SEMESTER I

15M101 CALCULUS AND ITS APPLICATIONS

3 2 0 4

DIFFERENTIAL CALCULUS: Basic concepts - Limits, continuity, differentiation, functions of several variables, partial derivatives, total derivatives, Taylor’s formula for functions of two variables. (8+5)

INTEGRAL CALCULUS: Double integrals - double integrals over rectangles, double integrals as volumes, Fubini’s theorem (concept and statement only), double integrals in polar form, changing the order of integration. (6+4)

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, Bernoulli equation, modelling- mixing problems, Newton’s law of cooling. (8+5)

LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER: Homogeneous linear equations of second order, linearity principle, initial value problem, general solution, second order homogeneous equations with constant coefficients, Euler – Cauchy equation, solution by variation of parameters, modelling- free oscillations. (7+5)

VECTOR CALCULUS: Gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field. Integration in vector field – line integrals, work, circulation and flux, path independence, conservative fields, surface integrals. Green’s, Gauss divergence and Stoke’s theorems (concepts and statements only), evaluation of line, surface and volume integrals. (16+11)

TEXT BOOKS:

REFERENCES:

15A102/15M102/15P102 PHYSICS

3 0 0 3


Total = L: 45
15A/M/P/Y103 CHEMISTRY


**TEXT BOOKS:**

**REFERENCES:**

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15M104 ENGLISH LANGUAGE PROFICIENCY

**LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS:** Integrated Tasks focusing on Language Skills – Training based on Text based Vocabulary, tone, register and Syntax features

**GRAMMAR IN CONTEXT:** Word Order – Subject Verb Concord – Style features – Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals and Transformation of Sentences

**GUIDELINES FOR WRITTEN COMMUNICATION:** Principles of Clear Writing - Paragraph Writing – Essay Writing – Emphasis Techniques – Summarizing and Paraphrasing – Analytical Writing – Letter Writing
WRITING PRACTICE

FOCUS ON SPOKEN ENGLISH: Task – based activities with graded levels of difficulty and with focus on language functions

Level 1: Self – expression – Greetings in Conversation, Hobbies, Special interests, Daily routine
Level 2: General Awareness – Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review
Level 3: Advanced Skills – Making Short Speeches and Participating in Role Plays

LISTENING ACTIVITY: Task- based Activities using Language Lab

TEXT BOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15M105 PROBLEM SOLVING AND C PROGRAMMING

INTRODUCTION TO PROBLEM SOLVING: Program development - Analyzing and Defining the Problem - Algorithm - Flow Chart.

PROGRAMMING LANGUAGES: Definition - Types of programming language – Modular Programming - Program Development Environment.


CONTROL STATEMENTS: If else - Switch Case - While - Do While - For - Nested loops - break – continue – goto statements.

FUNCTIONS: Function prototype - Defining a function – function call - Passing arguments to a function - Storage classes - auto - static - extern and register variables.

ARRAYS: Defining an array - Processing an array - Passing array to a function - Multi dimensional array - Arrays & strings.

POINTERS: Definition - Pointer Arithmetic - Pointer and arrays – Dynamic memory allocation.

STRUCTURES AND UNIONS: Definitions - Processing a structure – Array and structures – Nested structures - Structures and pointers - Structures and functions.

FILES: Need for files – Operations on files - Sequential and Random access file functions - File Handling Functions - Error handling functions.

TEXT BOOKS:

REFERENCES:
15M106  CONCEPTS OF ENGINEERING DESIGN & ENVIRONMENTAL ISSUES  

VISUALIZATION AND FREEHAND SKETCHING: Understanding of form and functions, freehand sketching of typical engineering components  

ENGINEERING DESIGN: Engineering design process, Identification and analysis of needs, Organization of design concept, Modeling, Design Management, Information Gathering, Presentation Techniques, Rapid Prototyping.  

REVIEW OF MECHANICS: Force, torque, power, moment of inertia, bending moment, eccentric loading, friction, free body diagrams  


STRESS AND STRAIN: Loading (elastic and plastic), stress, strain, Young’s modulus, shear modulus, stress-strain curve (yield strength, ultimate tensile strength, proof strength, percentage elongation), tensile stress and shear stress computation, thermal stress, stress concentration factor, hoop stress, bending of beams, ductility, toughness, Hertzian contact stress, Fatigue (high-cycle, low-cycle), fracture mechanics (Initiation, Propagation, failure), springs-strain energy, bearings-an overview, theories of failure  

INNOVATION AND INVENTION SERIES: Creativity-development concepts, examples, Concept Evaluation, Mind Maps, TRIZ, Intellectual Property Rights  

PLANNED EXPERIMENTATION THROUGH GRAPHICAL PROGRAMMING: Introduction, the front panel, the block diagram, data acquisition, components of a DAQ system, DAQ hardware configuration, DAQ assistant, analog I/O, digital I/O, typical sensor interface examples.  

GREEN DESIGN PROCESS: Material life cycle, Embodied energy, 80-20 rule, Carbon foot print, Green design in industry, Sustainability, Biomimetics.  

PROJECT BASED LAB SESSIONS  
- Assembly and dismantling of a bicycle / pneumatic cylinder  
- Sensor Interface to monitor temperature by employing thermocouple using graphical programming  
- Study of cut sections of automotive components  
- CAD modeling of a typical engineering component using a CAD software  
- Make a component / product  

Total: L: 45  

TEXT BOOKS:  

REFERENCES:  

15M110 ENGINEERING GRAPHICS I  

INTRODUCTION: Introduction to Engineering Drawing- Lettering practice, drawing instrument practice, Bureau of Indian Standards (BIS), geometric constructions, principles of dimensioning.  

PICTORIAL PROJECTIONS: Principles of pictorial views, isometric view of simple engineering components. Free hand sketching of orthographic views from pictorial views. Free hand sketching of isometric views from given two or three views. Drawing pictorial views of four wheeler, multistoried building.

(4+15)

COMPUTER GRAPHICS: Introduction to computer aided drawing, co-ordinate system and reference planes, commands- 2D drawings. Drawing 2D view of machines like lathe, radial drilling machine.

(3+15)

Total: L: 15 + P: 60 = 75

TEXT BOOKS:

REFERENCES:

15M111 PHYSICS LABORATORY I

LIST OF EXPERIMENTS
1. Determination of Young’s modulus of a wooden bar – Cantilever method.
2. Determination of coefficient of viscosity of water – Poiseuille’s method.
5. Determination of thermal conductivity of bad conductor using Lee’s disc method

DEMONSTRATION:
1. Optical phenomena using He – Ne Laser
2. Ultrasonic cleaning.
3. Thin film deposition using DC/RF sputtering technique.
4. Surface Profilometer

Total: P: 30

REFERENCES:
1. Physics Practicals, Department of Physics, PSG College of Technology 2015.

15A/M/P112 CHEMISTRY LABORATORY I

1. Estimation of strength of an acid by pH -metry.
2. Estimation of acids in a mixture by conductometry.
3. Anodizing of aluminium and determination of thickness of anodic film, sealing and dyeing of anodic film.
4. Determination of total, permanent, temporary, calcium and magnesium hardness of water by EDTA method.

Total P: 30

REFERENCE:
1. Laboratory Manual Prepared by the Department.

15M113 ENGINEERING PRACTICES

2. Welding - Metal arc welding tools and equipment, exercises by Arc welding and TIG welding Processes.
5. Power Tools- Demonstration of tools and operations.
6. Plumbing-exercises external thread cutting and joining

Total: L: 15 + P: 60 = 75
7. Sheet metal work & Soldering - Tools, operations, exercises: Make a Rectangular Tray in Galvanized Iron sheet

**Total: P: 30**

**REFERENCES:**
1. Laboratory manual prepared by Mechanical Engineering department, 2010

**SEMESTER II**

**15M201 COMPLEX VARIABLES AND TRANSFORMS**

**3 2 0 4**

**COMPLEX VARIABLES:** Complex differentiation-Analytic function, Cauchy Riemann equations, harmonic functions. (6+4)

**COMPLEX INTEGRATION:** Cauchy’s integral theorem, Cauchy’s integral formula, Laurent series (concept and statement only), singularities and zeros, residue integration method (Residue integration of complex integrals only), linear fractional transformations. (8+5)

**LAPLACE TRANSFORMS:** Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t-shifting, Dirac’s delta function, periodic functions, convolution, differentiation and integration of transforms, Method of solving differential equations and integral equations by using Laplace transform technique. (12+9)

**FOURIER ANALYSIS:** Fourier series - functions of any period 2L, half range expansions. Fourier transforms, Fourier cosine and sine transforms. (9+6)

**HOMOGENEOUS PARTIAL DIFFERENTIAL EQUATIONS:** Basic concepts, modeling – vibrating string, wave equation, solution by separating variables, one-dimensional heat equation, steady state two-dimensional heat equation (Cartesian coordinates only) - solution by Fourier series. (10+6)

**Total L: 45+T: 30=75**

**TEXT BOOKS:**

**REFERENCES:**

**15M202 ENGINEERING MECHANICS**

**3 2 0 4**

**STATICS OF PARTICLES:** Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle – free body diagram – force in space – equilibrium of a particle in space. (7+4)

**STATICS OF RIGID BODIES IN 2 DIMENSION:** External, Internal forces – transmissibility – moment of a force – varignon’s theorem – moment of a couple – resolution of a force into a force and a couple – reduction of a system of forces – reactions at supports and connections – equilibrium of a two and three force bodies –case studies. (6+4)


**ANALYSIS OF STRUCTURES:** Simple trusses-Method of joints, method of sections – joints under special loading conditions – space trusses – analysis of frames (6+4)

**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA:** Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids. (6+4)

**KINEMATICS:** Introduction-plane, rectilinear and rotary motion-time dependent motion-rectangular coordinates-projectile motion. (5+4)

**KINETICS:** Equation of motion-rectilinear and rotary motion-Newton’s II law – D’Alembert’s principle- Energy - potential energy-kinetic energy-conservation of energy-work done by a force - work energy method. (5+4)

TEXT BOOKS:

REFERENCES:

15M203 INDUSTRIAL PSYCHOLOGY, SOCIOLOGY AND WORK ETHICS  2002

INDUSTRIAL PSYCHOLOGY: Objectives, Individual behavior, Group behavior, Group Dynamics, Leadership Styles, Industrial Fatigue. (4)

SOCIAL SYSTEM: Definition, Scope, Significance, Society, Community, Institutions, Culture, Socialization, Social systems. (4)

HUMAN RESOURCE MANAGEMENT: Definition, Importance, Functions, Training & Development. (3)

HUMAN VALUES: Value crisis in Contemporary Indian Society, Aesthetic Values, Moral and Ethical Values, Values in the Workplace. (4)

WORK ETHICS: Professional Values & Ethics, Need, Issues, Challenges, Ethical Leadership. (3)

SOCIAL RESPONSIBILITY AND ETHICS: Concept of Social Responsibility, Importance of Social Responsibility, Business Ethics. (4)

INTERPERSONAL RELATIONSHIP: Managing emotions, Emotional Intelligence, Building Better Interpersonal Relations, Managing the Boss, Dealing with Subordinates, Case Study. (4)

MOTIVATION AND PERCEPTION: Meaning, definition, Mechanism, Basic Theories of Motivation, Importance of Perception, Need for Shaping Perception. (4)

TEXT BOOKS:

REFERENCES:

15M204 MATERIALS SCIENCE  3003

MAGNETIC PROPERTIES: Magnetic dipoles and magnetic field vectors. Dia, para, ferro, anti-ferro and ferrimagnetism. Hard and soft magnets. Hysteresis loss, Low-conducting magnets, super conducting magnets and conducting magnets, magnetorheology and applications. (8)


COMPOSITES: Introduction, significance of composites, functions of matrix and reinforcement in composites. Polymer, metal and ceramic matrix composites, carbon carbon composites. Applications in machine tools, automobiles, aerospace and sports equipments. Influence of fiber length, fiber orientation and concentration in functionality of the composites. (9)


TEXT BOOKS:

REFERENCES:

15M205 CHEMISTRY OF ENGINEERING MATERIALS


BATTERIES AND FUEL CELLS: Batteries: types- characteristics- construction and working of Lechlanche cell, lead-acid battery, nickel-cadmium battery, lithium ion battery. Outline of batteries for special applications such as automobiles, airplanes, satellites, torpedoes. Fuel cells: hydrogen – oxygen, direct methanol and proton exchange membrane fuel cells. (5)


TEXT BOOKS:

REFERENCES:

Total L: 45
15M210 ENGINEERING GRAPHICS II

SECTION OF SOLIDS: Sections of regular solids, types of sections, BIS conventions, selection of sectional views. Sectional views of simple engineering components. Drawing sectional views of typical machine parts like bearing, drill spindle. (4+15)

DEVELOPMENT OF SURFACES: Development of lateral surfaces of regular solids, truncated solids and simple engineering sheet metal components. Preparation of parts like chimneys, air conditioning duct using cardboard material. (4+15)

PERSPECTIVE PROJECTION: Principles of perspective projection, methods, perspective projection of solids. Drawing free hand perspective projections of train, internal seating arrangement. (4+15)

COMPUTER GRAPHICS: Introduction to 3D modeling packages. Drafting practices - modeling of simple engineering components, sections and extraction of 2D drawings. Modeling of plants like windmill, solar panel system. (3+15)

Total: L: 15 + P: 60 = 75

TEXT BOOKS:

REFERENCES:

15M211 PHYSICS LABORATORY II

List of Experiments:
1. Determination of magnetic hysteresis
2. Determination of small thickness by interferometry
3. Determination of IV characteristics of solar cell
4. Measurement of temperature using IC thermal sensor LM35
5. Determination of specific resistance of metal and alloy using Carry Foster’s bridge.

Demonstration:
1. Laser micromachining.
2. Crystal Growth system
3. Thin film deposition using electron beam and thermal evaporation.
4. Differential scanning calorimeter(DSC)

Total P: 30

REFERENCES:
1. Department of Physics, “Physics Practicals”, PSG College of Technology 2015

15M212 CHEMISTRY LABORATORY II

1. a. Determination of alkalinity and TDS of water.
   b. Determination of acid value, saponification value and iodine number of oils.
2. Electroplating of nickel & copper and determination of cathode efficiency.
3. a. Determination of Redwood / Saybolt numbers and kinematic viscosity of lubricating oils.
   b. Determination of flash and fire point, cloud and pour point of oil.

Total P: 30

REFERENCE:
1. Laboratory Manual Prepared by the Department.
Module 1: Basics About Industry: Layout of HED & RMD, Organization structure, Safety measures.

HEAVY ENGINEERING DIVISION:
Module 2: List of machine tools, Components and operations on each machine tool, Cutting tools, Work holding and tool holding devices in each machine tool, Basics of Welding process.


ROTATING MACHINERY DIVISION:
Module 4: INDUCTION MOTOR & SUBMERSIBLE MOTOR: Stator & Rotor fabrication, Winding, Motor Component list, Component drawing and function, Machining details, Process sheet.

Module 5: PUMP: Types of pumps, Pump Component list, Component drawing and function, Machining details.

Module 6: Assembly & Testing of motor and pump.

COMPUTER NUMERICAL CONTROL:
Module 7: Basics of CNC Machine. Study of various power transmission elements used in industries.

NEELAMBUR FOUNDRY DIVISION:
Module 8: Layout, Process - Pattern shop, Sand preparation, Core & Mould making.

Module 9: Melting and Pouring, Fettling.

Module 10: Machine moulding, DISA Flux machine, Defects in casting.


