CREDIT TABLE

FOR

102 - MECHANICAL ENGINEERING

SEMESTER – I

Sl. No.	Course Code	Course Title	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	BSC	Physics (Electromagnetism)	30	70	100	3	1	0	4	4
2	BSC	Mathematics –I (Calculus and Linear Algebra)	30	70	100	3	1	0	4	4
3	ESC	Basic Electrical Engineering	30	70	100	3	1	0	4	4
4	ESC	Engineering Graphics & Design	30	70	100	1	0	0	1	1
Practical										
1	BSC	Physics (Electromagnetism)	20	30	50	0	0	3	1.5	3
2	ESC	Basic Electrical Engineering	20	30	50	0	0	2	1	2
3	ESC	Engineering Graphics & Design	20	30	50	0	0	4	2	4
	Total				550				17.5	22

TOTAL MARKS: 550 TOTAL CREDITS: 17.5 TOTAL HOURS: 22

BSC	**Physics (Electromagnetism)**	**L:3**	**T:1**	**P:3**	**Credit:5.5**

INTRODUCTION TO ELECTROMAGNETIC THEORY [L: 3; T: 1; P: 0 (4 CREDITS)] ***PRE-REQUISITES (IF ANY) MATHEMATICS COURSE WITH VECTOR CALCULUS*** ***DETAILED CONTENTS:***

MODULE 1: ELECTROSTATICS IN VACUUM (8 LECTURES)

CALCULATION OF ELECTRIC FIELD AND ELECTROSTATIC POTENTIAL FOR A CHARGE DISTRIBUTION; DIVERGENCE AND CURL OF ELECTROSTATIC FIELD; LAPLACE'S AND POISSON'S EQUATIONS FOR ELECTROSTATIC POTENTIAL AND UNIQUENESS OF THEIR SOLUTION AND CONNECTION WITH STEADY STATE DIFFUSION AND THERMAL CONDUCTION; PRACTICAL EXAMPLES LIKE FARADY'S CAGE AND COFFEE-RING EFFECT; BOUNDARY CONDITIONS OF ELECTRIC FIELD AND ELECTROSTATIC POTENTIAL; METHOD OF IMAGES; ENERGY OF A CHARGE DISTRIBUTION AND ITS EXPRESSION IN TERMS OF ELECTRIC FIELD.

MODULE 2: ELECTROSTATICS IN A LINEAR DIELECTRIC MEDIUM (4 LECTURES)

ELECTROSTATIC FIELD AND POTENTIAL OF A DIPOLE. BOUND CHARGES DUE TO ELECTRIC POLARIZATION; ELECTRIC DISPLACEMENT; BOUNDARY CONDITIONS ON DISPLACEMENT; SOLVING SIMPLE ELECTROSTATICS PROBLEMS IN PRESENCE OF DIELECTRICS – POINT CHARGE AT THE CENTRE OF A DIELECTRIC SPHERE, CHARGE IN FRONT OF A DIELECTRIC SLAB, DIELECTRIC SLAB AND DIELECTRIC SPHERE IN UNIFORM ELECTRIC FIELD.

MODULE 3: MAGNETOSTATICS (6 LECTURES)

BIO-SAVART LAW, DIVERGENCE AND CURL OF STATIC MAGNETIC FIELD; VECTOR POTENTIAL AND CALCULATING IT FOR A GIVEN MAGNETIC FIELD USING STOKES' THEOREM; THE EQUATION FOR THE VECTOR POTENTIAL AND ITS SOLUTION FOR GIVEN CURRENT DENSITIES.

MODULE 4: MAGNETOSTATICS IN A LINEAR MAGNETIC MEDIUM (3 LECTURES)

MAGNETIZATION AND ASSOCIATED BOUND CURRENTS; AUXILIARY MAGNETIC FIELD; BOUNDARY CONDITIONS ON AND. SOLVING FOR MAGNETIC FIELD DUE TO SIMPLE MAGNETS LIKE A BAR MAGNET; MAGNETIC SUSCEPTIBILITY AND FERROMAGNETIC, PARAMAGNETIC AND DIAMAGNETIC MATERIALS; QUALITATIVE DISCUSSION OF MAGNETIC FIELD IN PRESENCE OF

MAGNETIC MATERIALS.

MODULE 5: FARADAY'S LAW (4 LECTURES)

FARADAY'S LAW IN TERMS OF EMF PRODUCED BY CHANGING MAGNETIC FLUX; EQUIVALENCE OF FARADAY'S LAW AND MOTIONAL EMF; LENZ'S LAW; ELECTROMAGNETIC BREAKING AND ITS APPLICATIONS; DIFFERENTIAL FORM OF FARADAY'S LAW EXPRESSINCURL OF ELECTRIC FIELD IN TERMS OF TIME-DERIVATIVE OF MAGNETIC FIELD AND CALCULATING ELECTRIC FIELD DUE TO CHANGING MAGNETIC FIELDS IN QUASI-STATIC APPROXIMATION; ENERGY STORED IN A MAGNETIC FIELD.

MODULE 6: DISPLACEMENT CURRENT, MAGNETIC FIELD DUE TO TIME-DEPENDENT ELECTRIC FIELD AND MAXWELL'S EQUATIONS (5 LECTURES)

CONTINUITY EQUATION FOR CURRENT DENSITIES; MODIFYING EQUATION FOR THE CURL OF MAGNETIC FIELD TO SATISFY CONTINUITY EQUATION; DISPLACE CURRENT AND MAGNETIC FIELD ARISING FROM TIME- DEPENDENT ELECTRIC FIELD; CALCULATING MAGNETIC FIELD DUE TO CHANGING ELECTRIC FIELDS IN QUASI- STATIC APPROXIMATION. MAXWELL'S EQUATION IN VACUUM AND NON-CONDUCTING MEDIUM; ENERGY IN AN ELECTROMAGNETIC FIELD; FLOW OF ENERGY AND POYNTING VECTOR WITH EXAMPLES. QUALITATIVE DISCUSSION OF MOMENTUM IN ELECTROMAGNETIC FIELDS.

MODULE 7: ELECTROMAGNETIC WAVES (8 LECTURES)

THE WAVE EQUATION; PLANE ELECTROMAGNETIC WAVES IN VACUUM, THEIR TRANSVERSE NATURE AND POLARIZATION; RELATION BETWEEN ELECTRIC AND MAGNETIC FIELDS OF AN ELECTROMAGNETIC WAVE; ENERGY CARRIED BY ELECTROMAGNETIC WAVES AND EXAMPLES. MOMENTUM CARRIED BY ELECTROMAGNETIC WAVES AND RESULTANT PRESSURE. REFLECTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES FROM A NON-CONDUCTING MEDIUM-VACUUM INTERFACE FOR NORMAL INCIDENCE.

SUGGESTED TEXT BOOKS

- DAVID GRIFFITHS, INTRODUCTION TO ELECTRODYNAMICS

SUGGESTED REFERENCE BOOKS:

- *HALLIDAY AND RESNICK, PHYSICS*
- *W. SASLOW, ELECTRICITY, MAGNETISM AND LIGHT*

LABORATORY - INTRODUCTION TO ELECTROMAGNETIC THEORY [L:0;T:0;P:3 (1.5 CREDITS)]

CHOICE OF EXPERIMENTS FROM THE FOLLOWING:

- EXPERIMENTS ON ELECTROMAGNETIC INDUCTION AND ELECTROMAGNETIC BREAKING;
- LC CIRCUIT AND LCR CIRCUIT;
- RESONANCE PHENOMENA IN LCR CIRCUITS;
- MAGNETIC FIELD FROM HELMHOLTZ COIL;
- MEASUREMENT OF LORENTZ FORCE IN A VACUUM TUBE

BSC	Mathematics –I (Calculus & Linear Algebra)	L:3	T:1	P:0	Credit:4

DETAILED CONTENTS

MODULE 1: CALCULUS: (6 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.

MODULE 2: CALCULUS: (6 LECTURES)

ROLLE'S THEOREM, MEAN VALUE THEOREMS, TAYLOR'S AND MACLAURIN THEOREMS WITH REMAINDERS; INDETERMINATE FORMS AND L'HOSPITAL'S RULE; MAXIMA AND MINIMA.

MODULE 3: SEQUENCES AND SERIES: (10 LECTURES)

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

MODULE 4: MULTIVARIABLE CALCULUS (DIFFERENTIATION): (8 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 5: MATRICES (10 LECTURES)

INVERSE AND RANK OF A MATRIX, RANK-NULLITY THEOREM; SYSTEM OF LINEAR EQUATIONS; SYMMETRIC, SKEW-SYMMETRIC AND ORTHOGONAL MATRICES; DETERMINANTS; EIGENVALUES AND EIGENVECTORS; DIAGONALIZATION OF MATRICES; CAYLEY-HAMILTON THEOREM, AND ORTHOGONAL TRANSFORMATION.

SUGGESTED TEXT/REFERENCE BOOKS

. *G.B. THOMAS AND R.L. FINNEY, CALCULUS AND ANALYTIC GEOMETRY, 9TH EDITION,*

PEARSON, REPRINT, 2002.

- *ERWIN KREYSZIG, ADVANCED ENGINEERING MATHEMATICS, 9TH EDITION, JOHN WILEY & SONS, 2006.*
- *VEERARAJAN T., ENGINEERING MATHEMATICS FOR FIRST YEAR, TATA MCGRAW-HILL, NEW DELHI, 2008.*
- *RAMANA B.V., HIGHER ENGINEERING MATHEMATICS, TATA MCGRAW HILL NEW DELHI, 11TH REPRINT, 2010.*
- *D. POOLE, LINEAR ALGEBRA: A MODERN INTRODUCTION, 2ND EDITION, BROOKS/COLE, 2005.*
- *N.P. BALI AND MANISH GOYAL, A TEXT BOOK OF ENGINEERING MATHEMATICS, LAXMI PUBLICATIONS, REPRINT, 2008.*
- *B.S. GREWAL, HIGHER ENGINEERING MATHEMATICS, KHANNA PUBLISHERS, 36TH EDITION, 2010.*

COURSE OUTCOMES

THE OBJECTIVE OF THIS COURSE IS TO FAMILIARIZE THE PROSPECTIVE ENGINEERS WITH TECHNIQUES IN CALCULUS, MULTIVARIATE ANALYSIS AND LINEAR ALGEBRA. IT AIMS TO EQUIP THE STUDENTS WITH STANDARD CONCEPTS AND TOOLS AT AN INTERMEDIATE TO ADVANCED LEVEL THAT WILL SERVE THEM WELL TOWARDS TACKLING MORE ADVANCED LEVEL OF MATHEMATICS AND APPLICATIONS THAT THEY WOULD FIND USEFUL IN THEIR DISCIPLINES.

THE STUDENTS WILL LEARN:

- TO APPLY DIFFERENTIAL AND INTEGRAL CALCULUS TO NOTIONS OF CURVATURE AND TO IMPROPER INTEGRALS. APART FROM SOME OTHER APPLICATIONS THEY WILL HAVE A BASIC UNDERSTANDING OF BETA AND GAMMA FUNCTIONS.
- THE FALLOUTS OF ROLLE'S THEOREM THAT IS FUNDAMENTAL TO APPLICATION OF ANALYSIS TO ENGINEERING PROBLEMS.
- THE TOOL OF POWER SERIES AND FOURIER SERIES FOR LEARNING ADVANCED ENGINEERING MATHEMATICS.
- TO DEAL WITH FUNCTIONS OF SEVERAL VARIABLES THAT ARE ESSENTIAL IN MOST BRANCHES OF ENGINEERING.
- THE ESSENTIAL TOOL OF MATRICES AND LINEAR ALGEBRA IN A COMPREHENSIVE MANNER

ESC	Basic Electrical Engineering	L:3	T:1	P:2	Credit:5

MODULE 1: DC CIRCUITS (8 LECTURES)

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

MODULE 2: AC CIRCUITS (8 LECTURES)

REPRESENTATION OF SINUSOIDAL WAVEFORMS, PEAK, RMS AND AVERAGE VALUES (FORM FACTOR AND PEAK FACTOR), IMPEDANCE OF SERIES AND PARALLEL CIRCUIT, PHASOR REPRESENTATION, REAL POWER, REACTIVE POWER, APPARENT POWER, POWER FACTOR, 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.

MODULE 3: MAGNETIC CIRCUITS: (4 LECTURES)

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

MODULE 4: TRANSFORMERS (6 LECTURES)

MAGNETIC MATERIALS, BH CHARACTERISTICS, IDEAL AND PRACTICAL TRANSFORMER, EMF EQUATION, EQUIVALENT CIRCUIT, LOSSES IN TRANSFORMERS, REGULATION AND EFFICIENCY. AUTO-TRANSFORMER AND THREE-PHASE TRANSFORMER CONNECTIONS.

MODULE 5: ELECTRICAL MACHINES (10 LECTURES)

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-SLIP CHARACTERISTIC. LOSS

COMPONENTS AND EFFICIENCY, STARTING AND SPEED CONTROL OF INDUCTION MOTOR. CONSTRUCTION AND WORKING OF SYNCHRONOUS GENERATORS.

MODULE 6: ELECTRICAL INSTALLATIONS (6 LECTURES)

COMPONENTS OF LT SWITCHGEAR: SWITCH FUSE UNIT (SFU), MCB, ELCB, MCCB, TYPES OF WIRES AND CABLES, EARTHING. TYPES OF BATTERIES, IMPORTANT CHARACTERISTICS FOR BATTERIES. ELEMENTARY CALCULATIONS FOR ENERGY CONSUMPTION, POWER FACTOR IMPROVEMENT AND BATTERY BACKUP.

SUGGESTED TEXT / REFERENCE BOOKS

- *D. P. KOTHARI AND I. J. NAGRATH, "BASIC ELECTRICAL ENGINEERING", TATA MCGRAW HILL, 2010.*
- *D. C. KULSHRESHTHA, "BASIC ELECTRICAL ENGINEERING", MCGRAW HILL, 2009.*
- *L. S. BOBROW, "FUNDAMENTALS OF ELECTRICAL ENGINEERING", OXFORD UNIVERSITY PRESS, 2011.*
- *E. HUGHES, "ELECTRICAL AND ELECTRONICS TECHNOLOGY", PEARSON, 2010.*
- *V. D. TORO, "ELECTRICAL ENGINEERING FUNDAMENTALS", PRENTICE HALL INDIA, 1989.*
- *BASIC ELECTRICAL ENGINEERING BY FITZERALD, ET AL, TATA MCGRAW HILL*
- *FUNDAMENTALS OF ELECTRICAL ENGG. BY R. PRASAD, PHI PUBLICATION*
- *BASIC ELECTRICAL ENGINEERING BY V.K. MEHTA AND ROHIT MEHTA, S.CHAND PUBLICATION*

COURSE OUTCOMES

- TO UNDERSTAND AND ANALYZE BASIC ELECTRIC AND MAGNETIC CIRCUITS
- TO STUDY THE WORKING PRINCIPLES OF ELECTRICAL MACHINES AND POWER CONVERTERS.
- TO INTRODUCE THE COMPONENTS OF LOW VOLTAGE ELECTRICAL INSTALLATIONS

LABORATORY

LIST OF EXPERIMENTS/DEMONSTRATIONS

- BASIC SAFETY PRECAUTIONS. INTRODUCTION AND USE OF MEASURING INSTRUMENTS
  – 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-C CIRCUITS TO A STEP CHANGE IN VOLTAGE (TRANSIENT MAY BE OBSERVED ON A STORAGE OSCILLOSCOPE). SINUSOIDAL STEADY STATE RESPONSE OF R-L, AND R- C CIRCUITS – IMPEDANCE CALCULATION AND VERIFICATION. OBSERVATION OF PHASE DIFFERENCES BETWEEN

CURRENT AND VOLTAGE. RESONANCE IN R-L-C CIRCUITS.

