloud Computing Principles and Paradigms, RajkumarBuyya, James Broberg, AndrzejGoscinski, Wiley Publishers 2011
2. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers 2010
2. Mastering Cloud computing, RajkumarBuyya, Christian Vacchiola, S ThamaraiSelvi, McGraw Hill 2013
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly 2010
4. Cloud Computing by Shailendra Singh 2018

Course outcomes:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Identify problems, and explain, analyze, and evaluate various cloud computing solutions
4. Provide the appropriate cloud computing solutions and recommendations according to the applications used.
5. Attempt to generate new ideas and innovations in cloud computing

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110727	Object Oriented Programming using C++	3L:0T: 0P	3 credits

Objectives of the course:

1. To impart the basic concepts of Object Oriented Programming.
2. To understand concepts about Classes and Data Abstraction
3. To understand basic concepts about Inheritance.
4. To enable them to write algorithms for solving problems using object oriented approach.

Detailed contents:

Module 1 **Lecture: 3 hrs.**

Introduction to C++ : Object Oriented Technology, Advantages of OOP, Input- output in C++, Tokens, Keywords, Identifiers, Data Types C++, Derives data types. The void data type, Type Modifiers, Typecasting, Constant, Operator, Precedence of Operators, Strings.

Module 2 **Lecture: 6 hrs.**

Control Structures and Functions: Decision making statements like if-else, Nested if-else, goto, break, continue, switch case, Loop statement like for loop, nested for loop, while loop, do-while loop. Parts of Function, User- defined Functions, Value- Returning Functions, void Functions, Value Parameters, Function overloading, Virtual Functions.

Module 3 **Lecture: 12 hrs.**

Classes and Data Abstraction : Structure in C++, Class, Build- in Operations on Classes, Assignment Operator and Classes, Class Scope, Reference parameters and Class Objects (Variables), Member functions, Accessor and Mutator Functions, Constructors, default Constructor, Destructors.

Module 4 **Lecture: 8 hrs.**

Overloading, Templates and Inheritance: Operator Overloading, Function Overloading, Function Templates, Class Templates. Single and Multiple Inheritance, virtual Base class, Abstract Class, Pointer and Inheritance, Overloading Member Function.

Module 5 **Lecture: 11 hrs.**

Pointers, Arrays and Exception Handling: Void Pointers, Pointer to Class, Pointer to Object, Void Pointer, Arrays. The keywords try, throw and catch. Creating own Exception Classes,

Exception Handling Techniques (Terminate the Program, Fix the Error and Continue, Log the Error and Continue), Stack Unwinding.

Suggested books:

1. Thinking in C++, Volume 1 & 2 by Bruce Eckel, Chuck Allison, Pearson Education
2. Mastering C++, 1/e by Venugopal, Tata McGraw Hill.
3. Object Oriented Programming with C++, 3/e by E. Balaguruswamy, Tata McGraw Hill.
4. Starting Out with Object Oriented Programming in C++, by Tony Gaddis, Wiley India.

Suggested Reference Books:

1. The C++ Programming language 3/e by BjarneStroustrup, Pearson Education.
2. C++, How to Programme, 4e, by Deitel, Pearson Education.
3. Big C++ by Cay Horstmann, Wiley India.
4. C++ Primer, 3e by Stanley B. Lippmann, JoseeLajoie, Pearson Education.
5. C++ and Object Oriented Programming Paradigm, 2e by Debasish Jana, PHI.
6. Programming with C++, 2/e by Ravichandran, Tata McGraw Hill.
7. C++ Programming Black Book by Steven Holzner, Dreamtech Press.

Course outcomes

After the completion of course, students can able to able to:

1. Understand the concepts of Class, Object, Inheritance and Polymorphism.
2. Apply overload operators in C++
3. Understand the difference between function overloading and function overriding
4. Incorporate exception handling in object-oriented programs
5. Able to use template classes.
6. Able to write object-oriented programs of moderate complexity in C++

110730	Block Chain Technique	3L:0T:0P	3 Credits

Objective of the Course:

To provide conceptual understanding of how block chain technologycan beusedtoinnovateandimprovebusinessprocesses.Thecoursecovers the technologicalunderpinningofblockChain operations.