Total: P: 30

TEXT BOOKS:

REFERENCES:

SUMMER TERM

15M215 PROFESSIONAL SKILLS

UNIT I A: HISTORICAL PERSPECTIVE OF MANUFACTURING ENGINEERING:

Industrial revolution, purpose and evolution of production engineering, materials in manufacturing, conscious design & manufacturing, economics - time and cost analysis, recent technologies - digital manufacturing, case studies. (L: 8)

UNIT I B: TRAINING IN CAD PACKAGE:

Solid modeling and assembly practice, Extraction of 2D view from 3D modeling, Coloring and shading of 3D models. (L: 8 P: 16)

UNIT II: SEMINAR PRESENTATION AND TECHNICAL REPORT WRITING


Each student will be required to submit a technical report based on the guidelines provided by the department. (L: 8 P: 6)
PROJECT PRESENTATION: Each student will be required to make one technical presentation for a minimum 15 minutes duration in this course. Individual topics will be assigned to the students by the department.  

(P: 6)

PROFESSIONAL COMMUNICATION – ORAL SKILLS: Principles of group communication, interviewing, and making presentations—group discussions, role plays, mock interviews—talking about some visual information—giving and receiving instructions.  

(P: 8)

Total: L: 24 + P: 36 = 60

15M216 INPLANT TRAINING & TECHNICAL SEMINAR  6 0 9 2

1. Factory layout, Organization structure, various departments.
2. Study of Broaching machine – Construction, mechanism of working.
5. Study of Pressure die casting process.
7. Study of Motor Assembly.
8. Study of Lathe Assembly.
9. Study of Electro Discharge Machining and die making.
10. Visit to Foundry Division.
11. Visit to TIFAC – CORE
12. Visit to Nano Technology Laboratory.

Note: Students will make presentations on the details of activities carried out during InPlant Training in the presence of a committee of faculty members every week. At the end of InPlant Training, a comprehensive report will be submitted by the students for assessment.

Total: L: 24 + P: 36 = 60

SEMESTER III

15M301 NUMERICAL METHODS  2 2 0 3

ERRORS: Approximations and round-off errors - truncation errors.  

(2+1)


(5+5)


(4+4)


(4+4)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation - equally spaced and unequally spaced data, numerical integration, Newton-Cotes formulae, Trapezoidal rule, Simpson’s 1/3 rule.  

(4+4)


(6+6)


(5+6)

Total L: 30 + T: 30 = 60
INTRODUCTION: Properties of fluids. Concept of gauge and absolute pressure, measurement of pressure using manometers of different types. Types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Stream line, streak line and path line. (3+3)

FLUID STATICS & KINEMATICS: Hydrostatic forces on submerged bodies, Buoyancy, flotation and stability, Lagrangian and Eulerian approach, fluid particle motion along a curved path, vorticity, circulation, flow nets (3+3)

IDEAL FLOW: Irrotational and rotational flows, stream function, potential function, D’Alembert paradox, continuity equation - derivation and applications to one dimensional flow, differential momentum equation, Impact of jets - force on fixed and moving vanes, flat and curved. (3+3)

FLUID DYNAMICS: Navier Stokes equation - derivation and problems, derivation of Euler's equation and Bernoulli's energy equation, examples illustrating the use of energy equations. (3+3)

LAMINAR FLOW: Hagen-Poiseuille equation - velocity profile, power calculations. Laminar flow between parallel plates - Couette flow. (4+4)

FLOW THROUGH PIPES: Pipes in series and parallel. Reynolds number, Darcy-Weisbach equation, use of Moody diagram, minor losses - sudden expansion, sudden contraction and losses in pipe fittings. (3+3)

FLOW MEASUREMENT: Orifice meter, Venturi meter, Flow nozzle, Pitot tubes, Multi-hole probe and Anemometer, Rotameter, Hotwire anemometer, Magnetic flow meter, Displacement meter, Vortex flow meter, Turbine flow meter, Selection of flow meter. (3+3)

DIMENSIONAL ANALYSIS AND MODEL TESTING: Buckingham’s theorem, Reynolds, Froude and Mach number and their applications in model testing. (3+3)

BOUNDARY LAYER THEORY: Development of boundary layer, Prandtl’s boundary layer equations, Blasius solution, integral momentum equation, drag on a flat plate, boundary layer separation and its control, streamlined and bluff bodies - flow around circular bodies and aerofoils, calculation of lift and drag. (5+5)

Total = L: 30 + T: 30 = 60

STRESSES AND STRAINS: Stress and strain due to axial force, elastic limit, Hooke's law - factor of safety - stepped bars, uniformly varying sections, stresses in composite bar due to axial force and temperature. Strain Energy due to axial force - proof resilience, stresses due to gradual load, sudden load and impact load. (5+5)
CHANGES IN DIMENSIONS AND VOLUME: Lateral strain - Poisson's ratio, volumetric strain, changes in dimensions and volume, shear stress, shear strain, relationship between elastic constants. Hoop and Longitudinal stresses in thin cylindrical and spherical shells under internal pressure-changes in dimensions and volume. (4+4)

BENDING MOMENT AND SHEAR FORCE: Relationship between load, shear force and bending moment - shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads, concentrated moments, maximum bending moment and point of contra flexure. (6+6)

BENDING STRESSES: Theory of simple bending and assumptions - derivation of equation, section modulus, normal stresses due to bending. (3+3)

TORSION: Theory of torsion and assumptions-derivation of the equation, polar modulus, stresses in solid and hollow circular shafts, power transmitted by a shaft, close coiled helical spring with axial load. (3+3)

PRINCIPAL STRESSES AND STRAINS: (Two dimensional only) State of stress at a point - normal and tangential stresses on a given plane, principal stresses and their planes, plane of maximum shear stress, analytical method, Mohr's circle method, application to simple problems. Determination of principal stresses in a shaft subjected to bending, axial and torsional load. (5+5)

DEFLECTION OF DETERMINATE BEAMS: Governing differential equation - Macaulay's method-moment area method, application to simple problems; Introduction to buckling of columns - Euler Formula. (4+4)

Total L:30+T:30=60

TEXT BOOKS:

REFERENCES:

15M304 MANUFACTURING PROCESSES I


BULK DEFORMATION PROCESSES: Hot working and cold working of metals-Forging processes-Open, impression and closed die forging-types of Forging machines-Typical forging operations-Swaging-Rolling of metals-Types of rolling mills-Flat strip rolling-Shape rolling operations-Defects in rolled parts-principle of rod and wire drawing-Tube drawing-Principles of extrusion-Types of Extrusion-hot and cold extrusion-Equipment used. (9)

SHEET METAL PROCESSES: Sheet metal characteristics-Typical shearing operations, bending and drawing operations, blanking, piercing, punching, trimming, etc. -formability of sheet metal-test methods of formability-Presses for sheet metal working. Elements of a simple die; punch and die clearances; Progressive, compound and combination dies and Blanking force Calculations. Special forming methods:Explosive forming, electromagnetic forming, electro hydraulic forming, composite mouldings. (9)

POWDER METALLURGY: Definition-Advantages, Disadvantages/Limitations of powder metallurgy-Applications of powder metallurgy-Manufacture of parts by powder metallurgy-Production of metal powders-Blending of metal powders-pressing or compaction of metal powders-sintering-finishing operations. (4)


Total L: 45

TEXT BOOKS:
REFERENCES:
4. NPTEL web and video course on Manufacturing Processes-I

15M305 KINEMATICS OF MACHINERY

3204


KINEMATICS: Displacement, velocity and acceleration analysis in simple mechanisms, graphical method, velocity and acceleration polygons. Kinematic analysis by algebraic method, a demonstration, vector approach, Chace equation, computer applications in the kinematics analysis of simple mechanisms. (9+6)

FRICTION DRIVES: Limiting ratio of belt/rope tensions, centrifugal tensions. Condition for maximum power transmission, corresponding speed in belt and rope drives, (6+6)

KINEMATICS OF CAM: Flat type, the fundamentals of cam, Classifications, displacement diagrams-parabolic, uniform velocity, simple harmonic paths. Layout of plate cam profiles for different types of followers - knife - edged, roller, design, derivatives of follower motion, pressure angle, transmission angle. (6+4)

GEARS: Spur gear terminology and definitions. Fundamental law of toothed gearing and tooth forms. Interchangeable gears, gear tooth action-interference and undercutting. Helical, bevel, worm, rack and pinion gears (basics only). Gear trains, epicyclic gear trains, differentials, automotive transmission gear trains. (8+5)

GYROSCOPIC COUPLE: Gyroscopic couple and its effect in ship, car, motorcycle, aircraft and space vehicles, gyroscopic stabilization. (5+3)

SYNTHESIS OF LINKAGES: Number and dimensional synthesis – two position synthesis of slider crank and four bar mechanisms. (5+4)

Total = L: 45 + T: 30 = 75

TEXT BOOKS:

REFERENCES:

15M306 ENGINEERING THERMODYNAMICS

3204

BASIC CONCEPTS OF THERMODYNAMICS: Introduction, System, property, temperature and International Temperature Scale, Zeroth law of thermodynamics and application, Thermodynamics state and equilibrium, process and cycle, work, heat and other forms of energy. (5+6)

FIRST LAW OF THERMODYNAMICS: First law of thermodynamics, applications to closed and open systems, uniform and non-uniform processes, steady state and unsteady state processes, general energy equation and applications to thermal equipment. (5+3)

PROPERTIES OF PURE SUBSTANCES, IDEAL GASES AND PROPERTIES OF STEAM: Ideal gas equation, Properties of Ideal Gases, Equations of State, Law of Corresponding States, Properties of Mixtures, compressibility, universal compressibility chart, Pure Substances, PVT Surfaces, PV, TV, and PT diagrams of water and other substances and differences of the same, phase-change processes, Concept of Vapor Pressure, Properties of steam, Saturation Temperature and Pressure, Use of property tables, TS diagrams, Mollier Chart, Rankine Cycle. (13+6)
SECOND LAW OF THERMODYNAMICS: Kelvin-Planck and Clausius statements-heat engines and heat pump, reversibility, Carnot cycle, Carnot theorem, Thermodynamic temperature scale, Deduction of the third law of thermodynamics, Types of Irreversibility. I and II law Efficiency.


THERMODYNAMIC RELATIONS: Thermodynamic Relations, Maxwell’s Equations, Joule Kelvin Effect, Clausius-Clapeyron Equation, Conditions of Thermodynamic Equilibrium and Stability.

Total = L: 45 + T: 30 = 75

TEXT BOOKS:

REFERENCES:

15M310 MANUFACTURING PROCESS LABORATORY

CYCLE 1-LATHE
1. Study of construction features and manufacturing methods – Head stock, Tail stock, Carriage, Cross slide, Compound rest, Belt, Guide ways, Feed gear box, Apron gear box.
2. Turning - Facing, chamfering and step turning
3. Turning -Taper turning and knurling
4. Turning- Step turning and Grooving
5. Turning –Step turning and Thread cutting-External
6. Turning -Eccentric turning
7. Turning- Facing, Drilling and Boring
8. Turning –Pin and bush assembly for H8 e8 clearance fit
9. Turning- Boring and internal thread cutting
10. Dismantling and assembly of Headstock and Tailstock

CYCLE 2-OTHER MACHINE TOOLS
1. Spur gear Milling
2. Spur, helical gear hobbing
3. Shaft grinding, Tool & cutter grinder
4. Plastic Injection Molding
5. Machining with EDM
6. Pocket milling
7. Drilling &force measurement
8. Shaping & slotting
9. Study of super finishing process
10. Study of Rapid Prototyping Machine

Total P: 60

REFERENCE:
1. Laboratory Manual prepared by Department of Mechanical Engineering.

15M311 FLUID MACHINERY LABORATORY

1. Flow measurement using mouthpiece and orifice.
2. Calibration and comparison of instruments for measuring flow through pipes-orifice, venturimeter, water meter and rotameter.
3. Calibration and comparison of open channel flow measuring instruments- V-notch and rectangular notch.
4. Experiment on force induced on the vane due to impact of jets.
5. Model study in wind tunnel.
6. Performance test on centrifugal pumps.
7. Load test on impulse and reaction water turbine.
8. Performance test on axial flow fan.
10. Fluid flow analysis using computational fluid dynamics

REFERENCES:
1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMIESTER IV

15M401 PROBABILITY AND STATISTICS

PROBABILITY: Sample spaces and events, interpretations of probability, addition rule, conditional probability, multiplication and total probability rules, independence, Baye’s theorem. (4+4)

RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS: Random variables - discrete random variables, probability distributions and probability mass functions, cumulative distribution functions, expectation, binomial, Poisson and geometric distributions - continuous random variables – probability distributions and probability density functions, cumulative distribution functions, expectation, uniform, normal, and exponential distributions. (6+6)

JOINT PROBABILITY DISTRIBUTIONS: Two dimensional discrete and continuous random variables, marginal and conditional probability distributions, independence, covariance, correlation and linear regression. (8+6)

POINT ESTIMATION OF PARAMETERS AND SAMPLING DISTRIBUTIONS: Sampling distributions and the central limit theorem, point estimation - unbiased estimators, variance of a point estimator, standard error and mean squared error of an estimator, method of point estimation - maximum likelihood estimation. (4+4)

HYPOTHESIS TESTING: Statistical hypothesis, tests of statistical hypothesis, one-sided and two–sided hypothesis, confidence intervals, large and small sample tests, inference concerning means, variances and proportions - Chi-square test for goodness of fit and independence of attributes. (5+6)

ANALYSIS OF VARIANCE: Introduction, assumptions of analysis of variance, completely randomized design, randomized block design, Latin square design. (3+4)

TEXT BOOKS:

REFERENCES:

15M402 BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING


INDUSTRIAL APPLICATIONS: Motor Selection – factors to be considered – power rating – types of Duty cycle – selection of motors for machine tools applications, centrifugal pumps. (3)

ELECTRONIC DEVICES: Operation of PN junction diodes, VI characteristics, zener diode, BJT-types -CB, CE, CC configurations, input and output characteristics, JFET, difference between FET and BJT-working principle and characteristics. MOSFET- types,
principle of operation and characteristics, Opto Electronic Devices-Introduction, types, photo conductive, photo diode, phototransistor, Light emitting diode - Principles and Applications.  

**ELECTRONIC CIRCUITS:** (Qualitative analysis only) Half wave and full wave rectifier, capacitive filters, zener voltage regulator, RC-coupled amplifier, frequency response, oscillator, Barkhausen criteria, RC phase shift oscillator.  

**LINEAR INTEGRATED CIRCUITS:** Operational amplifiers, Ideal op-amp characteristics, Inverting and Non-inverting amplifier, op-amp applications - Adder- Subtractor, integrator, differentiator, comparator, zero crossing detector – 555 Timer IC – Astable mode  

**DIGITAL ELECTRONICS:** Number systems- representation of signed numbers: 1’s complement and 2’s complement, logic gates, Half adder, full adder, parallel adder/subtractor, Flip flops, RS,JK,JK Master slave, D and T type, counters and shift registers.  

**TEXT BOOKS:**  

**REFERENCES:**  

15M403 MANUFACTURING PROCESSES II

**THEORY OF METAL CUTTING:** Introduction: material removal processes: Nomenclature of a single point cutting tool, mechanics of metal cutting, orthogonal and oblique cutting, Mechanism of chip formation, Types of chips Use of chip breaker in machining, Machining forces and Merchant’s Circle Diagram (MCD).Cutting tool materials-Thermal aspects- tool wear and tool life, surface finish, cutting fluids.  