- TRANSFORMERS: OBSERVATION OF THE NO-LOAD CURRENT WAVEFORM ON AN OSCILLOSCOPE (NON- SINUSOIDAL WAVE-SHAPE DUE TO B-H CURVE NONLINEARITY SHOULD BE SHOWN ALONG WITH A DISCUSSION ABOUT HARMONICS). LOADING OF A TRANSFORMER: MEASUREMENT OF PRIMARY AND SECONDARY VOLTAGES AND CURRENTS, AND POWER.
- THREE-PHASE TRANSFORMERS: STAR AND DELTA CONNECTIONS. VOLTAGE AND CURRENT RELATIONSHIPS (LINE-LINE VOLTAGE, PHASE-TO-NEUTRAL VOLTAGE, LINE AND PHASE CURRENTS). PHASE-SHIFTS BETWEEN THE PRIMARY AND SECONDARY SIDE. CUMULATIVE THREE-PHASE POWER IN BALANCED THREE-PHASE CIRCUITS.
- DEMONSTRATION OF CUT-OUT SECTIONS OF MACHINES: DC MACHINE (COMMUTATOR- BRUSH ARRANGEMENT), INDUCTION MACHINE (SQUIRREL CAGE ROTOR), SYNCHRONOUS MACHINE (FIELD WINGING - SLIP RING ARRANGEMENT) AND SINGLE-PHASE INDUCTION MACHINE.
- TORQUE SPEED CHARACTERISTIC OF SEPARATELY EXCITED DC MOTOR.
- 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.
- SYNCHRONOUS MACHINE OPERATING AS A GENERATOR: STAND-ALONE OPERATION WITH A LOAD. CONTROL OF VOLTAGE THROUGH FIELD EXCITATION.
- DEMONSTRATION OF (A) DC-DC CONVERTERS (B) DC-AC CONVERTERS – PWM WAVEFORM
  (C) THE USE OF DC-AC CONVERTER FOR SPEED CONTROL OF AN INDUCTION MOTOR AND (D) COMPONENTS OF LT SWITCHGEAR.

LABORATORY OUTCOMES

- GET AN EXPOSURE TO COMMON ELECTRICAL COMPONENTS AND THEIR RATINGS.
- MAKE ELECTRICAL CONNECTIONS BY WIRES OF APPROPRIATE RATINGS.
- UNDERSTAND THE USAGE OF COMMON ELECTRICAL MEASURING INSTRUMENTS.
- UNDERSTAND THE BASIC CHARACTERISTICS OF TRANSFORMERS AND ELECTRICAL MACHINES.
- GET AN EXPOSURE TO THE WORKING OF POWER ELECTRONIC CONVERTERS

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

TRADITIONAL ENGINEERING GRAPHICS:

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

COMPUTER GRAPHICS:

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).

(EXCEPT THE BASIC ESSENTIAL CONCEPTS, MOST OF THE TEACHING PART CAN HAPPEN CONCURRENTLY IN THE LABORATORY)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING

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

MODULE 2: ORTHOGRAPHIC PROJECTIONS

PRINCIPLES OF ORTHOGRAPHIC PROJECTIONS-CONVENTIONS - PROJECTIONS OF POINTS AND LINES INCLINED TO BOTH PLANES; PROJECTIONS OF PLANES INCLINED PLANES - AUXILIARY PLANES

MODULE 3: PROJECTIONS OF REGULAR SOLIDS

THOSE INCLINED TO BOTH THE PLANES- AUXILIARY VIEWS; DRAW SIMPLE ANNOTATION, DIMENSIONING AND SCALE. FLOOR PLANS THAT INCLUDE: WINDOWS, DOORS, AND FIXTURES SUCH AS WC, BATH, SINK, SHOWER, ETC.

MODULE 4: SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS

COVERING, PRISM, CYLINDER, PYRAMID, CONE – AUXILIARY VIEWS; DEVELOPMENT OF SURFACES OF RIGHT REGULAR SOLIDS- PRISM, PYRAMID, CYLINDER AND CONE; DRAW THE SECTIONAL ORTHOGRAPHIC VIEWS OF GEOMETRICAL SOLIDS, OBJECTS FROM INDUSTRY AND DWELLINGS (FOUNDATION TO SLAB ONLY)

MODULE 5: ISOMETRIC PROJECTIONS

PRINCIPLES OF ISOMETRIC PROJECTION – ISOMETRIC SCALE, ISOMETRIC VIEWS, CONVENTIONS; ISOMETRIC VIEWS OF LINES, PLANES, SIMPLE AND COMPOUND SOLIDS; CONVERSION OF ISOMETRIC VIEWS TO ORTHOGRAPHIC VIEWS AND VICE-VERSA, CONVENTIONS

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS

LISTING THE COMPUTER TECHNOLOGIES THAT IMPACT ON GRAPHICAL COMMUNICATION, DEMONSTRATING KNOWLEDGE OF THE THEORY OF CAD SOFTWARE [SUCH AS: THE MENU SYSTEM, TOOLBARS (STANDARD, OBJECT PROPERTIES, DRAW, MODIFY AND DIMENSION), DRAWING AREA (BACKGROUND, CROSSHAIRS, COORDINATE SYSTEM), DIALOG BOXES AND WINDOWS, SHORTCUT MENUS (BUTTON BARS), THE COMMAND LINE (WHERE APPLICABLE), THE STATUS BAR, DIFFERENT METHODS OF ZOOM AS USED IN CAD, SELECT AND ERASE OBJECTS.; ISOMETRIC VIEWS OF LINES, PLANES, SIMPLE AND COMPOUND SOLIDS]

MODULE 7: CUSTOMISATION& CAD DRAWING

CONSISTING OF SET UP OF THE DRAWING PAGE AND THE PRINTER, INCLUDING SCALE SETTINGS, SETTING UP OF UNITS AND DRAWING LIMITS; ISO AND ANSI STANDARDS FOR COORDINATE DIMENSIONING AND TOLERANCING; ORTHOGRAPHIC CONSTRAINTS, SNAP TO OBJECTS MANUALLY AND AUTOMATICALLY; PRODUCING DRAWINGS BY USING VARIOUS COORDINATE INPUT ENTRY METHODS TO DRAW STRAIGHT LINES, APPLYING VARIOUS WAYS OF DRAWING CIRCLES.

MODULE 8: ANNOTATIONS, LAYERING & OTHER FUNCTIONS

COVERING APPLYING DIMENSIONS TO OBJECTS, APPLYING ANNOTATIONS TO DRAWINGS; SETTING UP AND USE OF LAYERS, LAYERS TO CREATE DRAWINGS, CREATE, EDIT AND USE CUSTOMIZED LAYERS; CHANGING LINE LENGTHS THROUGH MODIFYING EXISTING LINES (EXTEND/LENGTHEN); PRINTING DOCUMENTS TO PAPER USING THE PRINT COMMAND; ORTHOGRAPHIC

PROJECTION TECHNIQUES; DRAWING SECTIONAL VIEWS OF COMPOSITE RIGHT REGULAR GEOMETRIC SOLIDS AND PROJECT THE TRUE SHAPE OF THE SECTIONED SURFACE; DRAWING ANNOTATION, COMPUTER-AIDED DESIGN (CAD) SOFTWARE MODELING OF PARTS AND ASSEMBLIES. PARAMETRIC AND NON-PARAMETRIC SOLID, SURFACE, AND WIREFRAME MODELS. PART EDITING AND TWO-DIMENSIONAL DOCUMENTATION OF MODELS. PLANAR PROJECTION THEORY, INCLUDING SKETCHING OF PERSPECTIVE, ISOMETRIC, MULTIVIEW, AUXILIARY, AND SECTION VIEWS. SPATIAL VISUALIZATION EXERCISES. DIMENSIONING GUIDELINES, TOLERANCING TECHNIQUES; DIMENSIONING AND SCALE MULTI VIEWS OF DWELLING.

MODULE 9: DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT THAT ILLUSTRATES

GEOMETRY AND TOPOLOGY OF ENGINEERED COMPONENTS: CREATION OF ENGINEERING MODELS AND THEIR PRESENTATION IN STANDARD 2D BLUEPRINT FORM AND AS 3D WIRE- FRAME AND SHADED SOLIDS; MESHED TOPOLOGIES FOR ENGINEERING ANALYSIS AND TOOL- PATH GENERATION FOR COMPONENT MANUFACTURE; GEOMETRIC DIMENSIONING AND TOLERANCING; USE OF SOLID-MODELING SOFTWARE FOR CREATING ASSOCIATIVE MODELS AT THE COMPONENT AND ASSEMBLY LEVELS. FLOOR PLANS THAT INCLUDE: WINDOWS, DOORS, AND FIXTURES SUCH AS WC, BATH, SINK, SHOWER, ETC. APPLYING COLOUR CODING ACCORDING TO BUILDING DRAWING PRACTICE; DRAWING SECTIONAL ELEVATION SHOWING FOUNDATION TO CEILING; INTRODUCTION TO BUILDING INFORMATION MODELLING (BIM).

SUGGESTED TEXT/REFERENCE BOOKS:

- *BHATT N.D., PANCHAL V.M. & INGLE P.R., (2014), ENGINEERING DRAWING, CHAROTAR PUBLISHING HOUSE*
- *SHAH, M.B. &RANA B.C. (2008), ENGINEERING DRAWING AND COMPUTER GRAPHICS, PEARSON EDUCATION*
- *AGRAWAL B. & AGRAWAL C. M. (2012), ENGINEERING GRAPHICS, TMH PUBLICATION*
- *NARAYANA, K.L. & P KANNAIAH (2008), TEXT BOOK ON ENGINEERING DRAWING, SCITECHPUBLISHERS*
- *(CORRESPONDING SET OF) CAD SOFTWARE THEORY AND USER MANUALS*

COURSE OUTCOMES

ALL PHASES OF MANUFACTURING OR CONSTRUCTION REQUIRE THE CONVERSION OF NEW IDEAS AND DESIGN CONCEPTS INTO THE BASIC LINE LANGUAGE OF GRAPHICS. THEREFORE, THERE ARE MANY AREAS (CIVIL, MECHANICAL, ELECTRICAL, ARCHITECTURAL AND INDUSTRIAL) IN WHICH THE SKILLS OF THE CAD TECHNICIANS PLAY MAJOR ROLES IN THE 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

THIS COURSE IS DESIGNED TO ADDRESS:

- TO PREPARE YOU TO DESIGN A SYSTEM, COMPONENT, OR PROCESS TO MEET DESIRED NEEDS WITHIN REALISTIC CONSTRAINTS SUCH AS ECONOMIC, ENVIRONMENTAL, SOCIAL, POLITICAL, ETHICAL, HEALTH AND SAFETY, MANUFACTURABILITY, AND SUSTAINABILITY
- TO PREPARE YOU TO COMMUNICATE EFFECTIVELY
- TO PREPARE YOU TO USE THE TECHNIQUES, SKILLS, AND MODERN ENGINEERING TOOLS NECESSARY FOR ENGINEERING PRACTICE

THE STUDENT WILL LEARN:

- INTRODUCTION TO ENGINEERING DESIGN AND ITS PLACE IN SOCIETY
- EXPOSURE TO THE VISUAL ASPECTS OF ENGINEERING DESIGN
- EXPOSURE TO ENGINEERING GRAPHICS STANDARDS
- EXPOSURE TO SOLID MODELLING
- EXPOSURE TO COMPUTER-AIDED GEOMETRIC DESIGN
- EXPOSURE TO CREATING WORKING DRAWINGS
- EXPOSURE TO ENGINEERING COMMUNICATION

CREDITTABLE

FOR102-
MECHANICALENGINEERING

SEMESTER– II

Sl. No.	Course Code	CourseTitle	IA	ESE	TOTAL	L	T	P	Credit	Hours
Theory										
1	BSC	Chemistry	30	70	100	3	1	0	4	4
2	BSC	Mathematics–II(ODE& ComplexVariables)	30	70	100	3	1	0	4	4
3	ESC	ProgrammingforProblem Solving	30	70	100	3	0	0	3	3
4	ESC	WorkshopManufacturing 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	ProgrammingforProblem Solving	20	30	50	0	0	4	2	4
3	ESC	WorkshopManufacturing 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

TOTALHOURS:27 IA (INTERNAL

ASSESMENT), ESE (END SEMESTER EXAMINATION)

BSC	Mathematics–II(ODE&ComplexVariables)	L:3	T:1	P:0	Credit:4

DETAILEDCONTENTS

MODULE1:MULTIVARIABLECALCULUS(INTEGRATION):(10LECTURES)

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

MODULE2:FIRSTORDERORDINARYDIFFERENTIALEQUATIONS:(6LECTURES)

EXACT,LINEARANDBERNOULLI'SEQUATIONS,EULER'SEQUATIONS,EQUATIONSNOT OFFIRSTDEGREE:EQUATIONSSOLVABLEFORP,EQUATIONSSOLVABLEFORY,EQUATIONS SOLVABLE FOR X AND CLAIRAUT'S TYPE.

MODULE3:ORDINARYDIFFERENTIALEQUATIONSOFHIGHERORDERS:(8LECTURES)

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.

MODULE4:COMPLEXVARIABLE–DIFFERENTIATION:(8LECTURES)

DIFFERENTIATION, CAUCHY-RIEMANN EQUATIONS, ANALYTIC FUNCTIONS, HARMONIC FUNCTIONS, FINDING HARMONIC CONJUGATE; ELEMENTARY ANALYTIC FUNCTIONS (EXPONENTIAL, TRIGONOMETRIC, LOGARITHM) AND THEIR PROPERTIES; CONFORMAL MAPPINGS, MOBIUS TRANSFORMATIONS AND THEIR PROPERTIES.

MODULE5:COMPLEXVARIABLE–INTEGRATION:(8LECTURES)

CONTOUR INTEGRALS, CAUCHY-GOURSAT THEOREM (WITHOUT PROOF), CAUCHY INTEGRALFORMULA (WITHOUT PROOF), LIOUVILLE'S THEOREM AND MAXIMUM-MODULUS THEOREM (WITHOUT PROOF); TAYLOR'S SERIES, ZEROS OF ANALYTIC FUNCTIONS, SINGULARITIES, LAURENT'S SERIES; RESIDUES, CAUCHY RESIDUE THEOREM (WITHOUT PROOF),EVALUATIONOFDEFINITEINTEGRALINVOLVINGSINEANDCOSINE,EVALUATION OF CERTAIN IMPROPER INTEGRALS USING THE BROMWICH CONTOUR.