Detailed contents

Module 1 **Lectures 6 hrs.**

Introduction:Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Cryptocurrency to Block chain, Permissioned Model of Block chain, Overview of Security aspects ofBlock chainBasic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

Module 2 **Lectures 10 hrs.**

Understanding Block chain with Crypto currency: Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts,Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation andblock relay.

Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoinnetwork, Proof of Work (PoW) – basic introduction, HashcashPoW, BitcoinPoW, Attackson PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time,The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Module 3 **Lectures 12 hrs.**

Understanding Block chain for Enterprises: Permissioned Block chain: Permissioned model and use cases, Design issues for Permissionedblock chains, Execute contracts, State machine replication, Overview of Consensus models forpermissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus,Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFTAlgorithm, BFT over Asynchronous systems.

Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain

Module 4 **Lectures 12 hrs.**

Block chain application development: HyperledgerFabric- Architecture, Identities and Policies, Membership and Access Control,Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smartcontract using Ethereum, Overview of Ripple and Corda.

List of Suggested Books:

1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015
2. Josh Thompsons, "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming"
3. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017
5. AnshulKaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi.
6. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing
7. RiteshModi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing
8. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018

Learning Outcomes:

At the end of this course, the students will be able to:

1. Understand block chain technology.
2. Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
3. Build and deploy block chain application for on premise and cloud based architecture.
4. Integrate ideas from various domains and implement them using block chain technology in different perspectives.

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110706	**Power Systems – II**	**3L:0T:0P**	**3 credits**

Course Outcomes:

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

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

Module 1: Power Flow Analysis (7 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node.

Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

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

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

Module 3: Control of Frequency and Voltage (7 hours)

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

Power flow control using embedded dc links, phase shifters and

Module 4: Monitoring and Control (6 hours)

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

Module 5: Fault Analysis and Protection Systems (10 hours)

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.

Text/References:

1. J. Grainger and W. D. Stevenson, “Power System Analysis”, McGraw Hill Education,1994.
2. O. I. Elgerd, “Electric Energy Systems Theory”, McGraw Hill Education,1995.
3. A. R. Bergen and V. Vittal, “Power System Analysis”, Pearson Education Inc.,1999.
4. D. P. Kothari and I. J. Nagrath, “Modern Power System Analysis”, McGraw Hill Education,2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, “Electric Power Systems”, Wiley, 2012.

PCC-EE24: Power Systems-II Laboratory (0:0:2 – 1 credit)

Hands-on and computational experiments related to the course contents of EE20. This should include

programmingofnumericalmethodsforsolutionofthepowerflowproblemandstabilityanalysis.Visit to load dispatch centre is suggested.

ELECTRICAL SAFETY
(Open Elective)

COURSE CODE: 110728 **L T P C 3 0 0 3**

COURSE OUTCOMES:

At the end of the course the student shall be able to
CO1: Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention.
CO2: Summarize the Safety aspects during Installation of Plant and Equipment.
CO3: Describe the electrical safety in residential, commercial and agricultural installations.
CO4: Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing.
CO5: State the electrical systems safety management and IE rules.

MODULE 1.INTRODUCTION TO ELECTRICAL ELEMENTS AND ELECTRICAL SAFETY,

Basic knowledge of electrical circuit elements and parameters, measurements methods andmeasuringinstrumentsusedforelectricalparametersi.e.current,voltage,powerinDCnetworks; active power, reactive power, energy, frequency, power factor in single and threephaseAC networks, power factorcorrection, Reactivepower compensation.

Terms and definitions of Electrical safety, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

MODULE II INTRODUCTION TO TRANSFORMER COMMISSIONING AND INSTALLATION OF DISTRIBUTION AND LT SWITCHGEAR

Transformer and its commissioning, Knowledgeofcommissioning,pre-commissioningtestsandtestequipmentsused,transformer oil test, various transformer protections and relays used, knowledge of fire safetyoftransformer, preventive maintenanceof transformer.

DistributionandLTswitchgears, Type and selection of electrical elements used in distribution i.e. fuses, ACBs (Air CircuitBreaker), MCBs (Miniature Circuit Breaker), MCCBs (Molded Case Circuit Breaker), ELCB(Electric Leakage Circuit Breaker) / RCCB (Residual Current Circuit Breaker), switchboards,busduct, RMU (RingMain Unit), HTandLT Panel, PLC logicpanels.