**CENTRE LATHE AND SPECIAL PURPOSE LATHES:** Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism.  


**NON - TRADITIONAL MACHINING:** Need for Non Traditional Machining, Electric-Discharge Machining (EDM) -Electrochemical Machining-Ultrasonic Machining-chemical Machining-Laser Beam machining, Abrasive Water Jet machining (AWJM), electron Beam Machining (EBM), Ion Beam Machining (IBM), Plasma Arc Machining (PAM)-Equipments- Process- Process Parameters and Machining Characteristics,Applications,Limitations

**TEXT BOOKS:**  

**REFERENCES:**  
15M404 DYNAMICS OF MACHINERY

STATIC FORCE ANALYSIS OF MECHANISM: Free Body diagram-conditions of equilibrium, two, three and four force members, effect of friction. (6+4)

DYNAMIC FORCE ANALYSIS OF MECHANISM: Inertia force and D Alembert’s principle. Dynamic force analysis of mechanisms including slider crank mechanism. (7+4)

FLYWHEEL: Turning moment diagram-fluctuation of energy and speed, weight of flywheel required. (5+4)

BALANCING: Balancing of revolving, masses in single plane and several planes – Balancing of reciprocating masses, primary and secondary forces and couples, balancing of multicylinder inline engine. V and radial engines, direct and reverse crank technique. Balancing machines – field balancing, single and two planes. (8+6)

FREE VIBRATION: Basic features of vibratory systems-elements, degrees of freedom, single degree of freedom system. Undamped free vibration-equation of motion, natural frequency. Damped free vibration, equation of motion, logarithmic decrement, critical speed of shaft. (6+3)

FORCED VIBRATION: Response to periodic forcing-forcing by unbalance, support motion, force and amplitude transmissibility, force transmissibility, vibration isolation. (6+4)

TORSIONAL VIBRATION: Torsional vibration of two and three rotor systems, geared systems (5+3)

VIBRATION DIAGNOSIS AND CONTROL: General considerations- vibration measurement-vibration pickups, signature analysis (2+2)

Total = L: 45 + T: 30 = 75

TEXT BOOKS:

REFERENCES:

15M405 THERMAL ENGINEERING I

THERMODYNAMIC CYCLES: Determination of state’s properties, terminologies and cycle efficiencies: Carnot cycle, Air standard cycles- Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, and Dual Cycle. (3+3)

I C ENGINES: Classification. Principle and working of four stroke and two stroke petrol and diesel engines with P-V and T-S and valve and port timing diagrams. Comparison of petrol and diesel engines - two stroke and four stroke engines, Wankel engine- rotor and stator geometry, advantages and limitations. (4+4)

FUEL SUPPLY AND IGNITION SYSTEM: Working principles of carburetors, MPFI system. Battery and Magneto ignition type systems. Diesel fuel pumps and injector-working principle- CRDI system. Supercharging and turbo charging (3+3)

ENGINE LUBRICATION AND COOLING: necessity of lubricating system, properties of lubricating oil; Methods and types of lubrication systems; wet sump and dry sump systems; necessity of engine cooling; disadvantages of over cooling. Cooling systems; air cooling, water cooling: radiators. (4+4)

TESTING AND PERFORMANCE: Testing of IC engines-basics, engine measurements; air & fuel flow rate, constant speed and variable speed test, methods of estimating indicated power: Indicator diagram; Willan’s line; Morse test, brake power, volumetric efficiency. Heat balance test. emission measurement, emission reduction techniques (4+4)


TEXT BOOKS:
RECIPROCATING COMPRESSOR: Working principle-effect of clearance on volumetric efficiency, equations for shaft work and efficiencies, Multi-Stage Compression, inter-cooler, optimum intermediate pressure in a two stage compressor. (3+3)

ROTARY COMPRESSORS: Rotary positive displacement compressor- types-Roots Blower, Sliding Vane Compressor, Screw Compressor. Performance calculations. (3+3)

TEXT BOOKS:

REFERENCES:

15M410 MACHINE DRAWING

INTRODUCTION: Introduction to machine drawing, Importance of sectional views. Computer-aided drafting (2+6)

CONVENTIONS: Code of practice for engineering drawing-conventional representation of details- drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components-bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges. (3+6)

ASSEMBLY CONCEPTS: Assembly requirements, Bill of materials. Methods of assembly-bolts, nuts, studs, screws and pins.Methods of arresting motion of a member in an assembly. Assembly and dismantling exercise of a typical assembly with emphasis on assembly sequence and appropriate fits, (3+9)


ASSEMBLY DRAWING PRACTICE: Drawing practice of typical subassemblies-Sleeve and cotter joint, flange coupling, plummer block, stuffing box, gear box, foot step bearing, screw jack. (8+21)

ASSEMBLY USING SOLID MODELING: Modeling and assembly using a CAD software-extracting views and sections. Drawing of assemblies-, machine vice, stop valve, drill jig, tail stock.Creation of bill of materials, calculation of mass and section properties, interference check between solids. (6+12)

Total P: 60

TEXT BOOKS:

REFERENCES:

15M411 ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

1. Verification of Ohm's law and Kirchoff's laws.
3. Mechanical Characteristics of DC Shunt and Compound Motor
4. Load test on Three phase Induction Motor
5. Electric Braking of 3 Phase Induction Motor (Dynamic braking / plugging)
6. Study of Halfwave and Fullwave rectifiers with and without filters
7. RC coupled transistor amplifier
8. Applications of Operational Amplifier: Adder, Subtractor, Integrator and Differentiator
9. Study of logic gates and implementation of binary adder/subtractor
10. Implementation of Modulo-16 Counter

Total : P: 30

REFERENCE:
1. Laboratory Manual Prepared by the Electrical and Electronics Engineering Department.

SEMESTER V

15M501 METROLOGY AND INSTRUMENTATION

3 0 0 3


GEOMETRICAL MEASUREMENT AND MACHINE ELEMENTS: Angular measurement - optical protractors, sine bar, roundness measurement, limit gauge, design of plug gauge, Taylor’s principle, three basic types of limit gauges, Tomlinson surface meter, computer controlled CMM. ISO metric thread, measurement of major, minor and effective diameters. Gear terminology, spur gear measurement, checking of composite errors, base pitch measurement. (7)


PRESSURE AND FLOW MEASUREMENT: Elastic transducers - pressure cell, bulk modulus pressure gauge - Low Pressure Measurement: McLeod gauge - thermal conductivity gauge, calibration of pressure gauge. Flow measurement - turbine type meter, hotwire anemometer, magnetic flow meter. (7)

TEXT BOOKS:

REFERENCES:

Total : L: 45

15M502 DESIGN OF MACHINE ELEMENTS

2 2 0 3

INTRODUCTION TO DESIGN: Definition, phases in design process, machine element design, preferred numbers, standards and codes in design, criteria for failure, factor of safety. (3+0)

COMBINED STRESSES: Normal stresses, eccentric loading of members, combination of normal and shear stresses, principal stresses, theories of failure. (3+3)


DESIGN OF SHAFTS AND COUPLINGS: Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength, rigidity and critical speed. Design of keys-use of standards, couplings-types and applications, selection of rigid and flexible flange couplings. (4+4)
SPRINGS: Helical springs - stresses and deflection in round wire helical springs-accounting for variable stresses-concentric springs. Design of leaf springs- stress and deflection equation, nipping. Study of helical and leaf springs in automobile suspension system. (4+5)

RIVETED AND WELDED JOINTS: Strength equations, efficiency, design of riveted joints, eccentrically loaded riveted joints and Lozenge joints Types of welded joints-weld symbols, strength of welds, centrally loaded, unsymmetrical sections, axially loaded, eccentrically loaded joints; study of welded/ riveted joints for boilers and tanks. Introduction to bolted joints. (4+5)

SLIDING CONTACT BEARINGS: Theory of lubrication, hydrodynamic bearings, Sommerfield number, design of hydrodynamic bearings. (4+4)

ROLLING CONTACT BEARINGS: Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove ball bearing. Study of bearing mounting details for machine tool spindles, front and rear axles of automobiles. (4+5)

Total = L: 30 + T: P 30 = 60

TEXT BOOKS:

REFERENCES:

15M503 THERMAL ENGINEERING II

2 2 0 3

REFRIGERATION: Reversed Brayton cycle, air refrigeration, vapour compression refrigeration- use of T-s and p-h diagrams, problems, sub-cooling and superheating. Performance calculations of air vapour compression refrigeration systems. Vapour absorption refrigeration, adsorption cooling, evaporative cooling, Refrigerants- conventional and alternate types, designation and properties, working of Steam Jet Refrigeration-simple problems. (6+6)

PSYCHROMETRY: Atmospheric air-Properties, Psychrometry Chart, Psychrometric processes. (2+2)

AIR-CONDITIONING: Air-conditioning processes, Requirements for comfort and industrial air-conditioning, air washer, By-pass factor, summer and winter air conditioning systems, apparatus dew point, sensible heat factor, balancing of components, cooling load calculation-Estimation of cooling or heating load for building, Application-window type, split, package and centralized AC. (6+6)

COMPRESSIBLE FLOW: compressibility, Thermodynamic concepts, conservation equations, communication gases, stagnation state, pressure waves in gases, stagnation state, differential equations for 1D flow, Isentropic flow with area variations. (4+4)

NORMAL AND OBLIQUE SHOCKS: Normal and Oblique-Concepts, relations, moving normal shocks, property variations. (4+4)

NON-ISENTRONIC FLOWS: crocco’s theorem, Fanno flow, Rayleigh flow, various choking mechanisms, Ramjet and scramjets. (4+4)

FLOW VISUALIZATION TECHNIQUES: Schlieren, shadow graph, Interferometry. (1+1)

PROPULSION: Turbo propeller and Turbojet-thrust, fuel power, thrust power, propulsive power, propulsive efficiency, thermal efficiency and overall efficiency. Thrust augmentation. Rocket propulsion, specific impulse, Solid and liquid propellants. (3+3)

Total = L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:
CRYSTAL STRUCTURES: Unit cells, Crystal systems, Crystallographic directions and planes, FCC, BCC and HCP structures, linear and planar densities, Close packed structures, Imperfections in crystal structures, Point defects, Dislocations, Grain boundaries, Grain size determination, Slip and deformation.


HEAT TREATMENT AND STRENGTHENING METHODS: Heat treatment of steels, Annealing, Normalizing, Quench hardening, Tempering, Austempering, hardenability and hardenability test, Surface heat treatment / Case hardening, Carburising, Cyaniding, Nitriding, Flame hardening, Induction hardening, Strain hardening / Cold working and annealing, Three stages of annealing, Solid solution strengthening, Dispersion hardening, Precipitation / Age hardening, Strengthening by grain refinement.


STEELS AND CAST IRONS: Carbon steels and Low alloy steels, Effects of alloying elements, Important low alloy steels, Stainless steels, Ferritic, Martensitic and Austenitic stainless steels, Maraging steels, Tool steels, Types, Cast irons, White iron, Malleable iron, Grey iron, Ductile iron.


TEXT BOOKS:

REFERENCES:

ENERGY TRANSFER IN TURBOMACHINES: Energy transfer between fluid and a rotor. Euler’s energy transfer equation. Components of energy transfer, Degree Of Reaction, Impulse and reaction type, effect of blade angle on degree of reaction and energy transfer. Specific speed and its significance.


TURBO-COMPRESSORS: Classification. Radial flow- work done by the impeller - isentropic efficiency-pressure and flow coefficients - characteristic curves –surging and choking; Axial flow type- Aerofoil analysis-stalling. Calculation of delivery pressure, isentropic and polytropic efficiency-number of stages.

STEAM NOZZLE: Types-convergent, convergent-divergent, maximum mass flow rate and velocity of steam at exit, simple problems, critical pressure ratio, Meta stable flow in nozzle.
STEAM TURBINES: Types-single stage impulse type and reaction type, compounding of impulse turbines, degree of reaction, 50% reaction, calculation of efficiency, maximum efficiency for impulse and reaction turbine. (4+4)

GAS TURBINE: Brayton cycle-Open cycle, closed cycle, methods of improving the efficiency of a simple cycle, components of gas turbine, multistage compression, inter-cooling, reheating and regeneration, effect of operating variables on thermal efficiency, work ratio. (4+4)

TEXT BOOKS:

REFERENCES:

15M510 MATERIAL SCIENCE AND MECHANICS OF MATERIALS LABORATORY

1. a. Study of Metallurgical Microscope
   b. Specimen preparation for metallographic studies
2. Study of Grey cast iron, SG iron and Malleable cast iron
3. Study of low, medium and high carbon steel
4. Study of hardened steel and case carburized steel
5. Study of Al and Cu alloys
6. Tension test on metals-stress-strain characteristics, ductility, resilience, toughness
7. Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests
8. Impact test on metals-Charpy, Izod impact tests
9. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy
10. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy
   Total : P: 60

REFERENCE:
1. Laboratory Manual prepared by Department of Mechanical Engineering.

15M511 THERMAL ENGINEERING LABORATORY

1. Experimental study on valve timing diagram in 4-stroke engine and port timing diagram in 2 – stroke engine.
2. Experimental study on port timing diagram in 2-stroke engine cut model
3. Performance test on constant speed 4-stroke diesel engine
4. Performance test on variable speed test on multi-cylinder diesel engine
5. Performance test on 4-stroke diesel engine
6. Performance test on high pressure two stage reciprocating air compressor
7. Performance testing of boiler and steam turbine.
8. IC engine performance evaluation using PC interface
9. Experiment of heating, ventilation and air conditioning unit
10. Experiment on Refrigeration tutor
   Total : P: 60

REFERENCES:
1. Laboratory Manual prepared by Department of Mechanical Engineering.

SEMESTER VI

15M601 DESIGN OF TRANSMISSION SYSTEMS

BELTS AND CHAIN DRIVES: Design of belt drives using basic equations, Design of V-belt drive based on manufacturer’s data, Design of chain drives, Introduction to timing belt and silent chain (4+4)
POWER SCREWS: Forms of threads, square and trapezoidal threads, collar friction, force analysis, design of power screws. (4+4)

DESIGN OF GEARS: Review of gear fundamentals, interference and undercutting, gear forces. Design of spur gear pair. Design of helical gears - parallel axis helical gear, normal and transverse planes, helix angles, determining dimensions of helical gear pair. (5+5)

BEVEL AND WORM GEARS: Introduction to design of bevel gears, Design of worm gear drive - efficiency, thermal consideration. (4+4)

SPEED REDUCER AND GEAR BOX: Design of single stage speed reducer - gear tooth forces, shaft design and bearing selection. Design of gear box for machine tools - kinematic arrangement, ray diagram and number of gear teeth. Gear tooth profile correction (5+5)

CLUTCHES: Clutches - role of clutches, positive and gradually engaged clutches. Design of single plate and multiple plate clutches. (4+4)

BRAKES: Role of brakes - types of brakes - self energizing and de-energizing brakes, thermal considerations. Design of single shoe and double shoe brakes, design of disc brakes, design of internally expanding shoe brakes. Introduction to band brakes. (4+4)

Total = L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:

15M602 HEAT AND MASS TRANSFER

MODES OF HEAT AND MASS TRANSFER: Conduction, convection, radiation, thermal conductivity, Fourier Law, Fick’s Law, Newton’s Law, Stefan Boltzmann’s Law, heat transfer coefficient, mass transfer coefficient (2+2)

STEADY STATE HEAT CONDUCTION: Three-dimensional heat conduction equations in various co-ordinate systems, steady state heat conduction equation for plane, cylindrical and spherical shapes, Critical radius of insulation, single layer and multi layer-film coefficient, Variable thermal conductivity, heat transfer with heat generation in different shapes. Extended surfaces (fins)-numerical methods for varying sections of fins with different end conditions. (7+7)

UNSTEADY STATE HEAT CONDUCTION: Lumped parameter systems, Method of separation of variables, infinite solids, semi-infinite solids, numerical and graphical methods (4+4)

CONCEPTS OF BOUNDARY LAYERS: Differential and Integral equations for hydrodynamics and thermal boundary layer (4+4)

CONVECTION HEAT AND MASS TRANSFER: Forced Convection Heat and Mass transfer from flat plate, laminar and turbulent flow, cylinders and spheres, flow through tubes. Free convection, heat transfer from vertical and horizontal surfaces (4+4)

BOILING AND CONDENSATION: Boiling heat transfer, bubble growth, freezing and melting. Condensation, film wise condensation and drop wise condensation. (3+3)

HEAT EXCHANGERS: Types, tube and shell arrangements, single and multi pass types, parallel, counter and cross flow, compact heat exchangers, LMTD & Effectiveness method (NTU) to study performance of heat exchangers, (4+4)

RADIATION HEAT TRANSFER: Emissive power, grey body, Irradiation, radiosity, Radiation heat transfer between surfaces, shape factor, radiation shield, Gas radiation (4+4)

Total = L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:
DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY: DFM approach, DFM/DFA guidelines, comparison of materials on cost basis, DFA index.  