SUGGESTEDTEXT/REFERENCEBOOKS

- *G.B.THOMASANDR.L.FINNEY,CALCULUSANDANALYTICGEOMETRY,9THEDITION, PEARSON, REPRINT, 2002.*
- *ERWINKREYSZIG,ADVANCEDENGINEERINGMATHEMATICS,9THEDITION,JOHNWILEY & SONS,2006.*
- *W.E.BOYCEANDR.C.DIPRIMA,ELEMENTARYDIFFERENTIALEQUATIONSAND BOUNDARY*
- *VALUEPROBLEMS,9THEDN.,WILEYINDIA,2009.*
- *S.L.ROSS,DIFFERENTIALEQUATIONS,3RDED.,WILEYINDIA,1984.*
- *E.A.CODDINGTON,ANINTRODUCTIONTOORDINARYDIFFERENTIALEQUATIONS, PRENTICE HALL INDIA, 1995.*
- *E.L.INCE,ORDINARYDIFFERENTIALEQUATIONS,DOVERPUBLICATIONS,1958.*
- *J.W.BROWNANDR.V.CHURCHILL,COMPLEXVARIABLESANDAPPLICATIONS,7TH ED., MC- GRAW HILL, 2004.*
- *N.P.BALIANDMANISHGOYAL,ATEXTBOOKOFENGINEERINGMATHEMATICS, LAXMI PUBLICATIONS, REPRINT, 2008.*
- *B.S.GREWAL,HIGHERENGINEERINGMATHEMATICS,KHANNAPUBLISHERS,36TH EDITION, 2010.*

COURSEOUTCOMES

- THEOBJECTIVEOFTHISCOURSEISTOFAMILIARIZETHEPROSPECTIVEENGINEERS WITH TECHNIQUES IN
- MULTIVARIATEINTEGRATION,ORDINARYANDPARTIALDIFFERENTIALEQUATIONSAND COMPLEX VARIABLES. IT AIMS TO EQUIP THE STUDENTS TO DEAL WITH ADVANCED LEVEL OF MATHEMATICS AND APPLICATIONS THAT WOULD BE ESSENTIAL FOR THEIR DISCIPLINES.

THESTUDENTSWILLLEARN

- THEMATHEMATICALTOOLSNEEDEDINEVALUATINGMULTIPLEINTEGRALS

ANDTHEIR USAGE.

- THEEFFECTIVEMATHEMATICALTOOLSFORTHESOLUTIONSOFDIFFERENTIAL EQUATIONS THAT MODEL PHYSICAL PROCESSES.
- THE TOOLS OF DIFFERENTIATION AND INTEGRATION OF FUNCTIONS OF A COMPLEX VARIABLETHATAREUSEDINVARIOUSTECHNIQUESDEALINGENGINEERINGPROBLEMS

BSC	Chemistry	L:3	T:1	P:3	Credit5.5

MODULE1:ATOMICANDMOLECULARSTRUCTURE(10LECTURES)

FAILUREOFCLASSICALNEWTONIANANDMAXWELLWAVEMECHANICSTOEXPLAIN PROPERTIESOFPARTICLESATATOMICANDSUB-ATOMICLEVEL;ELECTROMAGNETIC RADIATION,DUALNATUREOFELECTRONANDELECTROMAGNETICRADIATION,PLANK'STHEORY, PHOTOELECTRIC EFFECT AND HEISENBERG UNCERTAINTY PRINCIPLE.FAILURE OF EARLIER THEORIESTOEXPLAINCERTAINPROPERTIESOFMOLECULESLIKEPARAMAGNETICPROPERTIES. PRINCIPLES FOR COMBINATION OF ATOMIC ORBITALS TO FORM MOLECULAR ORBITALS. FORMATIONOFHOMOANDHETERODIATOMICMOLECULESANDPLOTSOFENERGYLEVEL DIAGRAM OF MOLECULAR ORBITALS. COORDINATION NUMBERS AND GEOMETRIES, ISOMERISM INTRANSITIONALMETALCOMPOUNDS,CRYSTALFIELDTHEORYANDTHEENERGYLEVEL DIAGRAMS FOR TRANSITION METAL IONS AND THEIR MAGNETIC PROPERTIES.

MODULE2:SPECTROSCOPICTECHNIQUESANDAPPLICATIONS(8LECTURES)

PRINCIPLESOFVIBRATIONALANDROTATIONALSPECTROSCOPYANDSELECTIONRULES 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.

MODULE3:INTERMOLECULARFORCESANDPROPERTIESOFGASES(4LECTURES)

IONIC,DIPOLARANDVANDERWAALSINTERACTIONS.EQUATIONSOFSTATEOFIDEAL 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,THENERNSTEQUATIONANDAPPLICATIONS.CORROSION.USEOFFREE ENERGY CONSIDERATIONSINMETALLURGYTHROUGHELLINGHAMDIAGRAMS.SOLUBILITY EQUILIBRIA.

WATER CHEMISTRY, HARD AND SOFT WATER. PARAMETERS OF QUALITY OF WATER TO BEUSEDINDIFFERENTINDUSTRIESASFORDRINKINGWATER.CALCULATIONOFHARDNESS OFWATERINALLUNITS.ESTIMATIONOFHARDNESSUSINGEDTAANDALKALINITYMETHOD. REMOVAL OF HARDNESS BY SODA LIME AND ION EXCHANGE METHOD INCLUDING ZEOLITE METHOD

MODULE5:PERIODICPROPERTIES(4LECTURES)

EFFECTIVE NUCLEAR CHARGE, PENETRATION OF ORBITALS, VARIATIONS OF S, P, D ANDFORBITALENERGIESOFATOMSINTHEPERIODICTABLE,ELECTRONICCONFIGURATIONS, ATOMIC AND IONIC SIZES, IONIZATION ENERGIES, ELECTRON AFFINITY AND ELECTRONEGATIVITY, POLARIZABILITY, ACID, BASE, PRINCIPLE OF HSAB THEORY, OXIDATION STATES,HYBRIDIZATION ANDMOLECULAR GEOMETRIES.

MODULE6:STEREOCHEMISTRY(4LECTURES)

REPRESENTATIONSOF3-DSTRUCTURES,STRUCTURALISOMERSANDSTEREOISOMERS, CONFIGURATIONSANDSYMMETRYANDCHIRALITY,ENANTIOMERS,DIASTEREOMERS,OPTICAL ACTIVITY, ABSOLUTE CONFIGURATIONS AND CONFORMATIONAL ANALYSIS.

MODULE7:ORGANICREACTIONSANDSYNTHESISOFADRUGMOLECULE(4LECTURES)

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.

SUGGESTEDTEXTBOOKS

- *UNIVERSITYCHEMISTRY,BYB.H.MAHAN*
- *CHEMISTRY:PRINCIPLESANDAPPLICATIONS,BYM.J.SIENKOANDR.A.PLANE*
- *FUNDAMENTALSOFMOLECULARSPECTROSCOPY,BYC.N.BANWELL*
- *ENGINEERINGCHEMISTRY(NPTELWEB-BOOK),BYB.L.TEMBE,KAMALUDDINANDM. S.KRISHNAN*
- *PHYSICALCHEMISTRY,BYP.W.ATKINS*
- *ORGANICCHEMISTRY:STRUCTUREANDFUNCTIONBYK.P.C.VOLHARDTANDN.E. SCHORE, 5TH EDITION*
- *HTTP://BCS.WHFREEMAN.COM/VOLLHARDTSCHORE5E/DEFAULT.ASP*

COURSEOUTCOMES

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. DISTINGUISHTHERANGESOFTHEELECTROMAGNETICSPECTRUMUSEDFOREXCITIN G
DIFFERENTMOLECULARENERGYLEVELSINVARIOUSSPECTROSCOPICTECHNIQUES RATIONALISEPERIODICPROPERTIESSUCHASIONIZATIONPOTENTIAL,ELECTRONEG ATIVITY, OXIDATION STATES AND ELECTRONEGATIVITY.LIST MAJOR CHEMICAL REACTIONS THAT ARE USED IN THE SYNTHESIS OF MOLECULES.

CHEMISTRYLABORATORY

CHOICEOF10-12EXPERIMENTSFROMTHEFOLLOWING

- DETERMINATIONOFSURFACETENSIONANDVISCOSITY
- THINLAYERCHROMATOGRAPHY
- IONEXCHANGECOLUMNFORREMOVALOFHARDNESSOFWATER
- DETERMINATIONOFCHLORIDECONTENTOFWATER
- COLLIGATIVEPROPERTIESUSINGFREEZINGPOINTDEPRESSION
- DETERMINATIONOFTHERATECONSTANTOFAREACTION
- DETERMINATIONOFCELLCONSTANTANDCONDUCTANCEOFSOLUTIONS
- POTENTIOMETRY-DETERMINATIONOFREDOXPOTENTIALSANDEMFS
- SYNTHESISOFAPOLYMER/DRUG
- SAPONIFICATION/ACIDVALUEOFANOIL
- CHEMICALANALYSISOFASALT
- LATTICESTRUCTURESANDPACKINGOFSPHERES
- MODELSOFPOTENTIALENERGYSURFACES
- CHEMICALOSCILLATIONS-IODINECLOCKREACTION
- DETERMINATIONOFTHEPARTITIONCOEFFICIENTOFASUBSTANCEBETWEEN TWO IMMISCIBLE LIQUIDS

- ADSORPTIONOFACETICACIDBYCHARCOAL
- USEOFTHECAPILLARYVISCOSIMETERSTOTHEDEMONSTRATEOFTHEISOELECTRIC POINTASTHEPHOFMINIMUMVISCOSITYFORGELATINSOLSAND/ORCOAGULATION OF THE WHITE PART OF EGG.

LABORATORYOUTCOMES

THECHEMISTRYLABORATORYCOURSEWILLCONSISTOFEXPERIMENTS ILLUSTRATINGTHEPRINCIPLESOFCHEMISTRYRELEVANTTOTHESTUDYOFSCIENCEAND ENGINEERING. THE STUDENTS WILL LEARN TO: ESTIMATE RATE CONSTANTS OF REACTIONS FROM CONCENTRATION OF REACTANTS/PRODUCTS AS A FUNCTION OF TIME MEASURE MOLECULAR/SYSTEMPROPERTIESSUCHASSURFACETENSION,VISCOSITY,CONDUCTANCEOF SOLUTIONS,REDOXPOTENTIALS,CHLORIDECONTENTOFWATER,ETCSYNTHESIZE ASMALL DRUG MOLECULE AND ANALYSE A SALT SAMPLE

ESC	ProgrammingforProblemSolving	L:3	T:0	P:4	Credit:5

MODULE1:INTRODUCTIONTOPROGRAMMING(6LECTURES)

INTRODUCTIONTOCOMPONENTSOFACOMPUTERSYSTEM(DISKS,MEMORY,PROCESSOR, WHEREAPROGRAMISSTOREDANDEXECUTED,OPERATINGSYSTEM,COMPILERSETC).IDEA OFALGORITHM:STEPSTOSOLVELOGICALANDNUMERICALPROBLEMS.REPRESENTATIONOF 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), STORAGECLASSES(AUTO,REGISTER,STATIC,EXTERN),SYNTAXANDLOGICALERRORSIN COMPILATION, OBJECT AND EXECUTABLE CODE.

MODULE2:OPERATORS(3LECTURES)

ARITHMETICEXPRESSIONS/ARITHMETICOPERATORS/ RELATIONALOPERATORS/LOGICAL OPERATORS/BITWISE OPERATORS AND PRECEDENCE

MODULE3:CONDITIONALBRANCHINGANDLOOPS(5LECTURES)

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

MODULE4:ARRAYS(4LECTURES)

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

MODULE5:BASICALGORITHMS(6LECTURES)

SEARCHING (LINEAR SEARCH, BINARY SEARCH ETC.), BASIC SORTING ALGORITHMS (BUBBLE,INSERTIONANDSELECTION),FINDINGROOTSOFEQUATIONS,NOTIONOFORDER OF COMPLEXITY THROUGH EXAMPLE PROGRAMS (NO FORMAL DEFINITION REQUIRED)

MODULE6:FUNCTION(4LECTURES)

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

MODULE7:RECURSION(5LECTURES)

RECURSION,ASADIFFERENTWAYOFSOLVINGPROBLEMS.EXAMPLEPROGRAMS,SUCH AS FINDING FACTORIAL, FIBONACCI SERIES, REVERSE A STRING USING RECURSION, AND GCD OF TWO NUMBERS, ACKERMAN FUNCTION ETC. QUICK SORT OR MERGE SORT.

MODULE8:STRUCTURE/UNION(3LECTURES)

STRUCTURES, ACCESSING STRUCTURE ELEMENTS, WAY OF STORAGE OF STRUCTURE ELEMENT,DEFININGSTRUCTURESANDARRAYOFSTRUCTURES,BASICDEFINITIONOFUNION, COMPARISON B/W STRUCTURE & UNION WITH EXAMPLE

MODULE9:POINTERS(5LECTURES)

IDEAOFPOINTERS,DEFININGPOINTERS,USEOFPOINTERSINSELF-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.

MODULE10:FILEHANDLING

(ONLYIFTIMEISAVAILABLE,OTHERWISESHOULDBEDONEASPARTOFTHELAB)

SUGGESTEDTEXTBOOKS

- *BYRONGOTTFRIED,SCHAUM'SOUTLINEOFPROGRAMMINGWITHC,MCGRAW-HILL*
- *E.BALAGURUSWAMY,PROGRAMMINGINANSIC,TATAMCGRAW-HILL*

SUGGESTEDREFERENCEBOOKS

- *BRIANW.KERNIGHANANDDENNISM.RITCHIE,THECPROGRAMMINGLANGUAGE, PRENTICE HALL OF INDIA*
- *YASHWANTKANETKAR,LETUSC,BPBPUBLICATION*

THESTUDENTWILLLEARN

- TOFORMULATESIMPLEALGORITHMSFORARITHMETICANDLOGICALPROBLEMS.
- TOTRANSLATETHEALGORITHMSTOPROGRAMS(INCLANGUAGE).
- TOTESTANDEXECUTETHEPROGRAMSANDCORRECTSYNTAXANDLOGICALERRORS.
- TOIMPLEMENTCONDITIONALBRANCHING,ITERATIONANDRECURSION.
- TODECOMPOSEAPROBLEMINTOFUNCTIONSANDSYNTHESIZEACOMPLETEPROGRAM 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.
- TOAPPLYPROGRAMMINGTOSOLVESIMPLENUMERICALMETHODPROBLEMS,NAMELY ROT FINDING OF FUNCTION, DIFFERENTIATION OF FUNCTION AND SIMPLE INTEGRATION.

LABORATORYPROGRAMMINGFORPROBLEMSOLVING

[THELABORATORYSHOULDBEPRECEDEDORFOLLOWEDBYATUTORIALTOEXPLAINTHE APPROACH OR ALGORITHM TO BE IMPLEMENTED FOR THE PROBLEM GIVEN.]