MODULE III SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT:

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard

equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

MODULE III ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS, SAFETYFROMELECTRICITYANDFIRE

Personal protective equipments (PPE's) used in connection with safe use of electricity likeHand Gloves, Rubber Shoes, Waist belt, earthing rod, etc., Safe working clearances fordifferent voltage levels, fire extinguishers used for different applications, knowledge of staticelectricity,Lightningprotection, ElectricalsafetyAudit,elementaryknowledgeof firstaid.
Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations –Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

MODULE IV ELECTRICAL SAFETY IN HAZARDOUS AREAS:

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapors – classification of equipment/enclosure for hazardous locations.

EQUIPMENT EARTHING AND SYSTEM NEUTRAL EARTHING: Introduction, Distinction between system grounding and Equipment Grounding, Equipment Earthing, Functional Requirement of earthing system, description of a earthing system, , neutral grounding(System Grounding), Types of Grounding, Methods of Earthing Generators Neutrals.

MODULE V **ACT, SAFETY REGULATIONS AND RELEVANT CODE AND STANDARDS:**

The Electricity Act, 2003, (Part1, 2, 3,4& 5), FactoriesAct1948,CEA(MeasuresrelatingtoSafetyandElectric Supply),Regulations2010,CEA(TechnicalStandardsforConstructionofElectricalplantsandLines),Regulations2010,CEA(TechnicalStandardsforConnectivitytothegrid),Regulations2007,RelevantIS/NEC/IECStandards mentionedin CEARegulations.

SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE: Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility.

TEXT BOOKS:

1. S. Rao, Prof. H.L. Saluja, "Electrical safety, fire safety Engineering and safety anagement", Khanna Publishers. New Delhi, 1988.(units-I to V)
2. www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)
3. Switchgear Protection and Power Systems (Theory, Practice & Solved Problems):SunilS. Rao, Khanna Publishers.

REFERENCE:

1. Pradeep Chaturvedi, *"Energy management policy, planning and utilization",* Concept Publishing company, New Delhi, 1997.

Electrical & Electronics Engineering

Course Code	Paper Title	L	T	P	Credits	TH/PR	ESE	IA
1108xx	Open Elective- III	3	0	0	3	TH	70	30
1108xx	Open Elective-IV	3	0	0	3	TH	70	30
1108xx	Program Elective- V	3	0	0	3	TH	70	30
1108xx	Program Elective- VI	3	0	0	3	TH	70	30
100801	Project-II	0	0	12	6	PR	30	20

Open Elective

110807	Power Plant Engineering	3L:0T:0P	3 credits

Objectives:

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

Contents:

Module: 1

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. Sub systems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems. **(Lectures 8)**

Module : 2

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, **(Lectures 4)**

Module : 3

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. **(Lectures 8)**

Module : 4

Hydroelectric power plants, Hydrological cycle, Rainfall & run-off measurement & plotting of various curves for estimating stream flow, site selection, classification, comparison with other types of power plant, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems. **(Lectures 8)**

Module: 5

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, Geothermal power plants, Ocean thermal electric conversion,, M.H.D power generation. **(Lectures 6)**

Course Outcomes:

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

Text Books:

1 Power Plant Engineering, 5th Edition,, Laxmi Publications(P) Ltd

2 Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.

3 El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

4 Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

110809	**Automobile Engineering**	**3L:0T:0P**	**3 credits**

Objectives:

To understand the construction and working principle of various parts of an automobile

Contents:

Module: 1

Types of automobiles, vehicle construction and layouts, Car body Style, chassis, frame and body, vehicle aerodynamics, IC engines-components, function and materials, variable valve timing (VVT), Front engine front wheel drive, Front engine Rear wheel drive, foure wheel drive. **(Lectures 6)**

Module: 2

Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition & capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS). **(Lectures 6)**

Module: 3

Transmission systems, clutch types, cone clutch, Single plate, multi plate, diaphragm spring & centrifugal clutch, electromagnetic clutch & construction, gear boxes- manual and automatic gear shift mechanisms, over drive principles, transfer box, Transaxles, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive**.** **(Lectures 8)**

Module: 4

Steering geometry and types of steering gear box, power steering, types of front axle, types of suspension systems, constructional details & characteristics of Leaf spring, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control. **(Lectures 8)**

Module: 5

Caster, Camber, King pin inclination Toe in Toe out, Full Floating, three quarter floating &semi Floating rear axles. **(Lectures 5)**

Module: 6

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of

alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells.