TOLERANCE ANALYSIS: Process capability, process capability metrics, C_p, C_{pk}, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law 

SELECTIVE ASSEMBLY: Interchangeable and selective assembly, deciding the number of groups, Model-I: group tolerances of mating parts equal; Model-II: total and group tolerances of shaft equal; control of axial play-introducing secondary machining operations, laminated shims.  

DATUM SYSTEMS: Degrees of freedom, grouped datum systems-different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot, recess, pin, hole, tongue and slot, computation of translational and rotational accuracy, geometric analysis and applications.  

TRUE POSITION TOLERANCING THEORY: Comparison between co-ordinate and convention method of feature location, tolerancing and true position tolerancing, virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, compound assembly, Composite tolerancing, examples.  

FORM DESIGN OF CASTINGS AND WELDMENTS: Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – case studies  

DESIGN FOR MACHINING: Design features to facilitate machining, datum features - functional and manufacturing, component design-machining considerations, redesign for manufacture, examples.  

TOLERANCE CHARTING TECHNIQUE: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.  

TEXT BOOKS:  

REFERENCES:  

INTRODUCTION TO OPERATIONS RESEARCH: Operations research and decision-making, types of mathematical models and constructing the model. Role of computers in operations research  

LINEAR PROGRAMMING TECHNIQUES: Formulation of linear programming problem, applications and limitations, graphical method, simplex method, The Big –M method, the two-phase method, dual problems.  

TRANSPORTATION PROBLEMS: Least cost method, North West corner rule, Vogel’s approximation method, modified distribution method, optimization models, degeneracy in transportation model, unbalanced and maximization models.  

ASSIGNMENT MODELS AND SCHEDULING: Difference between transportation problem and assignment problem, Hungarian algorithm, unbalanced assignment problems maximization case in assignment problems, traveling salesman problem  

INVENTORY CONTROL: Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model.
QUEUING MODELS: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.  

PROJECT MANAGEMENT BY PERT AND CPM: Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing, resource levelling.

GAME THEORY: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game, n person zero sum game, graphical method, and linear programming in game theory.

REPLACEMENT MODELS: Replacement of items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement.

Total = L: 30 + T:30= 60

TEXT BOOKS:
2. G Srinivasan Operations Research principles and application 2010

REFERENCES:
1. Harvey M Wagner Principles of operations research with applications to managerial decisions, Phi learning 2010.

15M610 METROLOGY AND DYNAMICS LABORATORY

METROLOGY LABORATORY
1. Gear roll testing (i) tooth to tooth composite error (ii) Tooth thickness measurement using gear tooth Vernier Caliper
2. (i) Surface Roughness measurement of machined components (ii)Calibration of plug gauge using laser micrometer
3. (i) Auto collimator for form measurement (ii) Measurement of internal taper
4. Measurement of thread terminology using optical profile projector
5. Angular measurement using sine bar
6. Tool nomenclature assessment using tool makers microscope
7. Measurement of effective diameter of external parallel screw threads using floating carriage micrometer
8. (i) Measurement using height gauge (ii) Measurement using height Master

DYNAMICS LABORATORY
9. Static and dynamic balancing using dynamic balancing machine.
12. Study of undamped free vibration of equivalent spring mass system
15. Determination of mass moment of inertia of connecting rod and validation using software.
17. Wear measurement using Pin-On-Disc method.

Total : P: 60

REFERENCE:
1. Laboratory Manual prepared by Department of Mechanical Engineering.

15M611 HEAT TRANSFER LABORATORY

1. Determination of thermal conductivity in guarded hot plate apparatus.
2. Study of unsteady state heat conduction
3. Determination of thermal conductivity of insulating powder.
4. Experiment on Pin Fin apparatus
5. Experiment on natural convective heat transfer from vertical cylinder
6. Experiment on forced heat transfer inside tube
7. Determination of Stefan-Boltzmann constant
8. Determination of emissivity of grey surface
9. Effectiveness of parallel /counter flow heat exchanger
10. Experiment on boiling and condensation apparatus

Total : P: 60
15M612 INNOVATION PRACTICES

The aim of this course is to inculcate fundamental skills in product development through out-of-the-box and creative thinking to come up with innovative products and solutions.

- Study of Innovation Types, innovation tools and strategies
- Problem definition and Idea generation using brain storming and mind map
- Concept generation using 6-3-5 Brainwriting technique and Concept finalization
- Perform requirement engineering, PESTEL and SWOT analysis
- Establish product function, identify sub-systems and develop Function Analysis System Technique (FAST) diagram
- Generate embodiment design, product specification and Bill-of-Materials (BOM)
- Create product mock-up and proof-of-concept and prepare Failure Mode and Effect Analysis (FMEA) report
- Define the product life cycle by applying the principles of obsolescence management, sustenance engineering and End-of-Life (EoL)
- Prepare the Intellectual Property Rights (IPR) documents
- Product Documentation and presentation

Total P: 60

REFERENCES:

SEMESTER VII

15M701 COMPUTER NUMERICAL CONTROL AND ROBOTICS

INTRODUCTION: Constructional features, objectives and applications of Numerical Control(NC), Computer Numerical Control(CNC) and Direct Numerical Control(DNC), and Adaptive Control(AC) machine tools. Components of CNC Machine tools: AC & DC, Stepper & Servo motors, Selection criteria, Speed & Feed control units, Control of translational movements (Slideways and guideways), Control of rotational movements, Tool holders, Tool changing arrangements, work holders, Linking structures. Output Transducers: Transducers, Positional transducers, Encoders. (7+5)

NUMERICAL CONTROL OPERATION: Designation of axes on NC machine tools, linear and rotary motions, Positioning control, linear and contour control. Principles of operation of NC machine tools: Basic principles, closed loop systems, open loop, input signals, methods of input. Calculations of pulse frequency as input to drives, Basic Length Unit (BLU), system resolution & accuracy. (7+5)

CNC PROGRAMMING: Design of CNC control panel, Word address programming, Part programming, datum, G-codes, Parts of CNC program, incremental and absolute programming, Linear and circular interpolation, Tool length and diameter offset, work holding and tooling for machining centers, machine zero, tool change position, part origin, offsets, program editing, diagnostics. (6+3)

PROGRAMMING CNC TURNING MACHINES & MILLING MACHINES: Planning the program, work holding, tooling considerations, process plan, tool offset, programming examples., Cutter diameter & length compensation. (6+3)

ADVANCED CNC FEATURES: Do loops and subprograms, Macros, Canned cycles, Mirror imaging, Polar rotation (4+3)

ROBOTICS: Introduction to Robotics. Classification, components of robots, robotic applications. Functions of a robot, specifications of a robot system. Coordinate frames, Tool Center Point (TCP), Degrees-of-freedom (DOF), Links and types of joints. Kinematic diagrams (7+5)

MECHANICAL SYSTEMS, SENSORS AND MODELING: Manipulator, end effectors, electric actuators, Internal & External State Sensors. Forward Position Control, Denavit–Hartenberg (DH) parameters and DH matrix, Image Processing. (8+6)

Total = L: 45 + T: 30 = 75
TEXT BOOKS:

REFERENCES:

15M702 POWER PLANT ENGINEERING

TYPES OF POWER PLANTS: Thermal power plant, Diesel power plant, gas turbine power plant, Nuclear power plant, hydroelectric power plant. (3)

STEAM CYCLES: Rankine cycle-superheat, reheat and regeneration, super critical cycles, combined cycles - binary cycles, cogeneration. (5)

COMBUSTION EQUIPMENTS: Types of combustion, stokers, fuel and ash handling equipments. Selection of fans. Emission control, flue gas cleaning, particulate and gaseous emission control methods. (5)

THERMAL POWER PLANT: Steam generators-types, forced circulation, high-pressure boilers and super critical boilers, fluidized bed boiler, boiler accessories and mountings, Draft- forced, induced and balanced drafts, Heat recovery equipments-economisers, air preheaters and reheaters, different types of superheaters and de-superheaters. Boiler testing, development of a process flow diagram, heat and mass balance of the components of a process flow diagram. (6)

CONDENSERS AND COOLING TOWERS: Different types, design factors, air removal, performance calculation. Cooling towers- natural and mechanical draft types. (5)

HYDROELECTRIC POWER PLANT: Runoff river plants, pumped storage plants, underground stations, hydel plant axillaries and plant operation. (5)

NUCLEAR POWER PLANT: General nuclear fuels used in reactors, elements of nuclear reactor, moderator, control rods, coolants, description of different types of reactors. Radiation hazards, radioactive waste disposal. (4)

RENEWABLE ENERGY SOURCES: concentrating collectors, photovoltaic cell. Horizontal and vertical types of wind turbines. Other plants: Geothermal plants, tidal power plant, biomass and biogas plants, OTEC plants. (6)

POWER PLANT ECONOMICS: Plant load factor and utilization factor, cost economics – tariff rates, demand changes, load distributions. Energy conversion and audit. (6)

Total : L: 45

TEXT BOOKS:

REFERENCES:

15M703 TOOL DESIGN

CUTTING TOOLS: Materials-properties, classification, selection, insert and coated tools, tool wear, tool life. Recent developments in cutting tool technology. (4+4)

SINGLE POINT TOOLS: Nomenclature, types and styles, design and manufacture of HSS and carbide insert type tools for turning, boring, shaping, planning and slotting operations. Design of form tools. Tools and holders for CNC applications. (4+4)

MULTIPOINT CUTTERS: Nomenclature, classification and selection, construction methods, cutter setting, design and manufacture of drills, reamers, milling cutters, broaches, hobs and gear shaper cutters. Grinding-wheel specification and selection. (5+5)

JIGS: Degrees of freedom, principles of location and clamping, principles of jig design, fool proofing, elements of jigs, classification of jigs, design of jigs for drilling and reaming. (4+4)
FIXTURES: Principles of fixture design, locators and different types of clamps, elements of fixtures, provision for cutter setting, design of fixtures for milling, turning, boring and grinding operations. Fixtures for turning centers and machining centers. Modular fixture concepts and applications. (4+4)

PRESS TOOLS: Design of sheet metal parts, Design and manufacture of die sets for sheet metal components—simple, compound and progressive dies for punching and blanking operations. Dies for drawing and bending operations. Selection of press tools. (4+4)

DESIGN OF INJECTION MOLDING AND DIE CASTING DIES: Product and mold, thermal considerations, design of two plate mold, runner and gate design, mold cooling and ejection. Overview of shrinkage and warpage analysis. (4+4)

LIMIT GAUGES: Design of plug, ring and snap gauges. (1+1)

Total = L: 30+ T: 30 = 60

TEXT BOOKS:

REFERENCES:

15M710 COMPUTER AIDED ENGINEERING LABORATORY

1. Static structural analysis using 1D (spar & beam) elements.
2. Static structural analysis using 2D elements.
4. Modal and Harmonic analysis of mechanical parts like turbine blade, aircraft wing, etc.
5. Steady state thermal analysis of IC engine components, boiler, etc.
6. Transient thermal analysis of components and processes like engine cylinder block, casting solidification, etc.
7. Coupled field thermal-structural analysis.
8. Fluid flow analysis of pipes, nozzle, diffuser, etc.
10. Case study involving structural/thermal analysis of typical parts.

Total P: 60

TEXT BOOKS:
1. Lab manual prepared by department of mechanical engineering.

REFERENCES:

15M711 PNEUMATIC AUTOMATION AND SENSORICS LABORATORY

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of thermocouple to monitor temperature in a thermal chamber and controlling a fan and heating source to maintain the temperature of the chamber within a specified tolerance limits.
6. Interfacing of LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
7. Interfacing of hot wire anemometer with data acquisition system to measure the air flow rate and calibration of the same
8. Measurement of damping ratio of a machine tool base from free vibration studies using an impact hammer and an accelerometer pick up with data acquisition system.
9. Inspection using Machine vision System
10. Development of strain gauge set up to measure strains in a statically loaded cantilever beam and calibration of the same.
11. Control of speed, direction and number of revolutions of a stepper motor using PC

REFERENCE:  
1. Laboratory Manual prepared by Department of Mechanical Engineering.

15M720 PROJECT WORK I  
0 0 4 2

- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalisation of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Future trends in providing alternate solutions
- Consolidated report preparation of the above

Total : P: 60

SEMESTER VIII

15M820 PROJECT WORK II  
0 0 16 8

- The project work involves the following:
  - Preparing a project - brief proposal including
    - Problem Identification
    - A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
    - List of possible solutions including alternatives and constraints
    - Cost benefit analysis
    - Time Line of activities

- A report highlighting the design finalization [based on functional requirements & standards (if any)]
  - A presentation including the following:
    - Implementation Phase (Hardware / Software / both)
    - Testing & Validation of the developed system
    - Learning in the Project

- Consolidated report preparation

Total = P: 180 = 225

LANGUAGE ELECTIVES

15M080 COMMUNICATION SKILLS FOR ENGINEERS  
3 0 0 3

COMMUNICATION CONCEPTS: Process of Communication - Inter and Intrapersonal Communication - Essentials for Effectiveness. (4)


BUSINESS CORRESPONDENCE: Writing Emails - Preparing Resumes - Memos - Technical and Business Proposals. (7)

TECHNICAL COMMUNICATION: Seminars - Process Description and Group Discussions - Use of Visual Aids. (10)

Total L: 45

TEXTBOOK:  
1. Monograph prepared by the Faculty, Department of English, 2015.
REFERENCES:

15M081 BASIC GERMAN

INTRODUCTION: German Culture -Tradition -Universities and Companies -Alphabets -Greetings -Countries -Nationalities and Languages. (3)

VOCABULARY: Context Related to School -University -Professions -Family -Supermarket -Food and Beverages -Entertainment -Celebrations -Weather. (4)


SYNTAX: Word Order and Sentence Formation -Practice with Mini-Dialogues. (4)

COMMUNICATION SKILLS: Conversing in Formal and Informal Situations - Dialogue Writing - Letter Writing - Email Writing - Invitations and Telephone Conversations. (7)

PRACTICALS: Listening - Speaking - Reading and Writing. (6)

Total L: 45

TEXT BOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15M082 BASIC FRENCH

INTRODUCTION: (2)

UNITÉ-1: Faire connaissance - inviter et répondre à une invitation - décrire les personnes- articles définis et indéfinis - genre et nombre des noms et des adjectifs - interrogation et négation - conjugaison du présent - Paris monuments et lieux publics - la vie de quatre Parisiens de professions différentes. (T-R1) (10)


UNITÉ-3: Raconter et rapporter - donner son avis - se plaindre et réprimander - expliquer et justifier - pronoms compléments - futur proche - passé composé et imparfait - Plusieurs régions de France - différents univers sociaux. (T-R2) (11)


Total L: 45

TEXT BOOK:

REFERENCES:
15M083 BASIC JAPANESE

ORIENTATION SESSION: Geographic and Socio - Economic Perspective to Japan - Japanese People - Culture - Basic Greetings and Responses. (3)

BASIC SCRIPT: Method of Writing Hiragana and Katakana - Combination Sounds and Simple Words. (3)

TOPIC MARKER: "Wa" - Desu / Dewa Arimasen Cupolas - Interrogative Particle "Ka" - Grammar Particles "Mo" - "No" - " Introducing Someone: "Kochira Wa ~". Self Introductions: Hajimemashite". (3)

DEMONSTRATIVES: "Kore" - "Sore" - "Are"-Demonstrative: "Kono" - "Sono" - "Ano". Possessive Noun Particle "No" - Japanese Apartments: Greeting Your Neighbour. (2)


ASKING FOR AND TELLING THE TIME: Particle "Ni (At)" for Time - Kara (from) ~ Made (until) - Particle "To (and)" -Time Periods: Days of the Week - Months - Time of Day - Verbs (Present / Future And Past Tense). Telephone Enquiry: Asking for a Phone Number and Business Hours. (2)