TUTORIAL1:PROBLEMSOLVINGUSINGCOMPUTERS:
LAB1:FAMILIARIZATIONWITHPROGRAMMINGENVIRONMENT

TUTORIAL2:VARIABLETYPESANDTYPECONVERSIONS:
LAB2:SIMPLECOMPUTATIONALPROBLEMSUSINGARITHMETICEXPRESSIONS

TUTORIAL 3: BRANCHING AND LOGICAL EXPRESSIONS: LAB3:PROBLEMSINVOLVINGIF-THEN-ELSESTRUCTURES

TUTORIAL4:LOOPS,WHILEANDFORLOOPS:
LAB4:ITERATIVEPROBLEMSE.G.,SUMOFSERIES

TUTORIAL5:1DARRAYS:SEARCHING,SORTING:
LAB 5: 1D ARRAY MANIPULATION
TUTORIAL6:2DARRAYSANDSTRINGS
LAB6:MATRIXPROBLEMS,STRINGOPERATIONS

TUTORIAL7:FUNCTIONS,CALLBYVALUE:
LAB7:SIMPLEFUNCTIONS

TUTORIAL8:NUMERICALMETHODS(ROOTFINDING,NUMERICALDIFFERENTIATION, NUMERICAL INTEGRATION):
LAB8:PROGRAMMINGFORSOLVINGNUMERICALMETHODSPROBLEMS

TUTORIAL9:RECURSION,STRUCTUREOFRECURSIVECALLS LAB 9: RECURSIVE FUNCTIONS

TUTORIAL10:POINTERS,STRUCTURESANDDYNAMICMEMORYALLOCATION LAB 10: POINTERS AND STRUCTURES

TUTORIAL11:FILEHANDLING:
LAB11:FILEOPERATIONS

LABORATORYOUTCOMES

- TOFORMULATETHEALGORITHMSFORSIMPLEPROBLEMS
- TOTRANSLATEGIVENALGORITHMSTOAWORKINGANDCORRECTPROGRAM

- TOBEABLETOCORRECTSYNTAXERRORSASREPORTEDBYTHECOMPILERS
- TO BE ABLE TO IDENTIFY AND CORRECT LOGICAL ERRORS ENCOUNTERED AT RUN TIME
- TOBEABLETOWRITEITERATIVEASWELLASRECURSIVEPROGRAMS
- TOBEABLETOREPRESENTDATAINARRAYS,STRINGSANDSTRUCTURESAN D MANIPULATE THEM THROUGH A PROGRAM
- TOBEABLETODECLAREPOINTERSOFDIFFERENTTYPESANDUSETHEMIN DEFINING SELF- REFERENTIAL STRUCTURES.
- TOBEABLETOCREATE,READANDWRITETOANDFROMSIMPLETEXTFILES.

ESC	WorkshopManufacturingPractices	L:1	T:0	P:4	Credit:3

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

DETAILEDCONTENTS:

1. MANUFACTURINGMETHODS-CASTING,FORMING,MACHINING,JOINING,ADVANCED MANUFACTURING METHODS (3 LECTURES)
2. CNCMACHINING,ADDITIVEMANUFACTURING(1LECTURE)
3. FITTINGOPERATIONS&POWERTOOLS(1LECTURE)
4. CARPENTRY(1LECTURE)
5. PLASTICMOULDING,GLASSCUTTING(1LECTURE)
6. METALCASTING(1LECTURE)
7. WELDING(ARCWELDING&GASWELDING),BRAZING,SOLDERING(2LECTURE)

SUGGESTEDTEXT/REFERENCEBOOKS:

- *HAJRACHOUDHURYS.K.,HAJRACHOUDHURYA.K.ANDNIRJHARROYS.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.*
- *RAOP.N.,"MANUFACTURINGTECHNOLOGY",VOL.IANDVOL.II,TATAMCGRAWHILL HOUSE, 2017.*

COURSEOUTCOMES:

- *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.*

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

1. MACHINESHOP(10HOURS)ANDFITTINGSHOP(8HOURS)
2. CARPENTRY(6HOURS)
3. WELDINGSHOP(8HOURS)(ARCWELDING4HRS+GASWELDING4HRS)
4. CASTING(8HOURS)ANDSMITHY(6HOURS)
5. PLASTICMOULDING&GLASSCUTTING(6HOURS)
6. 3-DPRINTINGOFDIFFERENTMODELS(8HOURS)

EXAMINATIONSCOULDINVOLVETHEACTUALFABRICATIONOFSIMPLECOMPONENTS, UTILIZING ONE OR MORE OF THE TECHNIQUES COVERED ABOVE.

LABORATORYOUTCOMES

- UPON COMPLETION OF THIS LABORATORY COURSE, STUDENTS WILL BE ABLE TO FABRICATE COMPONENTS WITH THEIR OWN HANDS.
- THEYWILLALSOGETPRACTICALKNOWLEDGEOFTHEDIMENSIONALACCURA

CIESAND DIMENSIONAL TOLERANCES POSSIBLE WITH DIFFERENT MANUFACTURING PROCESSES.

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

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

DETAILEDCONTENTS

1. **VOCABULARYBUILDING**
   - A. THECONCEPTOFWORDFORMATION
   - B. ROOTWORDSFROMFOREIGNLANGUAGESANDTHEIRUSEINENGLISH
   - C. ACQUAINTANCEWITHPREFIXESANDSUFFIXESFROMFOREIGNLANGUAGESIN ENGLISH TO FORM DERIVATIVES.
   - D. SYNONYMS,ANTONYMS,ANDSTANDARDABBREVIATIONS.
   - E. AFFIXES,ACRONYMS

2. **BASICWRITINGSKILLS**
   - A. SENTENCESTRUCTURES
   - B. USEOFPHRASESANDCLAUSESINSENTENCES
   - C. IMPORTANCEOFPROPERPUNCTUATION
   - D. KINDSOFSENTENCES
   - E. USEOFTENSE,USEINCONTEXTANDCOHERENCEOFTENSEINWRITING
   - F. USEOFVOICE–ACTIVE/PASSIVEINSENTENCES
   - G. USEOFSPEECH–DIRECTANDINDIRECTSPEECH
   - H. FRAMINGQUESTIONS-DIRECT,USINGMODALVERBS

3. **IDENTIFYINGCOMMONERRORSINWRITING**
   - A. SUBJECT-VERBAGREEMENT
   - B. NOUN-PRONOUNAGREEMENT
   - C. MISPLACEDMODIFIERS
   - D. ARTICLES
   - E. PREPOSITIONS
   - F. REDUNDANCIES
   - G. CLICHÉS
   - H. COMMONENGLISHERRORS

4. **NATUREANDSTYLEOFSENSIBLEWRITING**
   - A. DESCRIBING
   - B. DEFINING
   - C. CLASSIFYING
   - D. PROVIDINGEXAMPLESOREVIDENCE
   - E. WRITINGINTRODUCTIONANDCONCLUSION
   - F. ORGANISINGPRINCIPLEOFPARAGRAPHSINDOCUMENTS
   - G. ARGUMENT,DESCRIBING/NARRATING/PLANNING,DEFINING,CLASSIFYING
   - H. LEXICALRESOURCES,USINGSUITABLELANGUAGEREGISTER
   - I. COHERENCE,WRITINGINTRODUCTION,BODYANDCONCLUSION,TECHNIQUESFOR WRITING PRECISELY,GRAMMAR AND ACCURACY

5. **WRITINGPRACTICES**
   - A. COMPREHENSION
   - B. FORMALLETTERWRITING/APPLICATION/REPORTWRITING/ WRITINGMINUTESOF MEETINGS
   - C. ESSAYWRITING

D. FORMALEMAILWRITING
E. RESUME/CVWRITING,COVERLETTER,
F. STATEMENTOFPURPOSE

6. ORALCOMMUNICATION

(THISUNITINVOLVESINTERACTIVEPRACTICESESSIONSINLANGUAGELAB)

A. LISTENINGCOMPREHENSION
B. PRONUNCIATION,INTONATION,STRESSANDRHYTHM
C. COMMONEVERYDAYSITUATIONS:CONVERSATIONSANDDIALOGUES
D. COMMUNICATIONATWORKPLACE
E. INTERVIEWS
F. FORMALPRESENTATIONS
G. ACQUAINTINGSTUDENTSWITHIPASYMBOLS
H. PHONETICS(BASIC)
I. SOUNDS–VOWELS,CONSONANTS
J. CLEARINGMOTHERTONGUEINFLUENCE
K. CLEARINGREDUNDANCIESANDCOMMONERRORSRELATEDTOINDIANISMS
L. GROUPDISCUSSION
M. EXPRESSINGOPINIONS
N. COHERENCEANDFLUENCYINSPEECH

7. READINGSKILLS

A. READINGCOMPREHENSION,
B. PARAGRAPHREADINGBASEDONPHONETICSOUNDS/INTONATION

8. PROFESSIONALSKILLS

A. TEAMBUILDING
B. SOFTSKILLSANDETIQUETTES

9. ACQUAINTANCEWITHTECHNOLOGY-AIDEDLANGUAGELEARNING

A. USEOFCOMPUTERSOFTWARE(GRAMMARLY,GINGER…)
B. USEOFSMARTPHONEAPPLICATIONS(DUOLINGO,BUSUU…)

10. ACTIVITIES

A. NARRATIVECHAIN
B. DESCRIBING/NARRATING
C. WRITINGESSAYSINRELAY
D. PEER/GROUPACTIVITIES
E. BRAINSTORMINGVOCABULARY
F. CUE/FLASHCARDSFORVOCABULARY
G. DEBATES

SUGGESTEDREADINGS:

- PRACTICALENGLISHUSAGE.MICHAELSWAN.OUP.1995.
- REMEDIALENGLISHGRAMMAR.F.T.WOOD.MACMILLAN.2007
- ONWRITINGWELL.WILLIAMZINSSER.HARPERRESOURCEBOOK.2001
- STUDYWRITING.LIZHAMP-LYONSANDBENHEASLY.CAMBRIDGEUNIVERSITY PRESS. 2006.
- COMMUNICATIONSKILLS.SANJAYKUMARANDPUSHPLATA.OXFORDUNIVERSITY PRESS. 2011.
- EXERCISESINSPOKENENGLISH.PARTS.I-III.CIEFL,HYDERABAD.OXFORD UNIVERSITY PRESS

COURSEOUTCOMES

THESTUDENTWILLACQUIREBASICPROFICIENCYINENGLISHINCLUDINGREADING AND LISTENING COMPREHENSION, WRITING AND SPEAKING SKILLS.

102 Mechanal

Semester III [Second year] Branch/Course: Mechanical Engineering

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
				L	T	P		
1	Basic Science Courses	BSC 202	Mathematics III (PDE, Probability & Statistics)	3	1	0	4	4
2	Basic Science Courses	BSC 203	Biology	2	1	0	3	3
3	Engineering Science courses	ESC 201	Basic Electronics Engineering	3	1	0	4	4
4	Engineering Science courses	ESC 202	Engineering Mechanics	3	0	2	4	4
5	Professional Core courses	PCC- ME 201	Thermodynamics	3	1	0	4	4
6	Professional Core courses	PCC-ME 202	Machine Drawing	0	0	4	4	2
7	Summer Internship	INST-ME 203	Inter/Intra Institutional Activities (Summer Vacation after 2nd Sem.) Internship	**Four Week**				4
8	Employability Enhancement	--	Professional Courses (Spoken Tutorial, KYP, etc.)	**12**				0
Total credits:								**25**

102 ME

BSC202	**Mathematics III (PDE, Probability & Statistics)**	**3L:1T:0P**	**4 credits**

Objectives:

1. To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering
2. To provide an overview of probability and statistics to engineers

Contents:

Module 1: **(14 lectures)**

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

Module 2: **(12 lectures)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

Module 3: **(12 lectures)**

Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square

test for goodness of fit and independence of attributes.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India,2002.

5.

Course Outcomes:

Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.

BSC203	**Biology** 2 (one hour) lectures and one (one hour) tutorial per week. Only lecture hours are shown	**2L:1T:0P**	**3 credits**

Module 1: Introduction **(2 lectures)**

Purpose: *To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry*

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

Module 2: Classification **(3 lectures)**

Purpose: *To convey that classification per seis not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted*.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E. coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus

Module 3: Genetics **(4 lectures)**

Purpose: *To convey that "Genetics is to biology what Newton's laws are to Physical Sciences*"

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

Module 4: Biomolecules **(4 lectures)**

Purpose: *To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine*

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

Module 5: Enzymes **(4 lectures)**

Purpose: *To convey that without catalysis life would not have existed on eart*h.

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

Module 6: Information Transfer **(4 lectures)**

Purpose: *The molecular basis of coding and decoding genetic information is universal*

Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7: Macromolecular analysis **(5 lectures)**

Purpose: *How to analyse biological processes at the reductionist level*

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

Module 8: Metabolism **(4 lectures)**

Purpose: *The fundamental principles of energy transactions are the same in physical and biological world.*

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keqand its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9: Microbiology (3 lectures)

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

References:

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

Course Outcomes:

After studying the course, the student will be able to:

Describe how biological observations of 18th Century that lead to major discoveries. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Classify enzymes and distinguish between different mechanisms of enzyme action. Identify DNA as a genetic material in the molecular basis of information transfer. Analyse biological processes at the reductionistic level Apply thermodynamic principles to biological systems. Identify and classify microorganisms.

ESC 201	Basic Electronic Engineering	3L:1T:0P	4 credits

Objectives:

To provide an overview of electronic device components to Mechanical engineering students

Contents:

Module 1: **(10 lectures)**

Semiconductor Devices and Applications: Introduction to P-N Junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Module 2: **(8 lectures)**

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Module 3: **(6 lectures)**

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as table and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Module 4: **(10 lectures)**

Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using Kmap, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module 5: **(8 lectures)**

Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Text /Reference Books:

1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Course Outcomes:

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

1. Understand the principles of semiconductor devices and their applications.

2. Design an application using Operational amplifier.

3. Understand the working of timing circuits and oscillators.

4. Understand logic gates, flip flop as a building block of digital systems.

5. Learn the basics of Electronic communication system.

ESC 202	Engineering Mechanics	3L:0T:2P	4 credits

Objectives:

The primary purpose of the study of engineering mechanics is to develop the capacity to predict the effects of force and motion while carrying out the creative design functions of engineering.

Contents:

Module 1: **(7 lectures)**

Statics: Force System, Moment of a force about a point and an axis; Equivalent force and moment

Module 2: **(6 lectures)**

Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimension; plane frames and trusses.

Module 3: **(8 lectures)**

Friction: Laws of Coulomb friction, impending motion problems involving large and small contact surfaces; square threaded screw; principle of virtual work and stability.

Module 4: **(6 lectures)**

Dynamics: Kinematics and kinetics of particles dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables.

Module 5: **(8 lectures)**

Properties of areas: Center of mass; Moments of inertia; kinematics of rigid bodies;Chasle's Theorem, concept of fixed vector, velocity and acceleration of particles in different frames of references. General plane motion.

Module 6: **(7 lectures)**

Work & Energy and impulse and Momentum methods for particles and rigid bodies: Conservation of momentum, coefficient of restitution, moment of momentum equation.