(Lectures 7)

Course Outcomes:

Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

1. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

Practical:

1. To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.
2. To study and prepare report on the constructional details, working principles and operation of the Automotive Transmission systems.
3. To study and prepare report on the constructional details, working principles and operation of the Automotive Drive Lines & Differentials.
4. To study and prepare report on the constructional details, working principles and operation of the Multi-cylinder: Diesel and Petrol Engines.
5. To study and prepare report on the constructional details, working principles and operation of the Fuels supply systems.
6. To study and prepare report on the constructional details, working principles and operation of the Engine cooling & lubricating Systems.
7. To study and prepare report on the constructional details, working principles and operation of the Automotive Suspension Systems.
8. To study and prepare report on the constructional details, working principles and operation of the Automotive Steering Systems.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.

110810	**ElectricalMaterials**	**3L:0T:0P**	**3credits**

MODULE 1 ELECTRICAL ENGINEERING MATERIALS (6H)

Introduction to Electrical Engineering Materials, Classification of materials, Material of importance- carbonated beverages container, Advanced Materials, Modern Material need, Atomic Structure and Interatomic Bonding, bonding forces and energies, secondary bonding and van-der-waals bonding,

MODULE II THE STRUCTURE OF CRYSTALLINE SOLIDS (8H)

The structure of crystalline solids, crystallographic points, directions and planes, X-Ray diffraction, determination of crystalline structure, imperfections and defects in solids, diffusion mechanisms, steady state diffusion, diffusion in semiconducting materials, material of importance- Aluminum for integrated circuit interconnects, mechanical properties of material, stress strain behavior. Structure and properties of ceramics, crystal ceramics, silicate ceramics, material of importance- carbon nano-tubes, Imperfections in ceramics, application and processing of ceramics, Glass ceramics, refractories, abrasives, cements, materials of importance –piezoelectric ceramics

MODULE IIIINSULATING PROPERTIES OF MATERIAL (8H)

Insulating materials; General Properties, Electrical Properties: Volume resistivity, surface resistance, dielectric loss, dielectric strength (breakdown voltage) dielectric constant, Thermal conductivity, Electro-thermal breakdown in solid dielectrics Insulating Materials and their applications:

Plastics, Definition and classification, Thermosetting materials, Phenol-formaldehyde resins (i.e. Bakelite) amino resins (urea formaldehyde and Malamine-formaldehyde), epoxy resins – their important properties and applications, Thermo-plastic materials: Polyvinyl chloride (PVC), polyethelene, silicons, their important properties and applications, Bitumen - Mineral and insulating oil for transformers switchgear capacitors, high voltage insulated cables, insulating varnishes for coating and impregnation - Enamels for winding wires, Glass fiber sleeves, SF6 their properties and applications

MODULE IV ELECTRICAL PROPERTIES OF MATERAILS (6H)

Electrical conduction ,electronic and ionic conduction, energy band structures in solids ,conduction in terms of band and atomic bonding models, electron mobility ,electrical resistivity of metals, materials of importance—aluminum electrical wires, semi conductivity , intrinsic semi conduction, extrinsic semi conduction, carrier mobility , semiconductor devices, electrical properties of polymers dielectric behavior, capacitance , field vectors and polarization, types of polarization, frequency dependence of the dielectric constant, dielectric materials, ferroelectricity, piezoelectricity.

MODULE V OPTICAL AND MAGNETIC PRPERTIES OF MATERIALS (10 H)

Optical properties,basic concepts, electromagnetic radiation, light interactions with solids atomic and electronic interactions optical properties of metals, optical properties of nonmetals, refraction, reflection, absorption, transmission, applications of optical phenomena,

luminescence, Materials of importance—light-emitting diodes, photoconductivity , lasers , optical fibers in communicationsDiamagnetism and Paramagnetism Ferromagnetism , Antiferromagnetism and Ferrimagnetism , The Influence of Temperature on Magnetic Behavior, Domains and Hysteresis, Magnetic Anisotropy, Soft Magnetic Materials, Materials of Importance—An Iron–Silicon Alloy That Is Used in Transformer Cores, Hard Magnetic Materials Magnetic Storage , Superconductivity

MODULE VISUPERCONDUCTIVITY (6H)