DESTINATION PARTICLE: "E" - Particles "De (Mode Of Transportation)" - To (With) - Japanese Train Station: Asking for Fare and Track Number / Types of Trains. (2)

DIRECT OBJECT PARTICLE: "O" - Particle "De (Place Of Action)" - Verbs ("Masen Ka" - "Mashou") and "Ohanami" Cherry Blossom Viewing. (2)

PARTICLES: Particle "De (By Means Of)" - Particle "Ni (To)" - Aaemasu (Give) - Moraimasu (Receive) - Visiting a Japanese House. (2)

ADJECTIVES: "I" and "Na" Type - Positive and Negative Usage-Particle "Ga (However - But)" - "Dore Which?)" - Leaving a Room - Thanking Someone for Hospitality. (2)

LIKES AND DISLIKES: Potential Verbs (Wakarimasu and Dekimasu) - "Kara (~ Because)" -Adverbs - Asking Someone out over the Phone. (2)

VERBS DENOTING PRESENCE: "Imasu" - "Arimasu" -Particle "Ni (In)" - "Dare (Who?)" - Adverbs ("Chikaku Ni ~") - Particle "Dare Mo (Negative ~ No One)" - Dare Ka (Anyone) - Dare Ga (Who) - Nani Ka (Anything) -Nani Ga (What) - ~Ya(And) ~ Nado (Etc.) - Asking for Directions. (2)

COUNTERS AND COUNTING SUFFIXES (2)

INTRODUCTION TO ADJECTIVES: Na and Ii Type - Different Usages of Adjectives - Comparison - Likes and Dislikes - Going to a Trip. (2)

NEED AND DESIRE: (Ga Hoshii) - Wanting to - (Tabeli Desu) - Going for a Certain Purpose (Mi –Ni Ikimasu) - Choosing from a Menu. (2)

VERB GROUPS: I - li and lii - Exercises to Group Verbs. (2)

PLEASE DO:(Te Kudasai)- Present Continuous Tenses (Te Imasu) - Shall I? ( ~ Mashou Ka) - Describing a Natural Phenomenon (It Is Raining). (2)

PERMISSION: To Grant Permission (~Te Mo li Desu) - Asking for Permission (~ Te Mo li Desu Ka) - Should Not Do (~ Te Wa Ikemasen). (2)

STATE AND ACTION:Describing a Continuing State - Describing a Habitual Action. (2)

ROLEPLAYS IN JAPANESE (2)

A DEMONSTRATION ON USAGE OF CHOPSTICKS AND JAPANESE TEA PARTY (2)

TotalL : 45

TEXT BOOK:
1. Minna no nohongo, "Romaji ban" (first 10 lessons of this book).
REFERENCE:

OPEN ELECTIVES
MATHEMATICS

15OH01 ADVANCED LINEAR ALGEBRA

VECTOR SPACES: General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space. (8)

INNER PRODUCT SPACES: Inner products, length and angle in inner product spaces, orthonormal bases, Gram-Schmidt process, orthogonal matrices, QR decomposition, best approximation - least square. (12)

LINEAR TRANSFORMATIONS: General linear transformation - kernel and range, matrices of linear transformations, change of basis, rank and nullity. (12)

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization, orthogonal diagonalization, quadratic forms, application of conic sections, quadratic surfaces - discrete dynamical systems. (13)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH02 ALGEBRAIC STRUCTURES

GROUPS: Groups, subgroups, permutation groups, cosets and Lagranges’s theorem, normal subgroups and quotient groups, homomorphisms, isomorphisms, Cayley’s theorem. (15)

CODING THEORY: Group codes, the communication model and basic notions of error correction, generation of codes by using parity checks - error recovery in group codes. (5)

RINGS: Rings, sub-rings, properties of rings, integral domain, ideals and quotient rings, polynomial rings. (12)

FIELDS: Fields, roots of polynomials, construction of straightedge and compass. (13)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH03 CALCULUS OF VARIATIONS AND TENSOR ANALYSIS

CALCULUS OF VARIATIONS: Basic concepts, method of variations in problems with fixed boundaries - variation and its properties, Euler equation. (12)

FUNCTIONALS: Functional involving first and higher order derivatives, functionals dependent on the functions of several independent variables, variational problems in parametric form – applications: vibrating string and membrane. (12)
VECTOR ANALYSIS: Basic concepts – gradient, directional derivative, divergence, curl, potential vector field, solenoidal vector field, Laplacian vector field. Green’s theorem, Stoke’s theorem and Gauss divergence theorem (statement and concepts only) (7)

TENSOR ANALYSIS: Concepts of a tensor field – Ostrogradski’s theorem, field of tensor of rank 2 - flux, divergence and derivative in a direction of tensor field. Integral theorems - theorems related to Ostrogradski’s theorem – applications: equation of motion of a liquid, Archimedes’ law. (14)

TEXT BOOKS:

REFERENCES:

15OH04 GRAPH THEORY AND ITS APPLICATIONS 3 0 0 3

GRAPHS AND DIGRAPHS: Common families of graphs, degree sequence, handshaking lemma, Havel-Hakimi theorem (statement and concepts). Walk, trail and path, connected graph, distance, radius and diameter. Graph isomorphism. Representations of graphs - adjacency and incidence lists – adjacency and incidence matrices. (10)

SPANNING TREES: Cayley’s formula: Prufer encoding-decoding algorithm. Matrix tree theorem (statement and problems only). Depth-first and breadth-first search algorithms, minimum spanning tree – Prim’s and Kruskal’s algorithms, shortest-path problem – Dijkstra’s algorithm. (9)

EULERIAN AND HAMILTONIAN GRAPHS: Eulerian graphs – Konigsberg bridge problem; Eulerian tour algorithm, characterization of Eulerian graph, optimal postman tour. Hamiltonian graphs - non Hamiltonian graphs, sufficient conditions for Hamiltonian graphs (only statements and concepts). Travelling salesman problem - nearest neighbour algorithm. (10)

VERTEX-COLORING: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, assignment of radio frequencies, fast register allocation for computer programming. (8)


TEXTBOOKS:

REFERENCES:
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall , New Delhi 2010.

15OH05 MATHEMATICAL FINANCE 3 0 0 3

FINANCIAL MATHEMATICS: Basic terminology, assumptions, derivative securities. (6)

FORWARD AND FUTURES CONTRACTS: Forward contract, forward price formula, value of a forward contract, futures contract, futures pricing. (12)

OPTION PRICING: Definition and preliminaries, behavior of option prices with respect to variables, pay-off curves, single period and multi period binomial lattice models for option pricing, pricing American options: a binomial lattice model, Black-Scholes formula. (12)

RISK FREE ASSETS: Time value of money, Simple interest, periodic compounding, streams of payments, continuous compounding. Money market: zero coupon bonds, coupon bonds, money market account. (9)

PORTFOLIO MANAGEMENT: Risk and return, expected return standard deviation as risk measure, two securities, risk and expected return on a portfolio. (6)

Total L: 45
TEXT BOOKS:

REFERENCES:

15OH06 MATHEMATICAL MODELING AND SIMULATION

SYSTEM MODELS AND STUDIES: System- continuous and discrete system, system modeling, types of models - static physical, dynamic physical, static mathematical, dynamic mathematical models, principles in modeling, corporate model, environment, production, management segment, system analysis – corporate model, system design – message processing in a computer, system postulation – function of liver in the human body.

SYSTEM SIMULATION: Technique of simulation, Monte Carlo Method – area under a curve, estimate of \( \pi \), comparison of simulation and analytical methods, distributed lag models – national economy, cobweb Models – supply and demand, exponential growth and decay models, logistic curves, simple system dynamics diagrams – population, multi-segment models – product sales, representation of time delays, feedback in socio-economic systems, host and parasite fluctuation.

STATIC SIMULATION: Basics and components of the simulation study, simulation as an analysis tool, static simulations - model for profit on a sale promotion, a financial model for an office building. Random number generation - linear congruential generator, Blum-Blum generator, random variates generation - Bernoulli, uniform, triangular, normal, exponential random variates, a model for loss ratio for an insurance agency.

DYNAMIC SYSTEMS SIMULATION: Financial models and @risk - a model for the price of a stock, dynamic financial models of stock prices, correlated asset values, fitting a distribution to data.

Total L:45

TEXT BOOKS:

REFERENCES:
1. Brian Albright, Mathematical Modeling with Excel, JonesBartlett publishers, Singapore 2010

15OH07 NUMBER THEORY FOR COMPUTING

DIVISIBILITY AND DIOPHANTINE EQUATIONS: Theory of divisibility - Basic concepts and properties of divisibility, fundamental theorem of arithmetic, Euclid’s algorithm, continued fractions. Diophantine equations - Linear Diophantine equations

ARITHMETICAL FUNCTIONS AND DISTRIBUTION OF PRIME NUMBERS: Multiplicative functions – functions \( \tau(n) \), \( \sigma(n) \) and \( s(n) \) - functions \( \phi(n) \), and \( \mu(n) \). Prime distribution function \( \pi (x) \), prime number theorem, the \( n^{th} \) prime.

THEORY OF CONGRUENCES: Basic concepts and properties of congruences — linear congruences — Fermat's Little theorem, Euler's theorem, Chinese remainder theorem, Legendre and Jacobi symbols, primitive roots.

COMPUTATIONAL NUMBER THEORY: Primality testing: Fermat’s pseudoprimality test, strong pseudoprimality test, integer factorization : trial division and Fermat method, quadratic and number field sieves.

APPLICATIONS TO CRYPTOGRAPHY: Random number generation - linear congruential generator, basics of cryptography, public key cryptography: discrete logarithm based cryptosystems - RSA public-key cryptosystem.

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH09 RELIABILITY AND QUALITY CONTROL

STATISTICAL PROCESS CONTROL: Chance and assignable causes of quality variation, statistical basis of the control charts - basic principles, choice of control limits, analysis of patterns on control charts. (7)

CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES: $\bar{x}$ chart, R chart, $s^2$ chart, $p$ chart, np chart, c chart, and u chart. (10)

ACCEPTANCE SAMPLING: Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans. (10)

BASIC RELIABILITY MODELS: The failure distribution, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model: Exponential reliability function. Time - dependent Weibull failure model, Time - dependent normal failure model. (10)

RELIABILITY OF SYSTEMS: Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system - system structure function, minimal cuts, minimal paths, common mode failures, three state devices. (8)

TEXT BOOKS:

REFERENCES:

15OH10 SOFT COMPUTING

FUZZY SETS: Basic concepts, membership functions, basic operations on fuzzy sets, properties of fuzzy sets, fuzzy relations. Propositional logic and predicate logic, fuzzy If-then rules, fuzzy mapping rules and fuzzy implication functions. (15)

NEURAL NETWORKS: Basic concepts, neural network architectures - single layer, multilayer, recurrent networks, learning methods, back propagation network. (15)

GENETIC ALGORITHMS: Basic concepts, encoding, fitness function, reproduction, inheritance operators, cross over, inversion and deletion, mutation operator, bit-wise operators, generational cycle. (10)

HYBRID SYSTEMS: Genetic algorithm based backpropagation networks, fuzzy backpropagation networks. (5)

TEXT BOOKS:

REFERENCES:

15OH11 STOCHASTIC MODELS

STOCHASTIC PROCESSES: Definition, Markov chains: Classifications of states, absorption probability, period, Chapman-Kolmogorov equations, steady state probabilities. (12)

BROWNIAN MOTION: First passage time distribution, maximum of a Brownian motion, zeros of Brownian motion, Brownian motion with drift, Geometric Brownian motion, applications to finance.  

QUEUEING MODELS: Basic definitions, steady-state solution: M/M/1, M/M/1/K, M/M/c, M/M/c/c, M/M/c/k Models, queues with unlimited service.  

TEXT BOOKS:  

REFERENCES:  

PHYSICS  
15OH20 ANALYTICAL TECHNIQUES FOR MATERIALS CHARACTERIZATION 3003  


ELECTRON AND ION SPECTROSCOPIC TECHNIQUES: Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Quadrupole mass spectrometer. Special surface techniques: X ray photoelectron spectroscopy (XPS or ESCA)-photoelectron process of spectrum- elemental analysis-Instrumentation and applications, Auger electron spectroscopy (AES)-Basic principles-information in Auger spectra-methods for surface and thin film characterization, Secondary ion mass spectrometry(SIMS) – Dynamic and static SIMS-common modes of analysis, Rutherford Backscattering Spectrometry (RBS), Field Ion Microscopy (FIM).  

SURFACE STRUCTURE ANALYSIS: The need for surface study. Surface chemical composition: The extension of bulk techniques to surface studies - Unit meshes of five types of surface nets - diffraction from diperiodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED).  


SANNING PROBE MICROSCOPY : Instrumentation, Scanning Tunnelling Microscopy, Tunneling current, probe tips and working environments, operational modes, typical applications, atomic force microscopy, near field forces, force sensors, operational modes, applications, image artifacts  

TEXTBOOKS:  

REFERENCES:  
**15OH21 LASER TECHNOLOGY**

**LASER CHARACTERISTICS:**  Einstein coefficients - negative absorption, shape and width of spectral lines, spontaneous and stimulated emission. Laser resonators, types of resonators, stability diagram. Spatial and temporal coherence. (9)


**DYE LASERS:**  Liquid lasers, dye lasers, fabrication and excitation mechanisms. Concept of Q-switching and mode-locking, second harmonic generation, theory and experiment, materials for optical SHG. (9)

**INDUSTRIAL APPLICATIONS:**  Laser cutting, drilling & Piercing. Laser welding, operating characteristics and applications. medical. Spectroscopic (qualitative), laser Raman effect, stimulated Raman effect - Brillouin scattering. (9)

**LASER SURFACE TREATMENT:**  Laser heat treatment, laser surface melting, laser surface alloying, laser cladding. Laser ablative processes. Macro and micromachining. (9)

**TEXTBOOKS:**

**REFERENCES:**

**15OH22 MICRO ELECTROMECHANICAL SYSTEMS**

**MEMS AND MICROINTEGRATED SYSTEMS:**  Introduction, history of MEMS development, intrinsic characteristics of MEMS. Devices: Sensors and Actuators. Overview of microfabrication, microelectronics fabrication process, silicon based MEMS processes, new materials and fabrication processes. Points of consideration for processing. (9)

**SCALING LAWS AND MINIATURIZATION:**  Introduction. Scaling in geometry. Scaling in rigid body dynamics. The trimmer force scaling vector – scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluid dynamics, scaling in heat conducting and heat convection. (9)


**MICROMACHINING METHODS**  Bulk micromachining. Isotropic and anisotropic etching. Wet etchants, etch stops, dry etching comparison of wet and dry etching. Dry etching – physical etching – reactive ion etching, comparison of wet and dry etching. Surface micromachining – process in general, problems in surface micromachining. The LIGA process – description, materials for substrates and photoresists, electroplating, the SLIGA process. (9)

**MICROSYSTEM PACKAGING:**  The three levels of microsystem packaging – die level, device level and system level. Essential packaging technologies – die preparation – surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of Microsystems – selection of packaging materials. (9)

**TEXTBOOKS:**

**REFERENCE:**

**15OH23 NANOMATERIALS AND APPLICATIONS**

**INTRODUCTION AND CLASSIFICATION:**  Atoms, Clusters and Nanomaterials-Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures,
vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

**NANOMATERIALS SYNTHESIS AND PROCESSING:** Top-down processes: Ball Milling, lithography, machining process; Bottom-up processes: i) Wet chemical synthesis of nanomaterials- sol-gel, liquid solid reactions; ii) Gas phase synthesis of nanomaterials- Furnace, Flame assisted ultrasonic spray pyrolysis; iii) Gas condensation processing; iv) Chemical vapour deposition (CVD)- plasma-assisted deposition process, MBE and MOVPE-Preparation, safety and storage issues -STM and AFM Techniques.