Text /Reference Books:

1. Engineering Mechanics by Shames, Pearson's Education.

2. Mechanics for Engineers. Beer, F.P. and Johnston. Tata McGraw Hill. New Delhi

3. Engineering mechanics. Meriam Wiley pub.

4. Engineering Mechanics. Timoshenko. McGraw Hill lnc.

Practical:

1. Practical based on mechanical advantage of different machines.
2. Verification of triangle law & parallelogram law of forces
3. Verification of polygon law of forces
4. Determination of moment of inertia of a flywheel
5. Crank Lever apparatus
6. Verification of support reactions of a simply supported beam
7. Verification of condition of equilibrium of a system of forces
8. Verification of axial forces in the members of a truss
9. Verification of equilibrium of three dimensional forces.
10. Determination of coefficient of friction between two surfaces
11. Verification of centroid of different laminae
12. Verification of Newton's laws of motion

*** At least 6 experiments should be performed from above list. Course outcomes:**

Students will be able to articulate and describe:

1. Relative motion. Inertial and non-inertial reference frames.
2. Parameters defining the motion of mechanical systems and their degrees of freedom.
3. Study of the interaction of forces between solids in mechanical systems.

4. Centre of mass and inertia tensor of mechanical systems.
5. Application of the vector theorems of mechanics and interpretation of their results.
6. Newton's laws of motion and conservation principles.

PCC-ME 201	Thermodynamics	3L:1T:0P	4 credits

Objectives:

1. To learn about work and heat interactions, and balance of energy between system and its
2. Surroundings
3. To learn about application of 1st law to various energy conversion devices
4. To evaluate the changes in properties of substances in various processes
5. To understand the difference between high grade and low grade energies and 2nd law limitations on energy conversion

Contents:

Module 1: **(5 lectures)**

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Module 2: **(5 lectures)**

Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.

Module 3: **(8 lectures)**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

Module 4: **(5 lectures)**

First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Module 5: **(5 lectures)**

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Module 6: **(8 lectures)**

Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of Entropy for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables-Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

Module 7: **(4 lectures)**

Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Yunus A. Cengel; Michael A. Boles, Thermodynamics: An Engineering Approach, McGraw-Hill.
5. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances
3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low grade energies.

PCC-ME202	Machine Drawing	0L:0T:4P	2 Credits

Objective:

The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components.

Module 1: **(2 Lectures)**

Introduction to full section, half section, revolved-section off-set section.

Module 2: **(3 Lectures)**

Nut Bolts, Riveted joints, Thread profiles, Screw jack.

Module3: **(3 Lectures)**

Bushed bearing, pedestal, bearing, foot step bearing.

Module 4: **(2 Lectures)**

Flanged coupling, flexible coupling, solid coupling.

Module5: **(2 Lectures)**

Engine parts - Stuffing box, Connecting rod, Atomizer, spark plug, etc.

Module 6: **(2 Lectures)**

Eccentric.

Module 7: **(2 Lectures)**

Cross Head.

Module 8: **(2 Lectures)**

Assembly of dissembled parts. disassembly of assembly parts.

Text Books:

1. Dhawan, R.K., A Text Book of Machine Drawing, S. Chand & Company, 1996.
2. Ostrowsky, O., Engineering Drawing with CAD Applications, ELBS, 1995.
3. Engineering Drawing Practice for Schools and Colleges SP: 46- 19
4. Engineering Drawing by ND Bhatt

Course Outcomes:

On successful completion of the course, the student will be able to,

1. Identify the national and international standards pertaining to machine drawing.
2. Apply limits and tolerances to assemblies and choose appropriate fits.
3. Recognize machining and surface finish symbols.
4. Explain the functional and manufacturing datum

IV SEMESTER
Branch/Course: Mechanical Engineering (102)

sr. no.	CODE	Course Title	L	T	P	H	Credit
1		Fluid Mechanics	3	0	3	6	4.5
2		Applied Thermodynamics	3	1	0	4	4
3		Strength of Materials	3	0	3	6	4.5
4		Engineering Materials	3	0	0	4	4
5		Instrumentation & Control	3	0	0	4	4
6		Environmental Science	2	-	-	2	0
7		From Mechanical Engineering	8 weeks				2
8		Professional Courses (Spoken Tutorial, KYP, etc.)	9				0
			TOTAL				23

Mechanical Engineering

IV Semester
Branch Code - 102

PCC-ME 203	Fluid Mechanics	3L:0T:3P	4.5 Credits

Objectives:

- To learn about the application of mass and momentum conservation laws for fluid flows
- To understand the importance of dimensional analysis
- To obtain the velocity and pressure variations in various types of simple flows
- To analyze the flow in water pumps and turbines.

Contents:

Module: 1 **(8 lectures)**

Definition of fluid, Units and dimensions, Newton's law of viscosity, Properties of fluids, mass, density, specific volume, specific gravity, viscosity, surface tension and capillarity, vapor pressure, compressibility and bulk modulus.**Hydrostatics**; fluid force on plane and curved surfaces, manometers, buoyancy, uniformly accelerated motion.

Module: 2 **(4 lectures)**

Kinematics of fluid flow: Generalized continuity equation, Irrotational motion and solution to Laplace equation. Concept of stream lines, Equipotential Lines, Flow Nets.

Module: 3 **(6 lectures)**

Dynamics of fluid flow: Control volume and control surface, application of

continuity equation and momentum equation, Bernoulli's equation and its applications.

Module: 4 **(4 lectures)**

Concept of boundary layer, boundary layer thickness, Displacement thickness, momentum thickness, energy thickness.

Module: 5 **(8 lectures)**

Laminar viscous flow through circular conduits, Couette and Poisuielle flow, Turbulent flow through pipes, Darcy Weisbach equation, friction factor for smooth and rough pipes, Moody's diagram**.**

Module: 6 **(6 lectures)**

Need for dimensional analysis, methods of dimension analysis, Similitude and types of similitude, Dimensionless parameters, application of dimensionless parameters Model analysis.

Module: 7 **(6 lectures)**

Forces on immersed bodies, concepts of separation, drag force, circulation and lift force.

Text Books:

1. Frank M. White, Fluid Mechanics (Sixth Edition), Tata McGraw-Hill, New Delhi (2008).
2. J. O. Wilkes, Fluid Mechanics for Chemical Engineers, Prentice Hall (1999).
3. Som and Biswas; Fluid Mechanics and machinery; TMH
4. Cengal; Fluid Mechanics; TMH
5. Modi & Seth; Fluid Mechanics; Standard Book House, Delhi

Practical:

1. Determination of density & viscosity of oil.
2. To determine the meta-centric height of a floating body.
3. Measurement of Coefficient of Discharge of given Orifice and Venturimeter
4. To determine the coefficient of discharge of Notch (Vand Rectangular types)
5. To determine the friction factor for the pipes.
6. To verify the Bernoulli's Theorem.
7. To find critical Reynolds number for a pipe flow.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To show the velocity and pressure variation with radius in a free and forced vortex

Atleast 8 experiments should be performed from above list

Course Outcomes:

1. State the Newton's law of viscosity and explain the mechanics of fluids at rest and in motion by observing the fluid phenomena.
2. Compute force of buoyancy on a partially or fully submerged body and analyze the stability of a floating body.

3. Derive Euler's Equation of motion and deduce Bernoulli's equation.
4. Examine energy losses in pipe transitions and sketch energy gradient lines.
5. Evaluate pressure drop in pipe flow using Hagen-Poiseuille's equation.
6. Distinguish the types of flows.

PCC-ME 204	Applied Thermodynamics	3L:1T:0P	4 credits

Objectives:

1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To understand about the properties of dry and wet air and the principles of psychometric
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about reciprocating compressors with and without intercooling
6. To analyze the performance of steam turbines

Contents:

Module 1: (8 lectures)

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysisof combustion reactions. Heat calculations using enthalpy tables. Adiabatic flame temperature. Chemical equilibrium and equilibrium composition calculations using free energy.

Module 2: (10 lectures)

Thermodynamic cycles, Gas power cycles: Air standard Otto, Diesel and Dual Cycles. Air standard Brayton cycle, effect of reheat, regeneration and intercooling. Combined gas and vapor power cycles. Vapor compression refrigeration cycles cycle and comparison with Carnot cycle, refrigerants and their properties.

Module 3: (6 lectures)

Vapor power cycles: Basic Rankine cycle, Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super- critical and ultra-super-critical Rankine cycle.

Module 4: (8 lectures)

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

Module 5: (5 lectures)

Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Module 6: (5 lectures)

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley andSons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering

Thermodynamics, John Wiley andSons.

4. Nag, P. K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd

Outcomes:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
3. They will be able to understand phenomena occurring in high speed compressible flows.

PCC-ME 205	**Strength of Materials**	**3L:0T:3P**	**4.5 credits**

Objectives:

- 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.
- 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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PCC-ME 206	Engineering Materials	3L:1T:0P	4 Credits

Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams and Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Contents

Module:1 **(6 lectures)**

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Module:2 **(8 lectures)**

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.

Module: 3 **(10 lectures)**

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength, Introduction to non-destructive testing (NDT).

Module: 4 **(10 lectures)**

Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves, T-T-T diagram and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.

Module: 5 **(8 lectures)**

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro- nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys.

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Understand how to tailor material properties of ferrous and non-ferrous alloys
3. How to quantify mechanical integrity and failure in materials

PCC-ME 207	Instrumentation and Control	3L:1T:0P	4 credits

Objectives:

1. To provide a basic knowledge about measurement systems and their components
2. To learn about various sensors used for measurement of mechanical quantities
3. To learn about system stability and control
4. To integrate the measurement systems with the process for process monitoring and control

Module: 1 **(10 lectures)**

Measurement systems and performance -configuration of a measuring system, Methods for correction for interfering and modifying inputs– accuracy, range, resolution, error sources, precision, error sensitivity etc.Classification of errors and statistical analysis of experimental data.

Module: 2 **(8 lectures)**

Instrumentation system elements -sensors for common engineering measurements. Transducers based on variable resistance, variable induction, variable capacitance and piezo-electric effects, Displacement transducer.

Module: 3 **(6 lectures)**

Signal processing and conditioning; correction elements- actuators: pneumatic, hydraulic, electric.

Module :4 **(10 lectures)**

Control systems – basic elements, open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers.

Module :5 **(6 lectures)**

System models, transfer function and system response, frequency response; Nyquist diagrams and their use.

Practical group based project utilizing above concepts.

Text Books:

1. Instrumentation and control systems by W. Bolton, 2nd edition, Newnes, 2000
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, Mechanical Measurements (6^{th} Edition) 6th Edition, Pearson Education India, 2007
3. Gregory K. McMillan, Process/Industrial Instruments and Controls Handbook, Fifth Edition, McGraw-Hill: New York, 1999.

Course Outcomes:

Upon completion of this course, the students will be able to understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

SemesterV(Thirdyear]

Branch/CourseMechanicalEngineering

SemesterV						
Branch/Course:MechanicalEngineering(102)						
sr.no.	CODE	CourseTitle	L	T	P	Credit
1		HeatTransfer	3	0	3	4.5
2		FluidMachinery	3	0	3	4.5
3		ManufacturingProcesses	3	0	3	4.5
4		KinematicsofMachine	3	1	0	4
5		ConstitutionofIndia/EssenceofIndianKnowledge Tradition	3	0	0	0
6		SummerEntrepreneurship-II	0	0	12	6
7		OpenElective-I(MOOCs/SWAYAM/NPTEL Courses –2)	3	0	0	3
8		GraduateEmployability Skills and Competitive Courses(GATE,IES, etc.)	3	0	0	0
			TOTAL			26.5

Mechanical EngineeringV Semester

PCC-ME301	HeatTransfer	3L:0T:3P	4.5Credits

Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing studentstothe threebasic modesnamelyconduction, convection and radiation.
2. Rigoroustreatmentofgoverningequationsandsolutionproceduresforthethreemodes will be provided, along with solution of practical problems using empiricalcorrelations.
3. The course will also briefly cover boiling and condensation heat transfer, and theanalysisand design of heat exchangers.

Contents:

Module:1 **(12lectures)**

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady onedimensionalsolutionforconductionheattransferin Cartesian,cylindricalandsphericalgeometry, concept of conduction and film resistances, critical insulation thickness, lumpedsystem approximation and Biot number, heat transfer through pin fins- Two dimensionalconductionsolutionsforbothsteady andunsteady heattransfer-approximatesolutiontounsteadyconduction heat transfer bytheuseof Heisslercharts.

Module:2 **(8lectures)**

Heat convection, basic equations, boundary layers- Forced convection, external and internalflows-Naturalconvectiveheattransfer-
Dimensionlessparametersforforcedandfreeconvection heat transfer-Correlations for forced and free convection- Approximate solutionsto laminar boundary layer equations (momentum and energy) for both internal and externalflow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriatecorrelationsforfreeandforced convection.

Module:3 **(8lectures)**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann'slaw, black and gray body radiation, Calculation of radiation heat transfer between surfacesusingradiativeproperties, view factors and the radiositymethod.

Module:4 **(6lectures)**

Types of heat exchangers, Analysis and design of heat exchangers using bothLMTD and ε-NTUmethods.

Module:5 **(3lectures)**

BoilingandCondensationheattransfer,Poolboilingcurve.

Module:6 **(3lectures)**

Introductionmasstransfer,Similaritybetween heatandmasstransfer

TextBooks:

1. Bejan,HeatTransferJohnWiley, 1993
2. J.P.Holman,HeatTransfer,EighthEdition,McGrawHill,1997.
3. F.P.Incropera,andD.P.Dewitt,FundamentalsofHeatandMassTransfer,JohnWiley,Sixth Edition,2007.
4. MassoudKaviany,PrinciplesofHeatTransfer,JohnWiley,2002
5. YunusACengel, HeatTransfer:APracticalApproach,McGraw Hill,2002

Practical:

1. DeterminationofThermalConductivityof aMetalRod.
2. DeterminationofOverallHeatTransferCoefficientofaCompositewall.
3. Tofindtheeffectivenessofapinfininarectangularductnaturalconvectiveconditionand plot temperaturedistribution alongits length.
4. Tofindtheeffectivenessofapinfininarectangularductunderforcedconvectiveandplot temperaturedistribution alongits length
5. DeterminationofHeatTransferCoefficientina freeConvectiononaverticaltube.
6. DeterminationofHeatTransferCoefficientinaForcedConventionFlowthroughaPipe.
7. DeterminationofEmissivityof aSurface.
8. DeterminationofStefanBoltzmann'sConstant.
9. DeterminationofLMDTandEffectivenessinaParallelFlowandCounterFlowHeatExchangers.

CourseOutcomes:

1. After completing the course, the students will be able to formulate and analyze a heattransferproblem involvinganyof thethreemodesof heattransfer
2. The students will be able to obtain exact solutions for the temperature variation usinganalyticalmethodswherepossibleoremployapproximatemethodsorempiricalcorrelationsto evaluatetherate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimatetheinsulation needed to reduceheatlosses where necessary.