Properties of superconductors, London equations, Quantum explanation of superconductivity, Applications of superconductors. Nanomaterials: Introduction to nanotechnology, Nanowire and Nanotube, Carbon nanotubes, Single wall carbon nanotubes, Multiwall carbon nanotubes, Fabrications, Properties and applications

Economic, Environmental, and Societal Issues in Materials Science and Engineering introduction , economic considerations , component design , materials , manufacturing techniques, environmental and societal considerations , recycling issues in materials science and engineering, materials of importance—biodegradable and biorenewable polymers/ plastics

110814 Satellite Communication 3L:0T:0P 3 Credits

1 Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

2 Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day

3 Satellite sub-systems: Study of Architecture and Roles of various sub systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC and M), Attitude and orbit control system (AOCS), Communication sub-system.

4 Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift Phenomena and expression for Doppler shift

5 Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, C/N ratio calculations in clear air and rainy conditions

Sl. No. Name of Authors / Books /Publishers

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications; Wiley
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill.

110817 Biomedical Instrumentation 3L:0T:0P 3 Credits

1 Biomedical signals and Physiological transducers : Source of biomedical

signal, Origin of bioelectric signals, recording electrodes, Electrodes for ECG, EMG and EEG Physiological transducers: Pressure, Temperature, photoelec- tric and ultrasound Transducers. Measurement in Respiratory system: Physi- ology of respiratory system, Measurement of breathing mechanics Spiro meter, Respiratory therapy equipments Inhalators ventilators and Respirators, Hu- midifiers, Nebulizers Aspirators, Biomedical recorders: ECG, EEG and EMG.

2 Patient Monitoring systems and Audiometers : Cardiac monitor, Bed-side patient monitor, measurement of heart rate, blood pressure, temperature, respiration rate, Arrhythmia monitor, Methods of monitoring fatal heart rate, Monitoring labor activity. Audiometers: Audiometers, Blood cell counters, Oximeter, Blood flow meter, cardiac output measurement, Blood gas analyz- ers.

3 Modern Imaging systems : Introduction, Basic principle and Block diagramof x-ray machine, x- ray Computed Tomography (CT), Magnetic resonance imaging system (NMR), ultrasonic imaging system. Eco-Cardiograph, Eco Encephalography, Ophthalmic scans, MRI. Therapeutic Equipments: Cardiac pacemakers, cardiac defibrillators, Hemodialysis machine, Surgical diathermy machine.

4 Patient's safety : Precaution, safety codes for electro medical equipment,Electric safety analyzer, Testing of biomedical equipment, Ultrasound therapy unit. Electrotherapy Equipments, Ventilators.

Sl. No. Name of Authors / Books /Publishers

1 "Hand book of Biomedical Instrumentation", R.S.Khandpur, TMH
2 "Biomedical Instruments: Theory and Design", Walter Welko- Witiz and SidDoutsch, Wiley
3 "Biomedical Instrumentation and Measurements", Lesile Cromwell, Fred J. Weibell and Erich A. Pfeiffer, PHI
4 "Introduction to Biomedical Equipment Technology", Joseph J. Carr and JohnM. Brown, Pearson
5 "Textbook of Biomedical Instrumentation System", Shakti Chatterjee, Cengage Learning

110819	E-Commerce and ERP	3L:0T:0P	3 Credits

Module 1 **Lecture: 10 hrs.**

Introduction to E- Commerce: Evolution of E-commerce, Advantage and Disadvantage of E Commerce, Roadmap of E-Commerce in India. Business Models of E–Commerce: Model Based On Transaction Party: B2B, B2C, C2B, C2C.

Module 2 **Lecture: 10 hrs.**

E marketing: The scope of E-Marketing, Identifying Web Presence goals, Uniqueness of the web, Meeting the need of website visitors, Website Design Issues: Factors that make People Return to Your Site, Strategies for Website Development. Site Adhesion: Content, format and access: maintaining a Website, E- Advertising, E-Branding,

Module 3 **Lecture: 10 hrs.**

E–Payment System: Digital Payment Requirement, Digital Token based E-Payment System, Electronic Cash, Smart card and Electronics payment system: Credit and Debit Card, Virtual Currency, Digital wallet, Risk of Electronics payment system, Digital Signature.