**SEMICONDUCTOR NANOSTRUCTURES:** Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques.


**REFERENCES:**

**15OH24 PHYSICS FOR SOLAR PV SYSTEMS AND SOLID-STATE LIGHTING SYSTEMS**


**TYPES OF SOLAR ENERGY CONVERTORS:** Thermal and PV systems. Advantages of PV systems. Semiconductor PV systems. IV characteristics. Other electrical parameters. Conditions for maximum power transfer. Conversion efficiency.

**PHYSICS OF SEMICONDUCTOR JUNCTIONS:** Elemental and compound semiconductors. Band structure of silicon p-n junctions and III-V compound semiconductor junctions. light emission and absorption. Creation and recombination of electron hole pairs. Lattice mediated recombination conservation of momentum. Direct and indirect band gap semiconductors. Structure of Solar PV devices and solid state lighting devices- LEDs. Factors limiting efficiency of conversion of light energy to electrical energy (PV) and vice versa (Lighting) High power LEDs


**REFERENCES:**
15OH25 SENSORS FOR ENGINEERING APPLICATIONS

STRAIN AND PRESSURE MEASUREMENT: Resistance strain gauge, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges. Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drop cup devices, piezoelectric devices. Rotary encoders.

LIGHT RADIATION: Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state, transducers liquid crystal devices.

HEAT AND TEMPERATURE: Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.

ELECTRONIC SENSORS: Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

TEXTBOOKS:

15OH26 THIN FILM TECHNOLOGY


DEPOSITION MONITORING AND CONTROL: Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).


DIELECTRIC PROPERTIES: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity.


TEXTBOOKS:

REFERENCES:
INTRODUCTION: Dynamical systems: Linear and Nonlinear Forces, Mathematical Implications of Nonlinearity- Linear waves-ordinary differential equations (ODEs): Partial differential equations (PDEs)- Methods to solve ODEs and PDEs- Numerical methods – Linear and Nonlinear oscillations- Nonlinear waves- Quantitative features


TEXT BOOKS:

REFERENCES:


OPTICAL SOLITONS AND DISPERSION MANAGEMENT: Soliton Characteristics - Soliton Stability - Bright and Dark Solitons – Other kinds of Solitons - Effect of Birefringence in Solitons - Solitons based Fiber Optic Communication System (Qualitative treatment) – Demerits - Dispersion Managed Solitons (DMS).


TEXT BOOKS:

REFERENCES:
15OH29 CHAOTRONICS


Total L: 45

TEXT BOOKS:

REFERENCES:

CHEMISTRY

15OH36 CORROSION SCIENCE AND ENGINEERING

THERMODYNAMICS OF CORROSION: Mechanism of electrochemical corrosion – galvanic and concentration cells. Free energy criteria for corrosion reaction – thermodynamic vs kinetic considerations- emf and galvanic series - Pourbaix diagram of Fe. (9)


FORMS OF CORROSION: Atmospheric corrosion, galvanic corrosion, crevice corrosion, pitting corrosion, inter granular corrosion. Mechanically assisted corrosion-erosion corrosion, cavitation corrosion, fretting corrosion, corrosion fatigue, environmentally induced cracking, stress corrosion cracking and hydrogen embrittlement. (9)

CORROSION MONITORING AND TESTING: Classification, weight loss method, salt spray test. Electrochemical polarization techniques, Tafel extrapolation, linear polarization, AC impedance methods. Application of - NDT techniques - outline of on stream and off stream corrosion monitoring methods. (9)


Total L: 45
TEXT BOOKS:

REFERENCES:

15OH37 ENERGY STORING DEVICES AND FUEL CELLS

BATTERIES: Types-battery characteristics - voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. Primary cells: Fabrication, performance aspects, packing and rating of zinc-carbon, alkaline-manganese, silver oxide cells. Lithium primary batteries. (9)

SECONDARY BATTERIES: Fabrication, performance aspects and rating of lead acid and sealed lead acid battery, nickel-cadmium, Ni-metal-hydride lithium ion batteries, Rechargeable Zinc alkaline batteries and thermal batteries. (9)

ADVANCED BATTERIES: Metal / air, zinc-bromine, sodium-beta alumina and lithium / iron sulphide batteries. Photogalvanic cells. Battery specifications for cars, heart pacemakers, torpedo batteries, satellite batteries. (9)

FUEL CELLS: Classification, working principle, components, applications and environmental aspects of alkaline, phosphoric acid, solid oxide, molten carbonate, direct methanol and proton exchange membrane fuel cells. (9)


Total L : 45

TEXT BOOKS:

REFERENCES:

15OH41 POLYMER SCIENCE AND TECHNOLOGY

INTRODUCTION TO POLYMERS: Classification, functionality of monomers, degree of polymerization, molecular weight of polymers. - number average and weight average, molecular weight distribution. Polymerisation reactions – chain – free radical, ionic, co-ordination polymerisations – condensation polymerisation, ring opening polymerisation. Polymerisation techniques - Addition polymerisation - bulk, solution, suspension and emulsion techniques. Condensation polymerisation - melt, solution and interfacial techniques. (9)


ADDITIVES AND PROCESSING: Degradation mechanisms – thermal, mechanical and photo degradations. Fillers, plasticizers, anti aging additives, UV stabilizers, colouring agents, flame retardants, blowing agents, crosslinking agents and lubricants. Polymer processing - compression, injection, extrusion & blow moulding, calendaring, film casting, foaming and thermoforming. (9)

polyimides - preparation, properties and applications. (9)


TEXT BOOKS:

REFERENCES:

COMPUTER APPLICATIONS

15OH46 COMPUTER GRAPHICS AND VIRTUAL REALITY

3 0 0 3


AREA FILLING, TRANSFORMATIONS AND VIEWING: Area filling: Inside/outside Test - scan line polygon fill algorithm - Boundary fill and flood fill algorithm. Basic geometrical 2D and 3D transformation. Viewing pipeline - view coordinate reference frame - window to viewport transformation. (9)

BASICS OF ANIMATION: Key frame animation - sequence - motion control methods - morphing - warping. (8)

VIRTUAL REALITY: Components of VR system - types of VR - position trackers - navigation - gesture interface – displays - Open GL rendering pipeline. (9)

VR PROGRAMMING: VRML, defining and using nodes and shapes - VRML browsers - Java 3D – visual object definition by shape 3D instances - ColorCube class - Geometric utility classes. (8)

TEXT BOOKS:

REFERENCES:

15OH47 DATA AND FILE STRUCTURES

3 0 0 3

INTRODUCTION: Data structures - Abstract data Types - Primitive data structures - Algorithms: Structure, properties – analysis of time complexities. (4)

ARRAYS: Representation of linear and multi dimensional arrays – Operations - Applications. (5)

STACKS: Representation - Operations - implementation - Applications: Recursion handling; Evaluation of expressions. (5)

QUEUES: Representation - Operations - sequential implementation – Circular Queues-Priority Queues - Deque – Applications: Job Scheduling systems. (7)

LISTS: Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists – Operations - Linked stacks - Linked queues - Applications: Addition of Polynomials; Sparse Matrix representation. (9)
FILEs: File Types – Basic file operations – Heap Organization- Sequential file organization – Indexed Sequential File – Direct file organization


TEXT BOOKS:

REFERENCES:

15OH48 DATABASE MANAGEMENT SYSTEM


DATAMODELING: Introduction to Hierarchical data model - Network data model- ER model: Entities, Attributes, relationships – Weak and strong entity types – Design of Entity Relationship data models.

RELATIONAL MODEL: Relational data model basics - properties of Relations- Domains and Key concept – Enforcing data integrity constraints - Relational algebra operations.

RELATIONAL DATABASE MANIPULATION: Introduction to Structured Query Language(SQL) – SQL commands for defining database – Manipulations on database – Basic data retrieval operations - aggregate function- order by/group by clause- sub queries-in-any-all-views in SQL.

DATA BASE DESIGN THEORY: Functional dependencies - Normal forms – Normalization: 1NF to 5NF- Domain Key Normal Form – losses join and dependency preserving decomposition.

DATABASE TRANSACTION & SECURITY: - Transaction processing – properties - Concurrency control mechanism - security and integrity threats - Defense Mechanism.

TEXT BOOKS:

REFERENCES:

15OH49 HIGH PERFORMANCE COMPUTING


PARALLEL COMPUTERS: Parallel architectures -Trends in architectures, CMPs, GPUs, and Grids, Multiprocessors, Multicomputers, Multithreading, Pipelining- Data access optimization - Balance analysis and lightspeed estimates - Storage order - Taxonomy of parallel computing paradigms - Shared memory computers - Distributed memory computers - Hierarchical systems – Networks - Basics of parallelization- Parallelism – Parallel scalability.

PRINCIPLES OF PARALLEL ALGORITHM DESIGN: Preliminaries - Decomposition techniques - Characteristics of tasks and interactions - Mapping techniques for load balancing - Methods for containing interaction overheads - Parallel algorithm models – Basic communication operations. (7)

SORTING AND GRAPH ALGORITHMS: Dense matrix Algorithm: Matrix-vector multiplication - Matrix- matrix multiplication- Issues in sorting on parallel computing - Sorting networks - Bubble sorts and its variants - Quick sort - Graph algorithms - Definition and representation - Prims algorithm - Dijkstra's algorithm - All pairs shortest path - Transitive closure – Connected components. (9)

TEXT BOOKS:

REFERENCES:

15OH50 MAINFRAME SYSTEMS

EVOLUTION OF MAINFRAME: Overview of Computer Architecture -Classification of Computers -micro, mini, mainframes and super computer -key features – benefits. (6)

MAINFRAME SYSTEM: Attributes of Mainframes - Reasons for opting Mainframes - Users of Mainframes - Difference between Centralized and Distributed computing - Batch processing - Online/Interactive transactions. (9)

MAINFRAME WORKLOADS: Concept - strategy and benefits of the z/OS environment - Application enablement in z/OS - Overview of e-business support in z/OS - Connectivity to the z/OS environment - Security support provided by z/OS (9)

SYSTEM MANAGEMENT: Scalability – availability - backup and recovery features in z/OS - z/OS system services - zSeries processor configurations. (6)

COBOL: Introduction to COBOL - Program Structure - Procedure Division - Table Handling - File Handling. (9)

CASE STUDY: z/VM – Linux – zVSE – zTPF. (6)

TEXT BOOKS:

REFERENCE:

15OH51 MOBILE APPLICATION DEVELOPMENT

INTRODUCTION: Open Source Platform – Mobile Devices – Open Handset Alliance – Mobile Applications. (4)


BUILDING MENUS: Menus and types – Creating menus through XML – Creating menus through coding – Using the ActionBar – Drop-down List ActionBar. (6)

PUBLISHING ANDROID APPLICATIONS: Setting versioning information – Signing and publishing the applications – Distributing applications - Monetizing the applications.

TEXT BOOKS:

REFERENCE:

15OH52 MULTICORE PROGRAMMING

3 0 0 3

BASICS OF MULTICORE : Definition - hybrid architectures - The software developer’s viewpoint - single core - multicore – Types: multicore designs.
CHALLENGES : Sequential model – Concurrency – software development - Processor architecture - Operating systems role.
COMMUNICATION AND SYNCHRONIZATION: Thread strategy approaches - Decomposition and encapsulation of work - Approaches to application design - PADL and PBS.
UML : Modelling the structure of a system - UML and concurrent behavior - Basic testing types - Defect removal for parallel programs - Standard software engineering tests.

TEXT BOOK:

REFERENCES:

15OH53 OBJECT ORIENTED PROGRAMMING

3 0 0 3


FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions – Default - Const Arguments

CLASSES AND OBJECTS: Data members - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects.


POLYMORPHISM: Compile and Run Time Polymorphism – Operators Overloading - Unary and Binary Operators Overloading - Function Overloading.

TEXT BOOKS:

REFERENCE:

15OH54 PROGRAMMING IN PYTHON

3003

BASICS: Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output. (8)


FUNCTIONS: Definition - Passing parameters to a Function - Variable Number of Arguments - Scope - Passing Functions to a Function - Mapping Functions in a Dictionary – Lambda - Modules - Standard Modules – sys – math – time - dir Function. (9)

ERROR HANDLING: Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data From a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories. (10)


Total L: 45

TEXT BOOKS:

REFERENCES:

15OH55 RESPONSIVE WEB DESIGN

3003


CASCADING STYLE SHEETS: Introduction - Levels of Style Sheets - Style Specification Formats – Style Classes - Properties and Property Values - Color - The span and div Tags. (7)

HTML5: Media Queries supporting different viewports – Syntax - Fluid Layouts- Fluid Images- Serving Different Images for different screen sizes - HTML 5 for responsive designs - semantic elements in HTML5 – Embedding Media in HTML5. (10)

CSS3: Selectors - Typography and Color Modes – Aesthetics with CSS3 – Text shadows - Box shadows - Background Gradients – patterns - Multiple Background images Transitions - Transformations and Animations Forms with HTML5 and CSS3. (12)


Total L: 45

TEXT BOOKS:

REFERENCE:


STRUCTURAL PROPERTIES OF SOCIAL NETWORKS: Notions of centrality - cohesiveness of subgroups - roles and positions - structural equivalence - equitable partitions.


WEB LINKAGE MINING: Hyperlinks- co-citation and bibliographic coupling- page rank and HITS algorithm – web community discovery – web graph measurement and modelling - using link information for webpage classification.

REFERENCES:

TEXT BOOKS:


REQUIREMENTS GATHERING: Requirements gathering tasks – Requirements Engineering Process - Qualities of good requirements-Types of Requirements-Requirements elicitation- Requirements documentation- Analysis Documentation.


PROGRAMMING STANDARDS: Structured programming coding standards-Maintainability of code.

SOFTWARE TESTING FUNDAMENTALS – Black-Box and White-Box testing – Basis Path testing – Requirements phase testing - Design phase testing - Program phase testing - Desk debugging and program peer view test tools - Evaluating test results - Installation phase testing - Acceptance testing – Testing GUI – Testing Web Applications


REFERENCES:
OBJECT ORIENTED CONCEPTS: Classes and objects - creation - access specifiers - constructors – Methods - static - Inheritance - Composition-polyorphism - nested classes - wrapper classes - Abstract classes. 

PACKAGES AND INTERFACES: - Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface. 

EXCEPTION HANDLING: Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested try statements - throw - throws - Java Built-in Exception - Creating user defined exceptions - Assertions. 

INPUT/OUTPUT: Files – Stream classes – Byte Streams – Character Streams – Serialization. 

MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Synchronization - Interthread Communication. 


Total L: 30+T:30 = 60

TEXT BOOKS: 

REFERENCES: 

15OH59   GEOGRAPHIC INFORMATION SYSTEM


DATA MANAGEMENT AND OUTPUT: Import / Export – Data Management functions - Raster to Vector - Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs Desktop GIS - Distributed GIS. 


Total L: 30 + T: 30 = 60

TEXT BOOKS: 

REFERENCES: 
15OH60 PROGRAMMING FOR ROBOTICS

BASICS OF ROBOTICS: History – Definition – Components – Building a robot – The Robot drive mechanism. (3+2)

ROBOT SIMULATION: Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo. (4+4)

DESIGNING CHEFBOT HARDWARE: Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. (5+5)

WORKING WITH ROBOTIC SENSORS: Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. (4+4)

PYTHON AND ROS: Introduction to OpenCV, OpenNI, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL. (6+6)


Total L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:
2. 