PCC-ME302	FluidMachinery	3L:0T:3P	4.5Credits

Objectives:
Theobjectiveistopresentthemathematicalandphysicalprinciplesinunderstandingthelinearcontinuum behavior ofsolids.
Contents:
Module:1

Introduction–Classificationoffluidmachinery. **(Lectures:**

2)Module:2

Dynamicaction of fluid jet–Impact of fluid jetonfixed andmovingflat places,impact ofjetonfixed andmovingcurvedvanes, flowover radialvanes, jetpropulsions. **(Lectures: 4)**

Module:3

Euler'sfundamentalequation,degreeofreaction.

(Lectures:2)Module:4

Hydraulic turbines, introduction, classification, impulse turbine, construction details, velocitytriangles, power and efficiency calculations, reaction turbines; constructional details, workingprinciple,velocitytriangles,powerandefficiencycalculations,drafttube,cavitation,governing. **(Lectures:10)**

Module:5

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

Module:6

Positive displacement pumps: Reciprocating pump; working principle, classification, slip,indicatordiagram,effectoffrictionandacceleration,theoryofairvessel,performancecharacteristicsgas gearoilpumpandscrewpump. **(Lectures: 4)**

Module:7

Rotodynamicpumps:Introduction,classification,centrifugalpump;maincomponents,working principle velocity triangle, effect of shape of blade specific speed, heats, power andefficiency,calculationsminimumsteeringspeed,multistagepumps,performancecharacteristic,comparisonwithreciprocatingpump. **(Lectures:7)**

CourseOutcomes:
Upon completion of this course, students will be able understand the deformation behavior ofsolidsunderdifferenttypesofloadingandobtainmathematicalsolutionsforsimplegeometries.

TextBooks:

1. G.T.Mase,R.E.SmelserandG.E.Mase,ContinuumMechanicsforEngineers,ThirdEdition,C RCPress,2004.
2. Y.C.Fung,FoundationsofSolidMechanics,PrenticeHallInternational,1965.
3. Lawrence.E.Malvern,IntroductiontoMechanicsofaContinuousMedium,PrenticeHall international, 1969.
4. HydranticMachinebyJagdishLal
5. Hydraulics &HydraulicMachinesbyVasandari
6. HydranticMachine byRD Purohit

Practical:

1. Performanceon hydraulicturbines:
    a. Peltonwheel
    b. Francisturbine
    c. Kaplanturbine.
2. Performanceonhydraulicpumps:
    a. Singlestageandmultistagecentrifugalpumps
    b. Reciprocatingpump.
3. Performancetestofatwostage reciprocatingair compressor
4. Performancetestonanair blower

OPTIONAL

1. Visittohydraulicpower station/Municipalwaterpumphouseandcasestudies.
2. Demonstrationofcutsectionmodelsofhydraulic turbinesandpumps.

PCC-ME303	ManufacturingProcesses	3L:0T:3P	4.5Credits

Objectives:

Tomotivateandchallengestudentstounderstandanddevelopanappreciationoftheprocesses in correlation with material properties which change the shape, size and form of theraw materials into the desirable product by conventional or unconventional manufacturingmethods

Contents:

Module:1

Conventional Manufacturing processes: Casting and Moulding: Metal casting processes andequipment,Heattransferandsolidification,shrinkage,riserdesign,castingdefectsandresidualstresses. **(Lectures6)**

Module:2

Introductiontobulkandsheetmetalforming,plasticdeformationandyieldcriteria;fundamentals of hot and cold working processes; load estimation for bulk forming(forging,rolling, extrusion,drawing)and sheetforming (shearing, deep drawing, bending) principlesofpowdermetallurgy. **(Lectures6)**

Module:3

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components:Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cuttingtool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes,IntroductiontoCNCmachining. **(Lectures8)**

Module:4

Joining/fastening processes: Physics of welding, brazing and soldering; design considerationsinwelding, Solid and liquid statejoiningprocesses; Adhesive bonding.

Additivemanufacturing:Rapidprototypingand rapidtooling **(Lectures5)**

Module:5Mach

ineTools:

(a) Lathe:Principle,types,operations,turret/capstan,semi/automatic,Toollayout.

(b) Shaper,slotted,planer,operation,drive.

(c) Milling,Millingcutter,up&downmilling,dividinghead indexing,Maxchipthickness,

powerrequired.

(d) Drilling and boring, reaming tools, Geometry of twist drill, Grinding, Grinding wheel,Abrasive, cutting action, grinding wheel specification, Grinding wheel wear, alterations,wear, fracture wear, dressing and trimming. Max chip thickness and guest criteria, Flatandcylindrical grinding, Centerless grinding,Superfinishing, Honinglapping,Polishing

(Lectures15)

CourseOutcomes:

Upon completion of this course, students will be able to understand the different conventionalandunconventional manufacturingmethodsemployedformakingdifferentproducts

TextBooks:

1. KalpakjianandSchmid,Manufacturingprocessesforengineeringmaterials(5thEdition)-PearsonIndia, 2014
2. MikellP.Groover,FundamentalsofModernManufacturing:Materials,Processes,andSystems
3. Degarmo,Black &Kohser,MaterialsandProcessesinManufacturing

Practical:

Minimumof10Experimentneedtobeperformed

I. MetalCastingLab:

1. PatternDesignand making– foronecastingdrawing.
2. Sandpropertiestesting(strengthsandpermeability)
3. Moulding,MeltingandCasting

II. WeldingLab:

1. ARCWeldingLap&ButtJoint
2. SpotWelding
3. GasWelding

III. MechanicalPress Working:

1. Blanking&Piercingoperationandstudyofsimple,compoundandprogressivepresstool.
2. Bendingand other operations

IV. MachiningLab:

1. Cuttingoperation(Orthogonal&Oblique)onlathemachine
2. Bolt makingon lathemachine
3. Facing,plain turningandstepturningknurling

4. Boringandinternalthreadcutting.
5. Finishingof asurfaceonsurface–grindingmachine
6. Gearcuttingonmillingmachine(SpurGear).
7. Machiningablock onshapermachine.
8. Drillingholesondrillingmachine

PCC-ME304	KinematicsofMachine	3L:1T:0P	4credits

Objectives:

1. Tounderstandthekinematicsandrigid-bodydynamicsofkinematicallydrivenmachinecomponents
2. Tounderstandthemotionoflinkedmechanismsintermsofthedisplacement,velocityand accelerationatanypoint in a rigid link
3. Tobeabletodesignsomelinkagemechanismsandcamsystemstogeneratespecifiedoutput motion
4. Tounderstandthekinematicsofgeartrains

Contents:

Module1

Introduction: Classificationofmechanisms:-BasickinematicconceptsandDefinitions-Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slidercrankchains. **(Lectures5)**

Module2

Kinematic analysis of plane mechanism: Displacement, velocity and acceleration analysisof simple mechanisms, graphical velocity analysis using instantaneous centers, kinematicanalysis of simple mechanisms- slider crank mechanism dynamics- Coriolis component ofacceleration. **(Lectures6)**

Module3

Frictiondevices: Beltdrive,Clutch,Shoebrakes,Bandandblockbrakes.

(Lectures6)Module 4

Gear:gearterminology,InvoluteandCycloidalgearprofiles,gearparameters,fundamentallawof gearingandconjugateaction,spur gear contactratioandinterference/undercutting.

GearTrain: Analysisofsimple,compound,revertedandepicyclicgeartrainwithproblems.

(Lectures10)

Module5

Balancing of rotating masses: Balancing of rotating masses in the same plane by a singlerevolving mass. Balancing of several rotating masses in the same plane. Balancing of severalrotatingmasses in different planes bytworevolvingmassesin suitable planes.

(**Lectures8**)

Module6

Governors: Watt,Porter,Proel&HartnellGovernors,Effectoffriction,controllingforce,governor effort and power, sensitivityand isochronisms.

(Lectures

6)CourseOutcomes

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- Aftercompletingthiscourse,thestudentscandesignvarioustypesoflinkage mechanismsforobtainingspecificmotion andanalysethem foroptimal functioning

TextBooks:

[1.] Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors,2005.

[2.] CleghornW.L.,Mechanismsof Machines,OxfordUniversityPress,2005.

[3.] Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill,2009.

[4.] Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, AffiliatedEast-WestPvt. Ltd, NewDelhi, 1988.

Semester VI (Third year]Branch/CourseMechanicalEngineering

Course Code	Paper Title	L	T	P	Credits	branch
	DesignofMachine Elements	3	1	2	5	102
	DynamicsofMachinery	3	0	3	4.5	102
	GraduateEmployabilitySkillsandCompetitiveCourses(GATE,IES, etc.)	3	0	0	0	102
	ManufacturingTechnology	3	0	3	4.5	102
	OpenElective-I	3	0	0	3	102
	ProgramElective-I	3	0	0	3	102
	ProgramElective- II	3	0	0	3	102

Semester VI (Third year] Branch/CourseMechanicalEngineering

PCC-ME 306	Dynamicsof Machinery	3L:0T:3P	4.5 Credits

Objectives:

1. To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
2. Develop knowledge of analytical and graphical methods for calculating balancing of reciprocating masses.
3. Developunderstandingofvibrationsanditssignificanceonengineeringdesign.
4. Develop understanding of dynamic balancing, flywheel analysis, gyroscopic forces and moments.

Contents:

Module:1

Forceanalysis ofmechanism: Dynamics ofplane motion ofarigid body, dynamicallyequivalent two mass system, correction torque, forced in mechanism and machines. **(Lectures 3)**

Module: 2

Turningmomentdiagram:Fluctuationsofcrankshaftspeedandenergyinadirectactingengine mechanism, flywheels. **(Lectures 5)**

Module:3

Cams: Classification of cams and followers, types of follower and retardation, cam profile and generation of concentric and offset radial cam profiles by graphical method. Cams with specified contours tangent cam with roller follower, circular arc cam with flat follower. **(Lectures 8)**

Module:4

Analysis of gyroscopic motion : Principle of gyroscope, gyroscopic couple and gyroscopic reaction couple, Gyroscopic effects on the movement of ships, aeroplanes, two wheeled and four wheeled vehicles, gyrostabilizers. **(Lectures 6)**

Module:5

Effects of inertia of reciprocating masses on engine frame: Unbalanced primary and secondary forcesandcouples,balancingofprimaryandsecondaryforces,partialbalancingoflocomotives,
balancing of multicylinder in line and radial engines, direct and reverse cranks methods forbalancing of radial engines. **(Lecture 8)**

Module:6

Mechanical vibrations : Basic concepts degree of freedom, types of damping and viscous damping; natural free, damped free and damped forced vibrations of a single degree of freedom spring mass system, reciprocating and rotating unbalance, vibration isolation and transmissibility, whirling of shaft, elementary treatment of two degree of freedom systems torsional vibrations of single rotor and two rotor systems, transverse vibration of simply supported beam energy method, Rayleigh's andDankerley method. **(Lecture12)**

Course outcomes:

Uponsuccessfulcompletionofthiscoursethestudentshouldbeable to:

1. Analyzestabilizationofseavehicles,aircraftsandautomobile vehicles.
2. Computefrictionallosses,torquetransmissionofmechanicalsystems.
3. Analyzedynamicforceanalysisofslidercrankmechanismanddesignof flywheel.
4. Understand how to determine the natural frequencies of continuous systems starting fromthegeneral equation of displacement.
5. Understandbalancingof reciprocatingand rotarymasses.

Text/ReferencesBooks:

1. TheoryofMachines /S.SRatan/ Mc.GrawHillPubl.
2. Mechanism and machinetheorybyAshok G. Ambedkar, PHIPublications.
3. Mechanismand Machine Theory/JS RaoandRVDukkipati /New Age.
4. Theoryof Machines/ Shiegly/MGH
5. Theoryof Machines / ThomasBevan / CBS Publishers
6. Theoryof machines / Khurmi /S.Chand.

Laboratory:

Minimumof10Experimentneedtobe performed

1. TostudyvarioustypesofLinks,Pairs,ChainandMechanism
2. Tostudyinversion of Four Bar Mechanism
3. To studyvelocitydiagram for Slider CrankMechanism.

4. Tostudyvarious kindsof beltsdrives.
5. Tostudyandfind coefficient offriction betweenbelt and pulley.
6. Tostudyvarious types of Cam and Followerarrangement.
7. ToplotfollowerdisplacementVscamrotationgraphforvariouscamfollowerarrangement.
8. TostudyDifferent typesofGear Trains.
11. To PerformExperimentonWatt,Porter,ProellandHartnellGovernorsandprepare Performance Characteristic Curves also analyze Stability & Sensitivity
12. Tostudygyroscopiceffectsthroughmodels.
13. Todetermine gyroscopiccoupleonMotorizedGyroscope.
14. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.
15. To studyDynamicallyEquivalentSystem.
16. Determinethemomentofinertialofconnectingrodbycompoundpendulummethodand trifler suspension pendulum.
17. To studythe varioustypes ofdynamometers.
18. To find out critical speed experimentally and to compare the Whirling Speed of a shaft withtheoretical values

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PCC-ME 307	ManufacturingTechnology	3L:0T:3P	4.5 Credits

Objectives:

(i) Toprovideknowledgeonmachinesandrelatedtoolsformanufacturingvariouscomponents.
(ii) Tounderstandtherelationshipbetweenprocessandsysteminmanufacturingdomain.
(iii) To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Course Contents:

Module:1

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applicationsand design; press tools – configuration,designofdieandpunch;principlesofforgingdiedesign. **(Lectures10)**

Module:2

Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear andpart quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as microscale machining, Inspection and workpiece quality. **(Lectures 10)**

Module:3

Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices. **(Lectures 6)**

Module:4

UnconventionalMachiningProcesses: Abrasive JetMachining,WaterJetMachining,Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, Dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM)and Electron Beam Machining **(Lectures 14)**

CourseOutcomes:

Upon completion of this course, students will be able to the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Text Books:

1. KalpakjianandSchmid,Manufacturingprocessesforengineeringmaterials(5thEdition)-PearsonIndia, 2014.
2. TahaH.A.,OperationsResearch,6thEdition,PrenticeHallofIndia,2003.
3. ShenoyG.V.andShrivastavaU.K.,OperationsResearchforManagement,WileyEastern, 1994.

Laboratory:

1. Measurementofangle usingSineCenter/Sinebar /bevel protractor
2. MeasurementofalignmentusingAutocollimator/Roller set
3. Measurementofcuttingtoolforcesusing
    a. LathetoolDynamometer
    b. DrilltoolDynamometer.
4. Measurementof ScrewThreads Parameters usingTwo wireor Three-wiremethod.
5. MeasurementsofSurface roughness,UsingTallySurf/Mechanical Comparator
6. MeasurementofgeartoothprofileusinggeartoothVernier/Geartooth micrometer
7. CalibrationofMicrometer usingslipgauges
8. MeasurementusingOptical Flats

PCC-ME 308	Designof MachineElements	3L:1T:2P	5 Credits

Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through 1. A strong background in mechanics of materials based failure criteria underpinningthesafety-critical design ofmachine components2.An understanding of the origins, nature and applicability of empiricaldesignprinciples, based on safety considerations 3. An overview of codes, standards and design guidelines for different elements 4.An appreciation of parameter optimization and design iteration 5. An appreciation of the relationshipsbetweencomponentleveldesignandoverallmachinesystemdesignand performance

Course Contents:

Module:1

Introduction to design: Steps in design process, design factors, practical considerations in design, selection of materials, strength of mechanical elements, impact load, shock load, fatigue loading, effects of surface, size, temperature and stress concentration, consideration of creep and thermal stress in design.