E Security: Security On the Internet: Network and Website Security Risk: Denial-of-Service attack, Viruses, Unauthorized access to computer Network. Security Standards: Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures.

Module 4 **Lecture: 10 hrs.**

Enterprise Resource Planning (ERP): Introductory Concepts, Advantages & disadvantages of ERP, ERP and Related Technologies: - Business Process Reengineering, Data Warehousing, Data Mining, Supply Chain Management. **ERP Implementation:** ERP Implementation Life Cycle –Implementation Methodology, Hidden Costs , Organizing Implementation – Contracts with Vendors, Consultants and Users , Project Management and Monitoring.

Module 5 **Lecture: 7 hrs.**

ERP Business Modules: Introduction to basic Modules of ERP System, Business Modules in an ERP Package- Finance – Manufacturing – Human Resource – Plant Maintenance – Materials Management – Quality Management – Sales and Distribution.

Case Study: Recent business issues on E-Commerce Perspective**.**

Text Books:

1. Alexis Leon, “ERP Demystified”, Tata McGraw Hill.

2. E-Commerce An Indian Perspective by P.T.Joseph, PHI

Reference Books

1. K.K. Bajaj, D. Nag "E-Commerce", 2nd Edition, McGraw-Hill Education, New Delhi.
2. Bhaskar Bharat, "Electronic Commerce-Technology and Application", McGraw-Hill Education, New Delhi.
3. Mary Sumner, "Enterprise Resource Planning", 2005, PHI Learning India Pvt. Ltd. /Pearson Education, New Delhi.
4. Chan, "E-Commerce fundamentals and Applications", Wiley India, New Delhi.
5. Vinod Kumar Garg and N.K .Venkata Krishnan, "Enterprise Resource Planning – concepts and Planning", Prentice Hall, 1998.

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Electrical & Electronics Engineering
Program Elective

110801	**Fiber Optic Communications [EC]**	**3L:0T:0P**	**3credits**

Course Outcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understand theprinciples fiber-optic communication, the componentsandthe bandwidthadvantages.
- Understandthepropertiesoftheopticalfibersandopticalcomponents.
- Understandoperationoflasers,LEDs,anddetectors
- Analyzesystemperformanceofopticalcommunicationsystems
- Designopticalnetworksandunderstandnon-lineareffectsinopticalfibers

Module1: Introductionto vectornatureoflight, propagationoflight, propagationoflight inacylindricaldielectricrod,Raymodel,wavemodel.

Module2: Differenttypesofopticalfibers,Modal analysisofastepindexfiber.Signal degradationonoptical fiberdue to dispersionand attenuation. Fabricationof fibersandmeasurementtechniqueslikeOTDR.

Module3: Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise,opticalreceivers.Opticallinkdesign- BERcalculation, quantumlimit, powerpenalties.

Module4: Opticalswitches-coupledmodeanalysisofdirectionalcouplers,electroopticswitches.

Module5: Opticalamplifiers-EDFA,Ramanamplifier.

Module6: WDMandDWDMsystems.PrinciplesofWDMnetworks.

Module7: Nonlineareffectsinfiberopticlinks.Conceptofself-phasemodulation,groupvelocitydispersionandsolitionbasedcommunication.

Text/ReferenceBooks

1. J.Keiser,FibreOpticcommunication,McGraw-Hill,5thEd.2013(IndianEdition).
2. T.Tamir,Integratedoptics,(TopicsinAppliedPhysicsVol.7),Springer-Verlag,1975.
3. J.Gowar,Opticalcommunicationsystems,PrenticeHallIndia,1987.
4. S.E.MillerandA.G.Chynoweth,eds.,Opticalfibrestelecommunications,AcademicPress, 1979.
5. G.Agrawal,Nonlinearfibreoptics,AcademicPress,2ndEd.1994.
6. G.Agrawal,FiberopticCommunicationSystems,JohnWileyandsons,NewYork,1997
7. F.C. Allard, FiberOpticsHandbookfor engineersandscientists, McGrawHill, NewYork (1990).