HUMANITIES

15OH61 AN INTRODUCTION TO INDIAN CONSTITUTION

PREAMBLE AND ITS PHILOSOPHY: Introduction and Evolution of Indian Constitution preamble and its Philosophy. (4)

CENTRE-STATE RELATIONS: Directive Principles of State Policy, Fundamental Rights and Duties, Centre-State Relations. (6)

UNION GOVERNMENT: Powers, Functions and Position of President, Vice-President and Council of Ministers. (6)


JUDICIARY: The Union Judiciary - Supreme Court and High Court. (6)

PUBLIC SERVICES: All India Services, Central Civil Services, State Services, Local Services and Training of Civil Services. (5)

INTERNATIONAL POLITICS: Foreign Policy of India, Foreign Policy of USA, International Institutions like UNO, WTO, SAARC and Environmentalism. (5)

Total L: 45

TEXT BOOKS:

REFERENCES:

**15OH62 ENTREPRENEURSHIP**

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)


DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)

APPRAISAL OF PROJECTS: Importance of Evaluating Various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. (8)

FORMS OF BUSINESS ORGANIZATION: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. (4)


THE MARKETING FUNCTION: Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. (5)

INTELLECTUAL PROPERTY PROTECTION AND ETHICS: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. (4)

**TEXT BOOKS:**

**REFERENCES:**

**Total L: 45**

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**15OH63 HUMAN RESOURCE MANAGEMENT**

NATURE AND SCOPE OF HUMAN RESOURCE MANAGEMENT: Meaning and Definition of HRM, Objectives and Functions of HRM, Models of HRM, HRM in a changing Environment, Human Resource Management in the wake of Globalization. (6)

TRAINING AND DEVELOPMENT: Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives. (6)

WAGE AND SALARY ADMINISTRATION: Principles and Techniques of Wage Fixation, Job Evaluation, Incentive Schemes. (5)


INTERNATIONAL HRM: Model, Variables that outline difference between local and International HRM approaches to IHRM, Linking HRM to International Expansion Strategies. (6)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH64 INDUSTRIAL PSYCHOLOGY  

INDUSTRIAL PSYCHOLOGY: Introduction – Concept and Meaning – Characteristics and Scope.  

Group Structure and Cohesiveness.  


INTERPERSONAL RELATIONSHIP: Managing emotions – Emotional Intelligence – Building Interpersonal Relations – Managing the 
Boss – Dealing with Subordinates.  


ORGANISATION CULTURE: Meaning – Types – Importance – Changing Organizational Culture and Matching People with 
Organizational Culture – Working Environment.  

INDUSTRIAL FATIGUE BOREDOM: Types of Industrial Fatigue – Symptoms – Causes and Remedies of Industrial Fatigue Industrial 
Boredom – Causes – Effective Ways to Reduce Boredom.  

JOB SATISFACTION: Job Satisfaction – Consequences – Tips for Reducing Job Dissatisfaction.  


Total L: 45

TEXT BOOKS:

REFERENCES:

15OH65 PRINCIPLES OF MANAGEMENT  

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, 
Organizing, Staffing, Directing and Controlling.  

ENGINEERS AND ORGANIZATIONAL ENVIRONMENT: Social, Economic, Technological and Political. Social Responsibility of 
Engineers.  

MANAGEMENT CONCEPTS: MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM. (Case Study)  

BUSINESS PROCESS REENGINEERING: Need for BPR, Various phases of BPR, Production and Productivity in six sigma and TQM – 
Factors Influencing Productivity.  

ORGANISATIONAL BEHAVIOUR: Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and 
Perceptions at work.  

Total L: 45

TEXT BOOKS:
INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (6)

MANAGING INFORMATION: Why Information Matters – Strategic Importance of Information – Cost of Useful Information – Getting and Sharing Information. (6)


TEXT BOOKS:

REFERENCES:

15OH66 BUSINESS STATISTICS

STATISTICS INTRODUCTION: Definition, Types of Statistics, Types of Variables, Descriptive Measures, Basic Definition and Rules of Probability, Independence of Events. (9)

DESCRIPTIVES MEASURES: Measures of central tendency, dispersion, Probability Distributions. (6)

SAMPLING: Definition, Selection of Statistical tools, Sampling Methods, Sampling Frame determining the sample size. (6)

HYPOTHESIS TESTING: ANOVA- Independent sample t test, Paired t test. (4)

PARAMETRIC TEST: Concept, Chi square tests for Association and homogeneity, One sample t test. (4)

CORRELATION AND REGRESSION: Karl Pearson Correlation, Linear regression (Both manual and software applications), Components, Trend-Method of least squares and moving averages, seasonal variation-Simple average method only. (10)

STATISTICAL DECISION THEORY: Uncertainty and risk and Decision tree analysis (6)

TEXT BOOKS:

REFERENCES:

15OH67 DISASTER MANAGEMENT

INTRODUCTION: Disaster – Definition, Factors and Significance, Difference between Hazard and Disaster, History of Disasters and Types, Disaster Aids. (4)

NATURAL DISASTERS: Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche. (5)

MAN MADE DISASTERS: Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster.- Forest Fire-Oil fire –accident in Mines. (8)

GEOSPATIAL TECHNOLOGY: Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping. (8)

RISK ASSESSMENT AND MITIGATION: Hazards, Risks and Vulnerabilities. -Disasters in and India ,Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans. (8)
DISASTER MANAGEMENT: Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism. (8)

GLOBAL PERSPECTIVE: Study of Environmental Impacts Induced by Human Activity, Industrial Accidents, Outbreaks of Disease and Epidemics, War and Conflicts. (4)

TEXT BOOKS:

REFERENCES:

15OH68 FINANCIAL AND MANAGERIAL ACCOUNTING

INTRODUCTION TO ACCOUNTING: Meaning, Definition and significance of Accounting, Accounting Principles, Concepts and Conventions, Classifications of Accounts. (9)

BASIC ACCOUNTING: Journal Entry, Ledger, and Trial Balance Sheet, preparation of final accounts: Trading, Profit & Loss Account, Balance sheet. (9)

BASIC FINANCIAL STATEMENTS: Meaning – Types of Financial Analysis Income Statement, common analysis, trend analysis, ratio analysis, corporate cash flow, DuPont Model. (9)

COST ACCOUNTING: Accounting for overheads, Cost sheet, Marginal and Absorption costing, Break even analysis, Effect on profits, Activity Based Costing system. (6)

ACCOUNTING FOR DECISION MAKING: CVP Analysis -Relevant Costs and Revenue for Decision Making, Pricing Decisions, Operational Decisions, Exploring New markets, Make or buy decisions. (6)

ACCOUNTING FOR PLANNING AND CONTROLLING: Budgets, Budgetary Control -Variance Analysis - Cost and Financial Variances. (6)

TEXT BOOKS:

REFERENCES:

15OH69 MARKETING MANAGEMENT


MARKETING STRATEGY: Formulating Marketing Strategy, Key Drivers of Marketing Strategy, Marketing Strategies- Marketing Mix Components. (7)

COMPETITOR ANALYSIS: Analysis of Consumer & Industrial Markets, Building Competitive Advantage. (6)


Total L: 45

TEXT BOOKS:

REFERENCES:

15OH70 DEFENCE PRACTICES AND DISASTER MANAGEMENT

3 0 0 3

HISTORY & ENVIRONMENTAL AWARENESS: NCC- Army, Navy, Air force; Aim and Motto; Ranks and Equivalent Ranks; Honors and Awards; Organization; Training – Nation Building; Civil affairs; Social Service & Needs; Environment & Ecology; Pollution; Rain Water Harvesting; Law and Order; Corruption.

WEAPONS: Introduction; Types of Weapons; Armed Forces Fighting Arms; Service Corps; Section Formation & Types; Firing Order; Judging Distance; Types of Land; Working Principle of Rifle, Tank, Missiles; Characteristics of supporting Rifle and its ammunitions; Field Craft and Battle Craft; Fighting - Role of Fighting Arms and map reading.

DISASTER MANAGEMENT: Definition; Types of Disaster; Elements of Disaster Management, Foundations of Disaster Studies-Review of Concepts, Organizations – NDMA, NIDM, NDMRT, NEC, Disaster Mitigation, Disaster Preparedness, Disaster Relief, Reconstruction Planning, Economic and Social Rehabilitation, Globalization and Disaster Studies, Social Science and Domains Approach.

LIFE SKILL MANAGEMENT: Introduction; Concept of Life Skills; Internalizing of Life Skills; Self awareness and Empathy; Knowing Myself; Self care; Empathizing with others; Creative Thinking & Critical Thinking; Practicing Decision making & Problem Solving; Effective Communication – Inter Personal Relationship; Coping with Emotions & Stress; Facilitation skills – Verbal & Non verbal; Training Methodologies.

HEALTH AND HYGIENE: Anatomy, Physiology, Microbiology – Personal and Mental Health ; Infectious and Contagious Diseases & its prevention; First Aid in common Medical Emergencies; Basics of Home Nursing; Treatment and care of Wounds and Fractures.

FIELD TRAINING: Foot Drill; Handling & Inspection Training; Map Reading; Physical Proficiency Training; Introduction to Yoga.

Total L: 45

TEXT BOOK:

REFERENCES:
4. http://nccindia.nic.in/

ENGLISH

15OH75 ENGLISH AND SOFT SKILLS FOR EMPLOYABILITY

3 0 0 3

SELF MANAGEMENT AND ATTITUDES: Self Concept, Stress management, Positive attitude, Influential Skills, Initiative, Empathy, Social Etiquette

COMMUNICATION STYLES : Presentation Skills, Interpersonal Communication Skills, Interviewing Skills, Verbal and Nonverbal (body language) skills, Active Listening, Professional Writing, Effective email writing

TEAM WORK: Inter team cooperation, Intra team cooperation, Diversity, Productivity, Goal Setting and action

Total L: 45
LEADERSHIP SKILLS: Empowerment, Planning, Establishing Credibility, Vision & direction, Supervision, Mentoring, Decision-making, Creativity, Flexibility, Team problem solving (5)

MANAGING TIME AND PRESSURES: Managing Change, Time management, Effective meetings (5)

EFFECTIVE AND EXCELLENT CUSTOMER SERVICE: Communication with the customer- telephonic and online services, Managing conflicts or Challenging communication, Setting and resetting customer expectations, Building customer confidence, Growing customer relationship, Opportunity management, Developing team approach to meet customer needs. (10)

TEXTBOOK:
Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15OH76 ENGLISH FOR COMPETITIVE EXAMINATIONS

READING COMPREHENSION: Focus on different levels of Comprehension- Literal, Inferential, Analytical and Critical reasoning (7)
Identifying key words and signal words, decoding the building blocks of a passage, understanding jargons and double distractors (2)

LISTENING COMPREHENSION: Micro skills and Macro skills of Listening (4)
Identifying tone and purpose, eliminating distracters in objective type questions (2)

SPEAKING: Sub skills of speaking- Genre-specific oral communication (4)

VERBAL ABILITY: Word formation and expansion, Selecting and ordering words - Identifying and correlating synonyms and antonyms - Collocations (5)
Sentence Completion (5)
Verbal analogies (3)
Spotting and correcting errors (4)

WRITING: Mapping ideas, developing points and employing Variety in sentence types (3)
Referencing, Ellipsis and substitution in writing – Skillful paragraphing (unity, coherence and cohesion) (3)
Register and Tone in Critical, Analytical writing -Useful Language for describing graphs -Expressing strong opinions (3)

Total L: 45

TEXTBOOK:
Monograph prepared by the Faculty, Department of English, 2015

REFERENCES:

15OH77 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.1

GUTEN TAG! - LEARNING: To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages; Vocabulary: related to the topic; Grammar: W – Questions, Verbs & Personal nouns I. (7.5)

FREUNDE, KOLLEGEN UND ICH - LEARNING: To speak about hobbies, jobs, learn numbers from 20; Vocabulary: related to the topic; Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural. (7.5)

IN DER STADT – LEARNING: To know places, buildings, question, know transport systems, understand international words; Vocabulary: related to the topic; Grammar: Definite & indefinite articles, Negotiation, Imperative with Sie. (7.5)
GUTEN APPETIT! – LEARNING: To speak about food, shop, converse; **Vocabulary:** related to the topic; **Grammar:** Sentence position, Accusative, Accusative with verbs. (7.5)

TAG FÜR TAG – LEARNING: To learn time related expressions, speak about family, ask excuse, fix appointments on phone; **Vocabulary:** related to the topic; **Grammar:** Preposition – am, im, um, von...bis, Possessive articles, Modalverbs. (7.5)

ZEIT MIT FREUNDEN – LEARNING: To speak about birthdays, understand & write invitations, converse in the restaurant; **Vocabulary:** related to the topic; **Grammar:** Accusative personal pronouns and prepositions. (7.5)

**TEXTBOOK:**

**REFERENCES:**

15OH78 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.2

3 0 0 3

**KONTAKTE - LEARNING:** To arrange appointments, understand and give instructions, understand and reply letters, find information in the text, identify the situations and understand the conversation; **Vocabulary:** related to the topic; **Grammar:** Datitive Preposition & Article, Accusative Possessive Article. (7.5)

**MEINE WOHNUNG - LEARNING:** To understand the advertisements related to flats/houses, describe a flat, write a text about a flat; **Vocabulary:** related to the topic; **Grammar:** Adjective with sein (sehr/zu), wechselpreposition with Dat. (7.5)

**ALLES ARBEIT? – LEARNING:** To describe daily routine, talk about the past, speak about jobs, position, advertisements, prepare telephone conversation; **Vocabulary:** related to the topic; **Grammar:** Conjunctions, Perfect tense (regular & irregular verbs). (7.5)

**KLEIDUNG UND MODE – LEARNING:** To speak about clothes, understand the conversation at shopping centers, about Berlin. **Vocabulary:** related to the topic; **Grammar:** Perfect tense (trennbare & nicht trennbare verbs), personal pronomen & verbs with Dat. (7.5)

**GESUND UND MUNTER – LEARNING:** To make personal statements, name body parts, understand sport activities, conversation with the doctor, get & give tips to healthy life, e-mail writing; **Vocabulary:** related to the topic; **Grammar:** Imperative, Modalverbs. (7.5)

**AB IN DEN URLAUB! – LEARNING:** To suggest a city tour, describe the directions, write a postcard, describe the weather, make a complaint in the hotel, speak about the trips, letter writing; **Vocabulary:** related to the topic; **Grammar:** Adverbs (time). (7.5)

**TEXTBOOK:**

**REFERENCES:**

15OH81 DATA STRUCTURES AND ALGORITHMS

2 2 0 3

**INTRODUCTION:** Data structures - Abstract Data Types - Basic data structures – Arrays, stacks, queues and linked lists-Operations and applications (5)

**ALGORITHMS:** Introduction-Analysis of algorithms - Best, worst and average case time complexities - notations. (2)

SORTING AND SEARCHING: Insertion sort, selection sort, heap sort, count sort and radix sort - searching, Linear Search.

BINARY SEARCH TREES: Searching – Insertion and deletion of elements-Balanced BST- AVL trees-Definition – searching – insertion and deletion of elements, AVL rotations

MULTIWAY SEARCH TREES: Indexed Sequential Access – m-way search trees – B-Tree – searching, insertion and deletion. (3)

GRAPHS: Definition – representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Graph search methods (Breadth first and depth first traversals).

DIVIDE AND CONQUER: Method – Merge sort, Quick sort, Binary Search.

GREEDY METHOD: Optimization problems – method – examples – Minimum cost spanning tree (Kruskal’s and prim’s algorithms), Knapsack problem

TUTORIAL PRACTICE:
Implementation of the following problems:
1. Sparse and dense Matrix operations using arrays.
2. Linked Lists: Singly linked, Doubly linked and Circular lists.
4. Problems using Queues.
5. Binary trees
6. Problems related to sorting and searching algorithms.
7. Binary search tree
8. Minimum cost spanning tree

Total L: 30+T:30 = 60

TEXT BOOKS:

REFERENCES:

15OH82 OPTIMIZATION TECHNIQUES

LINEAR PROGRAMMING: Graphical method for two dimensional problems – Central problems of Linear Programming – Definitions – Simplex Algorithm – Phase I and Phase II of Simplex Method.

CONVEX OPTIMIZATION: Convex sets and cones- Convex functions- Convex optimization problems- linear and quadratic programs; second-order cone and semi-definite programs; quasi-convex optimization problems; vector and multi-criterion optimization.