(**Lectures8**)

Module:2

Design of shafts: stresses in shafts, design of static loads, combined stresses, reversed bending and steadyloads,designof shaftsbasedondeflection and strength,critical speedof shafts. Analysisand design of sliding and rolling contact bearings,

(**Lectures10**)

Module:3

Riveted joint: Stresses in riveted joint, design of riveted joints with central and eccentric loads, boiler and tank joints, structural joints.

BoltJoints: Stressesinboltjoint,designofboltjointswithcentralandeccentricloads.

Welded joints: types of welded joints, stresses, design of welded joints subjected to axial, torsional and bending loads, welds subjected to fluctuating loads**.**

(Lectures8)

Module:4

Design of Clutches: Friction clutches, uniform wear and uniform pressure assumptions, centrifugal clutches.

Brakes: Design of internal expansion elements, assumptions, design of external contraction elements, band type brakes.

(**Lectures6**)

Module:5

Designoftransmissionelements:spur,helical,bevelandworm gears;

Springs: stresses in helical springs, deflection of helical compression and tension springs, springs subjected to fatigue loading, concentric and helical torsion spring, critical frequency of springs, leaf springs, and design of automotive leaf springs. (**Lectures 8**)

CourseOutcomes:

Uponcompletionofthiscourse,studentswillgetanoverviewofthedesignmethodologies employed for the design of various machine components.

Databooksallowedfor Examination:

1. Mahadevan&BalaveeraReddy:DesignDataHandBook
2. Dr.Linghaigh&Prof.NarayanaIyengar,Vol.1&2: DesignDataHandBook
3. P.S.G.Tech :DesignDataHand Book

TextBooks:

1. Shigley,J.E.andMischke,C.R.,MechanicalEngineeringDesign,FifthEdition,McGraw-Hill International; 1989.
2. Deutschman,D.,Michels,W.J.andWilson,C.E.,MachineDesignTheoryandPractice, Macmillan, 1992.
3. Juvinal,R.C.,FundamentalsofMachineComponentDesign,JohnWiley,1994.
4. Spottes,M.F.,DesignofMachineelements,Prentice-HallIndia,1994.
5. R.L.Norton,MechanicalDesign–AnIntegratedApproach,PrenticeHall,1998

Laboratory:

1. TostudythedesignprocedureofKnuckle&Cotterjoint.
2. Designofshaftssubjectedtotorsion,bendingmomentandcombinedbendingandtorsion.
3. Designofflatandsquarekey
4. Designanddrawingofrivetedjoints
5. Designanddrawingofscrewjack
6. JournalBearingTestRig

PEC-MEL 322	**Mechatronics Systems**	**3L:0T:0P**	**3 credits**

Description:

1. To understand the structure of microprocessors and their applications in mechanical devices
2. To understand the principle of automatic control and real time motion control systems, with the help of electrical drives and actuators
3. To understand the use of micro-sensors and their applications in various fields

Course Contents:

Module: 1

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronics approach, Integrated Product Design, Modeling, Analysis and Simulation, Man- Machine Interface;

(Lectures 10)

Module: 2
Sensors and transducers: classification, Development in Transducer technology, Opto-electronics- Shaft encoders, CD Sensors, Vision System, etc. **(Lectures 8)**

Module: 3
Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time ControlSystems;
(Lectures 12)

Module: 4
Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.
(Lectures 8)

Module: 5
Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.
(Lectures 12)

Course Outcomes:
Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:
1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3) A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited
4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

PEC-MEL 325	**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.

OEC-ME 201	**Renewable Energy Systems**	**3L:0T:0P**	**3 credits**

Pre-requisite: Basics of Thermodynamics, Heat Transfer and Electricity Generation.

Objective: An exposure of renewable energy systems and techniques to generate electricity on account of renewable energy sources.

Outcome: Knowledge of electricity generation from renewable energy sources such as solar, hydraulic, wind and bio-mass.

Module: 1

Principles of Renewable Energy: Introduction, Energy and sustainable development, Fundamentals, Scientific principles of renewable energy, Technical implications, Social implications, Problems.

(Lectures 6)

Module: 2

Solar radiation: Introduction, Extra-terrestrial solar radiation, Components of radiation, Geometry of collector and the solar beam, Effects of the Earth's atmosphere Measurements of solar radiation, Estimation of solar radiation, Solar water heating: Introduction, Calculation of heat balance: general remarks, Uncovered solar water heaters – progressive analysis, Improved solar water heaters, Evacuated collectors, Buildings and other solar thermal applications, Air heaters, Crop driers, Space cooling, Water desalination, Solar ponds, Solar concentrators, Solar thermal electric power systems, Problems.

(Lectures 12)

Module: 3

Photovoltaic generation: Introduction, The silicon p–n junction, Photon absorption at the junction, solar radiation absorption, Maximizing cell efficiency, Solar cell construction, Applications, Problems.

(Lectures 4)

Module: 4

Hydro-power: Introduction, Principles, Assessing the resource for small installations, An impulse turbine Reaction turbines, Hydroelectric systems, The hydraulic ram pump, Problems.

(Lectures 6)

Module: 5

Power from the wind: Introduction, Turbine types and terms, Linear momentum and basic theory, Dynamic matching, Blade element theory, Contents Characteristics of the wind, Power extraction by a turbine, Electricity generation, Mechanical power, Problems. **(Lectures 6)**

Module: 6 Biomass and Biofuels: Introduction, Biofuel classification, Biomass production for energy farming, Direct combustion for heat, Pyrolysis (destructive distillation), Further thermochemical processes, Alcoholic fermentation, Anaerobic digestion for biogas, Wastes and residues, Vegetable oils and biodiesel, Problems.

(Lectures 8)

Text/Reference Books:

Renewable Energy Resources by Johan Twidell and Tony Weir, Taylors and Francis

PCC-ME421	**Automation in manufacturing**	**3L:0T:3P**	**4.5 credits**

Objectives:

1. To understand the importance of automation in the of field machine tool basedmanufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation

Course Contents:

Module: 1

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

(Lectures12)

Module: 2

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control. **(Lectures12)**

Module: 3

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies. **(Lectures8)**

Module: 4

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications. **(Lectures8)**

Course Outcomes:

Upon completion of this course, the students will get a comprehensive picture of computer based automation of manufacturing operations

Text Books:

1. Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prenticeHall
2. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology,7th edition, Pearson
3. YoramKoren, Computer control of manufacturing system, 1stedition
4. Ibrahim Zeid , CAD/CAM : Theory & Practice, 2ndedition.

Practical:

At-least 10 experiment should be performed.

1. Case study on automated system of any industry.
2. Practice programming on manual part program.
3. Practice programming on APT.
4. Demonstration on robot.
5. Performance on robot.
6. Demonstration on CNC lathe.
7. Performance on CNC lathe.
8. Performance and simulation with CNC lathe software.
9. Demonstration on CNC milling.
10. Performance on CNC milling.
11. Performance and simulation with CNC milling software.
12. Case study on computer aided process planning
13. Case study on part coding and group technology
14. Case study on computer aided quality control
15. Case study on flexible manufacturing system

PEC-MEL321 Process Planning and Cost Estimation 3 Credits

Objectives:

To introduce process planning concepts to make cost estimation for various products

Contents:

Module: 1

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection. **(Lectures 8)**

Module: 2

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies. **(Lectures 8)**

Module: 3

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost

estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost. **(Lectures 10)**

Module: 4

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planing and Grinding. **(Lectures 8)**

Module: 5

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost. **(Lectures 6)**

Course Outcomes:

Upon completion of this course, the students will be able to use the concepts of process planning and cost estimation for various products

Text Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci. &Tech.2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley1998. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., PrenticeHall2002.

PEC-MEL 323	**Microprocessors in Automation**	**3L:0T:0P**	**3 credits**

Objectives:

To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller

Course Contents:

Module: 1

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers.

Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. **(Lectures 8)**

Module: 2

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing. **(Lectures 6)**

Module: 3

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255). **(Lectures 6)**

Module: 5

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features, **(Lectures 10)**

Module: 6

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm. **(Lectures 6)**

Course Outcomes:

Students who have done this course will have a good idea of the use of microprocessors for automation.

Text Books:

1) Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited

2) Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.

3) Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.

4) Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).

5) Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, PrenticeHall

EC-MEL 324	Composite Materials	3L:0T:0P	3 credits

Objectives:

1. To understand the mechanical behaviour of composite materials
2. To get an overview of the methods of manufacturing composite materials

Contents:

Module: 1

Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matrices-polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina-assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness. **(Lectures 10)**

Module: 2

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes. **(Lectures 6)**

Module: 3

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, **(Lectures 8)**

Module: 4

Generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates. **(Lectures 6)**

Module: 5

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies. **(Lectures 8)**

Course Outcomes:

Upon completion of this course, the students will have an overview of the mechanical behaviour and application of composite materials

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill,1998.

PEC-MEL 325	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.

Semester VII (Fourth Year]
Branch/Course Mechanical Engineering

Course Code	Course Title	L	T	P	Credits	Branch			
100701	Induction Program	3	0	0	0	102	TH	0	0
102701	Internal Combustion Engines	3	0	0	3	102	TH	70	30
1027xx	Open Elective- II	3	0	0	3	102	TH	70	30
1027xx	Program Elective - III	3	0	0	3	102	TH	70	30
1027xx	Program Elective- IV	3	0	0	3	102	TH	70	30
102701	Internal Combustion Engines	0	0	3	1.5	102	PR	30	20
100709	Project-I	0	0	12	6	102	PR	30	20
100702	Summer Entrepreneurship-III	0	0	16	8	102	PR	30	20

102701	Internal Combustion Engines	3L:T:3P	4.5 Credits

Objectives:

1. To familiarize with the terminology associated with IC engines.
2. To understand the basics of IC engines.
3. To understand combustion, and various parameters and variables affecting it in various types of IC engines.
4. To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Contents:

Module:1

Basics of IC Engines, Engine components and classification: Two strokes, four stroke (SI and CI) engines, engines parts, engines working principle and valve timing diagram.Ideal cycles and Fuel-air cycles. **(Lectures 6)**

Module: 2

Engine performance-test: purpose and types, measurement of power, Engine system & performance parameters evaluation. **(Lectures 4)**

Module: 3

Combustion in SI and CI engines: Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking,

combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation, combustion chamber for SI and CI engine. **(Lectures 7)**

Module: 4

Fuel supply systems in SI and CI engines, carburetors, Port fuel injection, Direct injection and Common rail injection. **(Lectures 6)**

Module: 5

Ignition system: Battery and magneto ignition system, spark plug, firing order, quality, quantity & hit and miss governing.

Lubrication system and Cooling system: Lubrication of engine components, Lubrication system – wet sump and dry sump, crankcase ventilation, Types of cooling systems – liquid and air cooled, comparison of liquid and air cooled systems. **(Lectures 7)**

Module: 6

Measurement and Testing of IC engines: Measurement of indicated power, brake power, fuel consumption and emission, Measurement of friction power by Willan's Line Method and Morse Test, calculation of brake thermal efficiency, brake power and brake specific fuel consumption of IC Engines, variable compression ratio engines, heat balance sheet of IC Engines.

Engine Emission and their control: Air pollution due to IC engines, constituent and types of emission HC, CO and NOx emission, catalytic convertor**.** Advanced IC Engine concepts.

(Lectures 8)

Module: 7

Super charging, engine lubrication and cooling. **(Lectures 4)**

Text Books:

1. Obert E. F, "Internal Combustion Engines and Air Pollution", Harper and Row Publication Inc. NY, 1973.
2. Heisler H, "Advanced Engine Technology", Edward Arnold, 1995.
3. Heywood J. B, "Internal Combustion Engine Fundamentals", McGraw Hill Book Co. NY, 1989
4. Heldt P. M, "High Speed Combustion Engines", Oxford & IBH publishing Co. India, 1985.
5. Stockel M W, Stockel T S and Johanson C, "Auto Fundamentals", TheGoodheart, Wilcox Co.
6. Inc., Illinois, 1996.

Course Outcomes:

Students who have done this course will have a good idea of the basics of IC engines and how different parameters influence the operational characteristics of IC Engines

Laboratory:

1. To study the cross-sectional view of I.C. engine.
2. Determination of the calorific value of a given fuel and its flash &fire points.

3. To study the actual valve timing diagram of 4-stroke engine.
4. To prepare the heat balance sheet by conducting performance test on a single cylinder 4-stroke diesel engine.
5. To prepare the heat balance sheet by conducting performance test on a single cylinder 4-stroke petrol engine.
6. Performance evaluation of multi cylinder Diesel Engine.
7. Conduct the Morse test on a multi cylinder petrol engine and find out the friction power.

102706	**Operations Research**	**3L:0T:0P**	**3 credits**

Pre-requisite: NIL

Objective: To enable students to understand and apply operations research techniques in industrial operations for obtaining optimized solutions.

Outcome: Determination of optimal or near optimal solution to complex decision making problems.

Module: 1

Introduction: Features of Operations Research (OR), Methodology of OR, Scopes and Objectives of OR, models in OR. (**Lectures 4)**

Module: 2

Inventory classification, Different cost associated to Inventory, Economic order quantity, Inventory models with deterministic demands, ABC analysis

Introduction and assumptions of LPP, Mathematical formulation of LPP, Graphical Method, Simplex Method. (**Lectures 9)**

Module: 3

Transportation Problems: Introduction, North – West Corner Method, Least Cost Method, Vogel's Approximation Method, Test for Optimality. Assignment Problems: Introduction, Hungarian Assignment Method, Unbalanced Assignment Problems. (**Lectures 8)**

Module: 4

Sequencing: Introduction, Formulation of Sequencing Problem, Johnson's Rule. Network Analysis: Introduction, PERT and CPM, Time – Cost Trade-off (Project Crashing), Resource Leveling. (**Lectures 7)**

Module: 5

Dynamic Programming: Introduction, Deterministic Dynamic Programming, Probabilistic Dynamic Programming. Simulation: Introduction, Monte Carlo Simulation, Simulation of Inventory and Queuing System. (**Lectures 7)**

Module: 6

Queuing Theory: Introduction, General Structure of Queuing System, Operating Characteristics of Queuing System, Queuing Models. Replacement Theory: Introduction, Replacement Policies: Gradually Deteriorating Equipments, Items that Fail Suddenly.

(Lectures 7)

Text/Reference Books:

1. Operations research – An Introduction, Hamdy A Taha, 8th Edition, Pearson Education.
2. Introduction to Operations Research, Hillier and Lieberman, 8th Edition, TMH.
3. Operations Research, R Panneerselvan, 2nd Edition, PHI.
4. Quantitative Techniques in Management, N D Vohra, 4th Edition, McGraw Hill.