110802	**Micro and Nano-Electronics [EC]**	**3L:0T:0P**	**3credits**

Course Outcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Analyze semiconductor devices, through numerical problems, using fundamental characteristics of semiconductor materials, such as carrier densities, transport, lifetime, generation and recombination.
- Understand various aspects of nano-technology and the processes involved in making nano components and material.
- Leverage advantages of the nano-materials and appropriate use in solving practical problems.
- Understand various aspects of nano-technology and theprocesses involved in making nano components and material.
- Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Module 1: Semiconductor crystal lattice and growth of high purity semiconductor materials Energy bands, Fermi-Dirac distribution function, and energy band diagrams Doping of semiconductors; carrier concentration in doped and intrinsic semiconductors Carrier transport phenomena - drift and diffusion current; device current equations

Module 2: Generation, recombination, carrier lifetime and mobility Semiconductor junctions p-n diodes: creation of space charge region in a p-n junction and current-voltage characteristics Metal-semiconductor contacts – Schottky and Ohmic contact LED – Application of p-n junction Basic operation principle of BJT and MOSFET transistors

Module 3: Introductiontonanotechnology,mesostructures, BasicsofQuantumMechanics:Schrodingerequation,Density ofStates.ParticleinaboxConcepts,Degeneracy.BandTheoryofSolids.Kronig-PennyModel.BrillouinZones.

Module 4: Shrink-downapproaches:Introduction,CMOSScaling,ThenanoscaleMOSFET,Finfets,VerticalMOSFETs,limitstoscaling,systemintegrationlimits(interconnectissuesetc.),

Module 5: ResonantTunnelingDiode,Coulombdots,Quantumblockade,Singleelectrontransistors,Carbonnanotubeelectronics,Bandstructureandtransport,devices,applications,2Dsemiconductorsand electronic devices, Graphene, atomistic simulation

Text/ReferenceBooks:

1. Semiconductor Physics and Devices, Donald A. Neamen, 4th edition, McGraw Hill Higher Education, ISBN # 978-0-07-352958-5

2. G.W.Hanson,FundamentalsofNanoelectronics,Pearson,2009.
3. W.Ranier,NanoelectronicsandInformationTechnology(AdvancedElectronicMaterial andNovelDevices), Wiley-VCH, 2003.
4. K.E.Drexler,Nanosystems,Wiley,1992.
5. J.H.Davies,ThePhysicsofLow-DimensionalSemiconductors,CambridgeUniversityPress, 1998.
6. C.P.Poole,F.J.Owens,IntroductiontoNanotechnology,Wiley,2003

110803	**PowerSystemProtection**	**3L:0T:0P**	**3credits**

CourseOutcomes: Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understandthedifferentcomponentsofaprotectionsystem.
- Evaluatefaultcurrentduetodifferenttypesoffaultinanetwork.
- Understandtheprotectionschemesfordifferentpowersystemcomponents.
- Understandthebasicprinciplesofdigitalprotection.
- Understandsystemprotectionschemes,andtheuseofwide-areameasurements.

Module1:Introductionand ComponentsofaProtection System (4 hours)
PrinciplesofPowerSystemProtection, Relays, Instrumenttransformers, Circuit Breakers

Module2:FaultsandOver-CurrentProtection (8hours)
Review of Fault Analysis, Sequence Networks. Introduction toOvercurrent Protection andovercurrentrelayco-ordination.

Module3:EquipmentProtectionSchemes (8hours)
Directional, Distance, Differential protection. Transformer and Generator protection.Bus barProtection,BusBararrangementschemes.

Module 4: Digital Protection (8 hours)

Computer-aided protection, Fourier analysis and estimation of Phasors from DFT. Sampling, aliasingissues.

Module 5: Modeling and Simulation of Protection Schemes (8 hours)

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

Module 6: System Protection (4 hours)

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

Text/References

1. J.L.Blackburn,"ProtectiveRelaying:PrinciplesandApplications",MarcelDekker,NewYork, 1987.
2. Y.G.Paithankarand S.R.Bhide,"Fundamentalsofpowersystemprotection",PrenticeHall,India,2010.
3. A.G.PhadkeandJ.S.Thorp,"ComputerRelayingforPowerSystems",JohnWiley&Sons,1988.
4. A.G.PhadkeandJ.S.Thorp,"SynchronizedPhasorMeasurementsandtheirApplications",Springer,2008.
5. D.Reimert,"ProtectiveRelayingforPowerGenerationSystems",TaylorandFrancis,2006.

110804	**Smart Grid**	**3L:0T:0P**	**3credits**

Course Outcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understand thebackground and fundamental building blocks of smart grid with stringent emphasis on practical applications in the existing power system network
- Emphasizes on renewable energy source integration in present grids as well as in micro and nano grids as part of the course and explores its issues in operation, analysis, management, control, protection and monitoring.

Module1: Introduction to Smart Grid: (8 hours)

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits.

Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

Module2: Smart Grid Technologies (8 hours)

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring,

Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency, Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

Module3: Smart Meters and Advanced Metering Infrastructure (8 hours)

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives,. AMI needs in the smart grid, Phasor Measurement, Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Module4:Power Quality Management in Smart Grid:(8 hours)

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources,. Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Module5: High Performance Computing for Smart Grid Applications (8 hours)

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad band over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid

Text /References:

1. Vehbi C. Güngör, Dilan Sahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids, 2011.
3. Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press, 2012.
4. A Keyhani, M Marwali, "Smart power grids", .
5. ArunPhadke, "omputer Relaying for Power Systems", .
6. Nikos Hatziargyriou, "Microgrids Architecture and control", .
7. Fang Lin Luo, Hong Ye , "Renewable Energy Systems", .

110805	**Transducer & Signal Conditioning**	**3L:0T:0P**	**3credits**

Course Outcomes:

Attheendofthiscourse,studentswilldemonstratetheabilityto

- Understand the basics oknowledge of the principles, working and characteristics of transducers and the associated signal conditioning circuits for industrial applications.

Module1: Transducers (10 hours)
Introduction,classification,mechanicaldevicesasprimarydetectors, basicrequirementsofatransducer,electricaltransducers,typeof transducersformeasuringdisplacement,strain,vibration,pressure,flow, temperature,force,torque,liquidlevel,humidity,P.H.value,velocity (angular&linear),acceleration,basicprinciplesofresistivetransducers, inductivetransducers,capacitivetransducers, thermoelectric transducers,piezoelectrictransducers,halleffecttransducers, electromechanicaltransducers,photoelectrictransducers,digital transducers.

Module2: Signal Processing Circuits (11 hours)
crossingdetector,zerocrossingdetectorwithhysteresis,invertingand non-inverting amplifiers, voltage-follower, adder, subtractor, multiplier, divider,integrator,differentiator,voltagetocurrentconverter,currentto voltage converter, phase shifter circuit, absolute-value circuit, peak detector,actodcconverter,logarithmicconverter,differential-amplifier, instrumentationamplifier, analogmodulators&demodulators.

Module3: DataDisplay and RecordingSystems (6 hours)
Introductiontoanalogganddigitaldisplaymethods,analogrecorders, C.R.O.,magnetictaperecorders,digitalinput-outputdevices,digital frequencymeter, digitalvoltmeter.

Module4:DataTransmissionandTelemetry (6 hours)
Introduction, characteristics of frequency divisionmultiplexing,time- divisionmultiplexing, transmissionchannelsandmedia.

Module5: DataAcquisitionand Conversion (7 hours)
Introduction, signal conditioning of the inputs, single channel DAS, Multi-channel DAS, data conversion, multiplexer, S/H circuit, A/D converter.

Text /References:

1. D.V. S. Murty, "TransducersandInstrumentation", Prentice-Hallof India Private Limited, 2013.
2. C.S. Rangan,G.R.Sarma andV.S.V. Mani, "InstrumentationDevices&Systems", McGraw Hill.
3. A. K. Sawhney, "AcourseinElectrical&ElectronicMeasurements& Instrumentation", DhanpatRai&Sons.

110806	Wind and Solar Energy Systems	3L:0T:0P	3 credits

Course Outcomes:

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

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

Module 1: Physics of Wind Power: (5 Hours)

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

Module 2: Wind generator topologies: (12 Hours)

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

Module 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solarday length, Estimation of solar energyavailability.

Module 4: Solar photovoltaic: (8 Hours)

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.

Module 5: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive powerregulation,voltageandfrequencyoperatinglimits,solarPVandwindfarmbehaviorduringgrid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and windsystems.

Module 6: Solar thermal power generation: (3 Hours)

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

Text / References:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd.,2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons,2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill,1984.
4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion

systems" John Wiley and Sons Ltd.,2006.
5. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications,2004.
6. J. A. Duffie and W. A. Beckman, "Solar Engineering of Thermal Processes", John Wiley & Sons,1991.