102702	**Refrigeration and Air Conditioning**	**3L:0T:3P**	**4.5 credits**

Objectives:

1. To familiarize with the terminology associated with refrigeration systems and air conditioning
2. To understand basic refrigeration processes
3. To understand the basics of psychometric and practice of applied psychometrics
4. To acquire the skills required to model, analyses and design different refrigeration as well asair conditioning processes and components.

Course Content:

Module: 1

Air refrigeration system: Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell – Coleman, refrigeration cycle, open and closed systems, application of air- refrigeration in air-crafts. **(Lectures 6)**

Module:2

Various compression systems: Simple vapour compression refrigeration cycle, merits and Refrigerants demerits of this system over air refrigeration system, factors affecting the performance of a vapour compression refrigeration system, sub cooling and superheating of vapour, wet and dry compression, multistage vapour compression system, intercooler, flash chamber, accumulator and heat exchanger. **(Lectures 8)**

Module:3

Vapour absorption system: Simple and modified vapour absorption refrigeration system, Electrolux refrigerator, COP of heat operated refrigeration system. **(Lectures 5)**

Module:4

Special refrigeration system, absorption, cascade, vortex, thermoelectric and steam jet refrigeration system. **(Lectures 4)**

Module: 5

Refrigerants: classification and nomenclature of refrigerants, primary and secondary refrigerants, properties of some common refrigerants, physical, chemical and thermodynamics properties, selection of refrigerants, leakage of refrigerants and methods of detection.

(Lectures 3)

Module:6

Psychometry: Properties of air vapour mixture, wet bulb, dew point & dry bulb temperatures, humidity, specific humidity, humidity ratio, degree of saturation, relative humidity, total heat psychometric relation, psychometric charts and its uses, psychometric processes evaporative cooling. **(Lectures 5)**

Module: 7

Air conditioning: General principle and requirement for comfort and air conditioning, thermodynamics of human body, estimation of heating and cooling loads, capacity of cooling coils, humidification and dehumidification unit and conditioner, central air conditioner, year around air condition, humidity and temperature control, industrial application of air conditioning system **(Lectures 10)**

Module:8

Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils. **(Lectures 4)**

Course Outcomes:

A student who has done the course will have a good understanding of the working principles of refrigeration and air-conditioning systems.

Note: Refrigeration Data Books are permitted for examination.

Text Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition,Prentice Hall, 1998.

Practical:

1. Determination of the COP of a vapour compression system.
2. Determination of the COP of vapour absorption apparatus.
3. Determination of the COP of a heat pump.
4. To find the performance parameter of cooling tower.
5. To study various components of room air conditioner and determine its performance for different psychometric condition.
6. Determination of COP of an Electrolux refrigerator.
7. To study the compressor and throttling valve used in refrigerator.

102703	Computer Aided Design	3L:0T:3P	4.5 credits

Objectives:

To provide an overview of how computers can be utilized in mechanical component design

Contents:

Module: 1

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation. **(Lectures 10)**

Module: 2

Geometric Modeling- representation of curves, Hermite curves, Bezier curves, B-spline curves, rational curves, Techniques of surface modelling, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces, Solid modelling techniques, CSG and B-rep. **(Lectures 10)**

Module: 3

Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation. **(Lectures 8)**

Module: 4

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checkingCAD standards- Graphical Kernel System (GKS), standards for vexchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards. **(Lectures 12)**

Course Outcomes:

Upon completion of this course, the students can use computer and CAD software for modelling mechanical components

Text Books:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co.2007.
2. C. McMohan and J. Browne, CAD/CAM Principles, II edition, Pearson Education,1999.
3. W. M. Neumann and R.F. Sproul, Principles of Computer Grahics, McGraw Hill,1989.
4. D. Hearn and M.P. Baker, Computer Graphics, Prentice Hall Inc.,1992.

Practical:

1. Initiating the Graphics Package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.
2. Drawing of primitives (Line, arc, circle, ellipse, triangle etc.)
3. Drawing a flange.
4. Drawing a bushing assembly.
5. Dimensioning the drawing and adding text.
6. Setting the layers and application of layers.
7. Isometric and Orthographic projections.
8. Viewing in three dimensions.

Removal of hidden lines – Shading and Rendering.

102704	Finite Element Analysis	3L:0T:3P	4.5 credits

Objectives:

1. To illustrate the principle of mathematical modeling of engineering problems
2. To introduce the basics and application of Finite Element Method

Contents:

Module: 1

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method. **(Lectures 8)**

Module: 2

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and naturalfrequencies.

(Lectures 12)

Module: 3

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

(Lectures 12)

Module: 4

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software. **(Lectures 8)**

Course Outcomes:

Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

1. Reddy J.N., AnIntroduction to Finite Element Method, 3rd ed., Tata McGraw Hill,2005.
2. SeshuP., Text Book of Finite Element Analysis, Prentice Hall, New Delhi,2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rded., Butterworth Heinemann, 2004.
4. Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

Practical:

Use these software for experiments: ANSYS, SIMULIA, ABAQUS, MATLAB etc.

1. Force and stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi-symmetric components.
5. Thermal stress and heat transfer analysis of plate.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of beams.

102705	Automobile Engineering	3L:0T:3P	4.5 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.

Module: 7

Air conditioning: General principle and requirement for comfort and air conditioning, thermodynamics of human body, estimation of heating and cooling loads, capacity of cooling coils, humidification and dehumidification unit and conditioner, central air conditioner, year around air condition, humidity and temperature control, industrial application of air conditioning system **(Lectures 10)**

Module:8

Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils. **(Lectures 4)**

Course Outcomes:

A student who has done the course will have a good understanding of the working principles of refrigeration and air-conditioning systems.

Note: Refrigeration Data Books are permitted for examination.

Text Books:

5. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
6. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill, 1986.
7. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
8. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition,Prentice Hall, 1998.

Practical:

8. Determination of the COP of a vapour compression system.
9. Determination of the COP of vapour absorption apparatus.
10. Determination of the COP of a heat pump.
11. To find the performance parameter of cooling tower.
12. To study various components of room air conditioner and determine its performance for different psychometric condition.
13. Determination of COP of an Electrolux refrigerator.
14. To study the compressor and throttling valve used in refrigerator.

Course Code	Paper Title	L	T	P	Credits	TH/PR	ESE	IA
1028xx	Open Elective- III	3	0	0	3	TH	70	30
1028xx	Open Elective-IV	3	0	0	3	TH	70	30
1028xx	Program Elective- V	3	0	0	3	TH	70	30
1028xx	Program Elective- VI	3	0	0	3	TH	70	30
100801	Project-II	0	0	12	6	PR	30	20

Mechanical Engineering

Open Elective

102806	**Computational Fluid Dynamics**	**3L:0T:0P**	**3 credits**

Pre-requisite: Heat Transfer and Numerical Analysis Techniques.

Objective: To introduce the CFD techniques and tools for modelling, simulating and analysing practical engineering problems with hands on experience using commercial software packages used in industry.

Outcome: Students are able to understand the use of different CFD techniques and tools for modelling, simulation and analysis of complex engineering problems.

Module: 1

Introduction: Philosophy of Computational Fluid Dynamics, Computational Fluid Dynamics as a research tool, Computational Fluid Dynamics as a design tool, the impact of Computational Fluid Dynamics on automobile and engine applications, Industrial manufacturing applications, environmental engineering applications. (**Lectures 9)**

Module: 2

Governing equations of Computational Fluid Dynamics: Models of the flow, the substantial derivative, divergence of velocity, continuity equation, momentum equation, energy equation, Physical boundary conditions. (**Lectures8)**

Module: 3

Partial differential equations: General method of determining the classification of partial differential equations, The impact of different equation on Computational Fluid Dynamics: Hyperbolic equations, Parabolic equations and Elliptic equations. (**Lectures 6)**

Module: 4

Basic aspects of Discretization: Introduction to finite differences, Difference equations, Explicit and implicit approaches. (**Lectures 6)**

Module: 5

Grids with appropriate transformation: General transformation of the equations, Matrices and Jacobians, Stretched (compressed) grids. (**Lectures 5)**

Module: 6

Some Simple Computational Fluid Dynamics Techniques: Lax-Wendroff Technique, Mac Cormack's Technique, Relaxation Technique, Pressure Correction Technique, etc.

(**Lectures 8)**

Text/Reference Books:

1. John D. Anderson, Jr. "Computational Fluid Dynamics", McGraw-Hill, Inc.
2. Date, A. W., "Introduction to Computational Fluid Dynamics", Cambridge University Press, 2005.
3. Sengupta, T. P. "Fundamental of Computational Fluid Dynamics", Orient Longman, Hyderabad, India, 2004.

102807	**Safety Management**	**3L:0T:0P**	**3 credits**

Objectives: This course is directed towards creating safety awareness, identifying hazards and mitigation of accidents along with introduction of legal requirements and following up action.

Outcome: After reading the course an engineer may develop confidence of over safe operations.

Module: 1

Need, Modern safety concepts, OSHA norms. (**Lectures 3)**

Module: 2

Safety Management function, Cost analysis of accidents, system safety analysis. (**Lectures 6)**

Module: 3

Hazards identification and control. Pressure hazard, fire hazard and Electrical hazard. **(Lectures 12)**

Module: 4

Hazard in construction industry, Hazard due to acceleration and fall, Mechanical hazard, Hazard due to heat and temperature. (**Lectures 11)**

Module: 5

Safe practices rules, Personal protective equipment. (**Lectures 4)**

Module: 6 Ergonomics. (**Lectures 6)**

Text/Reference Books:

1. Safety Management - John V. Grimaldi& Rollin H Simmands.
2. Ergonomics at work - Osborne, D. J, John wiley&Sons.s
3. Industrial safety Handbook - Handey, W, Mcgraw Hill.
4. Designer's Guide to OSHA - Mcgraw Hill.
5. Handbook of occupational safety and Health – Johnwiley& Sons.
6. Industrial Accident Prevention – Heinrich, Hetal, Mcgraw Hill.

102808	Non-Conventional Manufacturing	3L:0T:0P	3 credits

Objective: To understand how the material removal by using various energy and to know how the new materials and complex parts are produced with high accuracy by using new technology.

Module:1

Introduction: Historical background of non-conventional machining processes, Classification, Basic fundamentals of various process and related comparison. (**Lectures 4)**

Module: 2

Mechanical Machining Process: Principle and working and applications of mechanical machining processes such as ultrasonic machining, water jet cutting. (**Lectures 7)**

Module: 3

Thermal and Chemical Machining Process: Principle and working and applications of thermal and chemical machining processes such as electro-discharge machining, electro-chemical machining. (**Lectures 7)**

Module: 4

Non-conventional welding process: Principle and working and application of non-conventional welding processes such as laser beam welding, electron beam welding, ultrasonic welding, plasma arc welding. explosive welding, cladding under water welding, metallising.

(**Lectures 10)**

Module: 5

Non-conventional forming process: Principle, working and applications of high energy forming processes such as explosive forming, electro-magnetic forming, electro-discharge forming, water hammer forming, explosive compaction. (**Lectures 10)**

Module:6

Introduction to Micro Manufacturing: Micro manufacturing fundamentals, significance, application of NCMPs for micro manufacturing, Micro to Nano finishing processing information. (**Lectures 4)**

Text Books/ References Books:

1. P.C. Pandey and H.S. Shah, *Modern Machining Processes*, Tata Mcgraw-Hill Publishing Co. Ltd, New Delhi, 1980.
2. A. Ghosh and A.K. Mallik, *Manufacturing Science,* 2nd edition, Affiliated East West Press, New Delhi.
3. G.F. Benedict, *Nontraditional Manufacturing Processes*, Marcel Dekker Inc., New York (ISBN 0-8247-7352-7), 1987.
4. V.K. Jain, *Advanced Machining Processes*, Allied Publishers, 2009.
5. J. A. McGeough, *Micromachining of Engineering Materials*, Taylor & Francis, 2001.

Outcome: Students will be able to understand the fundamentals of various non-conventional machining processes and their influence on performance and their applications.

Program Elective

102801	**Principles of Management**	**3L:0T:0P**	**3 credits**

Objectives:

To understand the principles of management and their application to the functioning of an organization

Contents:

Module: 1

Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management. **(Lectures 8)**

Module: 2

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. **(Lectures 6)**

Module: 3

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.
(Lectures 10)

Module: 4

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication. **(Lectures 8)**

Module: 5

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

(Lectures 8)

Course Outcomes:

Upon completion of this course, the students will get a clear understanding of management functions in an organization

Text Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed.,2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education,2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill,1999.

102802	**Design of Transmission Systems**	**3L:0T:0P**	**3 credits**

Objectives:

To learn about the design procedures for mechanical power transmission components

Contents:

Module: 1

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets. **(Lectures 4)**

Module: 2

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

(Lectures 10)

Module: 3

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

(Lectures 10)

Module: 4

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications. **(Lectures 10)**

Module: 5

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake. **(Lectures 8)**

Course Outcomes:

Upon completing this course the students will be able to design transmission systems for engines and machines.

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill,2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley,2010.
3. MaitraG. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill,2001.

100808 Common Paper (ME/LT)	**Total Quality Management**	**3L:0T:0P**	**3 credits**

Objectives:

To facilitate the understanding of total quality management principles and processes

Contents:

Module: 1

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs toquality. **(Lectures 8)**

Module: 2

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection. **(Lectures 8)**

Module: 3

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types. **(Lectures 8)**

Module: 4

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures. **(Lectures 8)**

Module: 5

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors. **(Lectures 8)**

Course Outcomes:

Upon completion of this course, the students will be able to use the tools and techniques of TQM in manufacturing and service sectors.

Text Books:

1. Bester field D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

102804	**Energy Conservation and Management**	**3L:0T:0P**	**3 credits**

Objectives:

To understand the energy data from industries and carry out energy audit for energy savings

Contents:

Module: 1

Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energyauditing.

(Lectures 8)

Module: 2

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting. **(Lectures 10)**

Module: 3

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories. **(Lectures 10)**

Module: 4

Energy Conservation in major utilities, pumps, fans, blowers, compressed, air systems, Refrigeration & Air Conditioning system, Cooling Towers, DG sets. **(Lectures 6)**

Module: 5

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept. **(Lectures 6)**

Course Outcomes:

Upon completion of this course, the students will be able to perform of energy auditing for the energy consumption of industries.

Text Books:

1. Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988.
2. Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford,1981.
3. Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.
4. Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2004 (available at www.energymanagertraining.com).

102805	Gas Dynamics and Jet Propulsion	3L:0T:0P	3 credits

Objectives:

1. To understand the features of compressible isentropic flows and irreversibility like shocks.
2. To provide a basic knowledge of jet and rocket propulsion technologies.

Contents:

Module: 1

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow. **(Lectures 12)**

Module: 2

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables. **(Lectures 8)**

Module: 3

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

(Lectures 10)

Module: 4

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

(Lectures 10)

Course Outcomes:

Upon completion of this course, the students will be able to apply gas dynamics principles to jet and space propulsion systems.

Text Books:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press,2008.
2. H.S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing,2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley,1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley,1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York,1986.