INTEGER PROGRAMMING: Gomory cutting plane methods for all integer and mixed integer programming problems - Branch and Bound method (Land – Dolg and Dakin algorithms) – Zero-One Implicit enumeration Algorithm.


TUTORIAL PRACTICE:
1. Solving inequalities using Simplex, Two-phase, Dual simplex methods, Revised simplex method.
2. Finding initial basic feasible solution using (i) North-West corner rule(ii) Matrix minimum and (iii) Vogel’s approximation method and also perform optimalitytest using MODI method.
4. Gomory’s cutting plane methods for all IPP and mixed IPP.
6. Critical path for the given PERT and CPM networks.

**TEXT BOOK:**

**REFERENCES:**

**15OH83 DATA SCIENCE 2 2 0 3**

**INTRODUCTION TO DATA SCIENCE:** Data wrangling, cleaning, and sampling to get a suitable data set - Mathematics for understanding the data – Descriptive statistics: Visualizing Data - Central Tendency – Variability – Standardizing - Normal Distribution - Sampling Distributions. (6)

**DATA MANIPULATION AT SCALE:** Parallel databases, parallel query processing, in-database analytics, MapReduce, Hadoop, Key-value stores and NoSQL; tradeoffs of SQL and NoSQL. (5)


**COMMUNICATING RESULTS:** Visualization - descriptive statistics and visualization, privacy, ethics – multivariate visualization. (3)

**SPECIAL TOPICS:** Graph Analytics: structure, traversals, analytics, PageRank, community detection, recursive queries, Semantic web. (3)

**CASE STUDY:** Community Detection – Collaborative Network – Opinion mining – Co-citation network (2)

**TUTORIAL PRACTICE:**
1. Introduction to R and problems using R.
2. Collect datasets from Kaggle and Data Analysis.
3. Implementation of various predictive models.
4. Generate the results using Confidence levels.
5. Implementation of SVD.

**TEXT BOOK:**

**REFERENCES:**
5. Matthew A. Russell,"Mining the Social Web: Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites", O'Reilly Media, 2013.

**15OH84 DATA VISUALIZATION 2 2 0 3**

**INTRODUCTION:** Information visualization – Theoretical foundations – Information visualization types – Design principles - A framework for producing data visualization (5)

**STATIC DATA VISUALIZATION** – tools – working with various data formats (3)

**DYNAMIC DATA DISPLAYS:** Introduction to web based visual displays – deep visualization – collecting sensor data – visualization – D3 framework - Introduction to Many eyes and bubble charts (6)
MAPS – Introduction to building choropleth maps (3)

TREES – Network visualizations – Displaying behavior through network graphs (6)

BIG DATA VISUALIZATION – Visualizations to present and explore big data – visualization of text data and Protein sequences (7)

TUTORIAL PRACTICE:
Note: Explore software like R, Python, Google Vision, Google Refine, and ManyEyes; Data sets are available on Gapminder, Flowing data

1. Visualization of static data.
2. Visualization of web data.
3. Visualization of sensor data.
4. Visualization of protein data.

Total L: 30 + T: 30 = 60

TEXT BOOK:

REFERENCES:

15OH85 ARTIFICIAL INTELLIGENCE

2 2 0 3

INTRODUCTION: The foundations of AI - The History of AI- Intelligent agents- Agent based system. (2)


KNOWLEDGE REPRESENTATION AND REASONING: Knowledge representation - Logics – First order logic- Inference in first order logic – Higher order logic - Markov logic. (5)


DECISION-MAKING: basics of utility theory, sequential decision problems - decision network– policy -Decision process in infinite horizon: Optimal policy, Value iteration - policy iteration- Partially observable decision process – Decisions in Multi agent system: elementary game theory, (6)

LEARNING: Learning from observation - Knowledge in learning – Supervised Learning - Unsupervised and Reinforcement learning. (2)

ROBOTICS: Introduction. (2)

TUTORIAL PRACTICE:
Lab assignments will be provided for all the topics given below.
2. Hill climbing and genetic algorithm
3. Constraint satisfaction techniques,
4. Simple games – minimax and expectimax
5. Logic based exercises.
6. Implementing HMM models
7. Applications of sequential decision making and multi agent decision making
8. Implementing decision network and dynamic networks.

Total L: 30+T:30 = 60

TEXT BOOKS:

REFERENCES:

15OH86 PERVERSIVE COMPUTING

INTRODUCTION: Past, present, future; the pervasive computing market, m-Business, challenges and future of pervasive computing - modelling key for pervasive computing - pervasive system environment interaction - architectural design for pervasive system, application examples of pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment.

DEVICE TECHNOLOGY FOR PERVERSIVE COMPUTING: Hardware, computing devices and their characteristics - pervasive information access devices-smart identification, smart card, labels, tokens - embedded controls, smart sensors, actuators -Human-machine interfaces, Biometrics - Various operating systems for pervasive devices.


APPROACHES FOR DEVELOPING PERVERSIVE APPLICATIONS: Categorization - smart services for pervasive application development - developing mobile applications – presentation transcoding – device independent view component – heterogeneity of device platforms - Context Awareness and Mobility to build pervasive applications.

CONTEXT AWARE SYSTEMS: Modelling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts- autonomous systems - reflective and self-aware systems - self management and autonomic computing - complex systems.


TUTORIAL PRACTICE:
1. Create application with onClick, onKeyDown, onFocusChanged Event Handlers.
2. Create application with Toast Notifications.
3. Create application with Android's Advanced User Interface Functions.
5. Create application to Create, Modify and Query an SQLite Database.
6. Create application that Works with an Android Content Provider.
7. Create application that performs Data Storage and Retrieval from Android External Storage.
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API.
9. Implementation of small packages to demonstrate all APIs.
Note: All implementations using android.

Total L:30+T:30=60

TEXT BOOKS:

REFERENCES:
**15OH87 PARALLEL AND DISTRIBUTED COMPUTING**


**PARALLEL COMPUTER MEMORY ARCHITECTURES:** Shared Memory - Distributed Memory -Hybrid Distributed-Shared Memory Multiprocessors: Communication and Memory issues - Message Passing Architectures - Vector Processing and SIMD Architectures. (4)

**PARALLEL PROGRAMMING MODELS:** Overview -Shared Memory Model - Threads Model - Message Passing Model - Data Parallel Model - Other Models. (4)


**PRAM ALGORITHMS& BSP:** PRAM model of computation- Work-Time formalism and Brent’s Theorem; algorithm design techniques-parallel prefix, pointer jumping, (3)

**HIGH PERFORMANCE COMPUTING ARCHITECTURES** - Latency Hiding Architectures -Multithreading Architectures -Dataflow Architectures. (3)


**TUTORIAL PRACTICE:**
1. Basic Master -- Worker program and send messages.
2. Write a program to find the summation of largest number in a very larger array of integers. ( The contents of the array should be equally distributed to all processes ).
3. Write a parallel program in SPMD to calculate the PI value using integral approximation method.
5. Select your own choice of very dense computational problem having divide and conquer method and implement it in parallel algorithm. And produce the performance chart with 2, 4, 6 and 8 nodes.

**TEXT BOOKS:**

**REFERENCES:**

**15OH88 CYBER SECURITY**

**INTRODUCTION:** Security Goals, Attacks, Services and Mechanisms – Techniques – Understanding Threats. (2)


**PROGRAM SECURITY:** Secure Programs – Buffer overflows – Malware – viruses and other malicious code – Targeted Malicious code –Defense Mechanism. (6)

WEB SECURITY: Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS), Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection. (5)

OS SECURITY: Memory and Address protection – Access Control – file protection mechanisms –User authentication – models of security – Trusted OS design. (4)

TUTORIAL PRACTICE:
1. Design of a Client server application for a basic cryptosystem.
2. Detection of a Buffer overflow attack.
3. Packet Sniffing using Wireshark Tool to perform the traffic analysis attack.
4. Key distribution using RSA (KDC) – Key hacking.
6. Password authentication.
7. Transaction security using SQL Injection attacks.
8. Port scanning tools.
9. Performing attacks and testing with attack tools.
10. Security testing for Web applications.

Total L:30+TP:30 = 60

TEXT BOOKS:

REFERENCES:

15OH89 RANDOMIZED ALGORITHMS

INTRODUCTION: Randomized algorithms, randomized quick sort, Karger’s min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes. (4)

MOMENT, DEVIATION AND TAIL INEQUALITIES: Occupancy problem, Markov and Chebyshev inequalities- randomized selection- coupon collector’s problem, the Chernoff bound- routing in a parallel computer- a wiring problem. (4)

PROBABILISTIC METHODS: Overview of the method – maximum satisfiability - finding a large cut, Expander graphs. (4)

MARKOV CHAINS AND RANDOMWALKS: Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks. (4)

DATA STRUCTURES AND GRAPH ALGORITHMS: Random Treaps, hashing – hash tables – perfect hashing, skip lists - Fast min-cut. (4)

ONLINE ALGORITHMS: Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary, k-server problem. (4)

PARALLEL AND DISTRIBUTED ALGORITHMS: Sorting on a PRAM – Maximal Independent sets. (3)

DEERANDOMIZATION: The method of Conditional Probabilities – Derandomizing max-cut algorithm – Constructing pairwise independent values modulo a prime - Pairwise independent – large cut. (3)

TUTORIAL PRACTICE:
1. Implementation of randomized quick sort and solve real time problems using it.
2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.

Total L: 30+TP:30 = 60

87
TEXT BOOKS:

REFERENCES:

15OH90 APPROXIMATION ALGORITHMS

INTRODUCTION: Definition-performance ratios, vertex-cover problem.  
COMBINATORIAL ALGORITHMS: lower bounding techniques and Metric TSP, multiway cut problem, the minimum k-cut problem, FPTAS for knapsack, greedy algorithms for Makespan-PTAS for minimum Makespan, Euclidean TSP.  
LINEAR PROGRAMMING RELAXATIONS: LP-duality, min-max relations and LP-duality, rounding applied to vertex cover-simple rounding algorithm-randomized rounding, primal dual method and vertex cover.  
CUTS, METRICAL RELAXATIONS AND EMBEDDINGS: multiway cut, sum multi-commodity flow, some applications of multicut, rounding for Sparsest Cut via L1 Embeddings.  
SEMIDEFINITE PROGRAMMING: Strict quadratic programs and vector programs, properties of positive semidefinite matrices, the semidefinite programming problem, randomized rounding algorithm, improving the guarantee for MAX-2SAT.  
HARDNESS OF APPROXIMATION: reduction, graphs, and hardness factors, the PCP theorem, hardness of MAX-3SAT.  

TUTORIAL PRACTICE:
1. Implementation of vertex-cover algorithm.  
2. Implementation of Greedy algorithm for makespan.  
3. Problems related to Euclidean TSP.  
4. Implementation of different algorithms with rounding.  
5. Implementation of applications of multicut.  

Total L:30+T:30 = 60

TEXT BOOKS:

REFERENCES:

15OH91 NETWORK SCIENCE

BARABÁSI-ALBERT MODEL: Growth and preferential attachment, Barabási-Albert model, degree dynamics, degree distribution, diameter and the clustering coefficient, preferential attachment - absence of growth, measure, non-linearity, the origins.  
SCALE-FREE PROPERTY: Power laws and scale-free networks, Hubs, Universality, Ultra-small property, role of the degree exponent, Generating networks with a pre-defined degree distribution.  
DEGREE CORRELATIONS: Assortativity and disassortativity, Measuring degree correlations, Structural cutoffs, Degree correlations in real networks, Generating correlated networks, impact of degree correlations.  

Total L:30+T:30 = 60

TUTORIAL PRACTICE:
1. Implementation of Barabási-Albert model.  
2. Implementation of Watts-Strogatz model.  
3. Implementation of Bianconi-Barabási model.  
4. Obtaining Degree correlations in real networks.
5. Case studies of the theory concepts on real networks.

**TEXT BOOK:**

**REFERENCES:**

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**15OH92 APPLIED STOCHASTIC PROCESSES**

**STOCHASTIC PROCESSES:** Introduction – Classification of Stochastic Processes – Markov Chain


**RANDOM WALK MODELS:** Symmetric random walk – Random walk on graphs – Gambler’s Ruin model


**GENERAL QUEUEING MODELS:** Single and Multi server Poisson Queues - Single Server Queue with Poisson input and general service– General input and exponential service Queueing models.

**TUTORIALS PRACTICE:**
1. Case Study for Markov Chain: Passport Credit Card Company, Manufacturing, Telecommunication
2. Case Study for generalized Markov Process: Healthy Heart Coronary Care Facility
3. Modeling Network Protocols using Queueing Models
4. Performance Evaluation of Communication Systems
5. Page Ranking Algorithms

**TEXT BOOKS:**

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**15OH93 MODELLING AND SIMULATION**

**PRINCIPLE OF COMPUTER MODELLING AND SIMULATION:** Monte Carlo simulation. Nature of computer modeling and simulation. Limitations of simulation, areas of application.

**SYSTEM AND ENVIRONMENT:** Components of a system - discrete and continuous systems. Models of a system - A variety of modelling approaches.

**DATA-DRIVEN MODELS:** Empirical Models-Introduction - Linear Empirical Model- Predictions-Linear Regression - Nonlinear One-Term Model - Multiterm Models - Advanced Fitting with Computational Tools

DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Input - Output analysis - variance reduction techniques - Antithetic variables - verification and validation of simulation models. (4)

DISCRETE EVENT SIMULATION: Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. (5)

SIMULATION LANGUAGES - GPSS - SIMSCRIPT - SIMULA - SIMPLE_1, Programming for Discrete event systems in GPSS, SIMPLE_1 and C. (4)

CASE STUDIES: Simulation of LAN - Manufacturing system - Hospital system. (4)

TUTORIAL PRACTICE:
1. Implement variance reduction.
2. Implement event scheduling.
4. Simulate a manufacturing system.

TEXT BOOKS:

REFERENCES:

15OH94 GRAPH ALGORITHMS


MATCHING: Maximum and perfect matchings, augmenting path, Berge’s, Konig’s and Tutte’s theorems, Hall’s theorem, Hungarian algorithm, Edmond-Blossom algorithm. Kuhn-Munker’s algorithm for optimal assignment. (4)

NETWORK FLOW: Maximum flow in a network, minimum cut, Ford-Fulkerson algorithm, Max-flow min-cut theorem. Similarity between matching and flow theories. (3)


VERTEX COLORING: Vertex coloring and bounds. Sequential coloring, largest degree first algorithms. Maximum clique and vertex coloring. Mycielski’s construction for large chromatic number. (3)

GRAPH ISOMORPHISM: Isomorphism, subgraph isomorphism, László Babai’s quasi-polynomial time solution for graph isomorphism problem. (4)

PLANAR GRAPHS: Euler’s formula, dual graph, Kuratowski’s theorem, 4-color problem, Wagner’s theorem. Planarity testing – Hopcroft-Tarjan algorithm. (3)

TUTORIAL PRACTICE:
1. VLSI Physical design – maximum Independent set, maximum clique and minimum coloring for interval graphs, Steiner minimum tree in routine.
2. Isomorphism/subgraph isomorphism problem in Data mining - common subgraph pattern in networks, chemical compound within a chemical database.

Total L: 30+T: 30=60
3. Link verification using Eulerian trails.
4. Network flow – finding maximum flow in network
5. Register allocation, frequency assignment using vertex coloring
6. Traveling salesman problem using Hamiltonian concept
7. Planar graph embedding
8. Solving optimal assignment problem

TEXT BOOKS:

REFERENCES:

OPEN ELECTIVES OFFERED BY ENGINEERING DEPARTMENTS

DEPARTMENT OF AUTOMOBILE ENGINEERING

15AH01 AUTOMOTIVE INFOTRONICS

3 0 0 3

DRIVER ASSISTANCE SYSTEM: Driver information, driver perception, driver convenience, driver monitoring, general vehicle control, longitudinal and lateral control, collision avoidance, vehicle monitoring. (9)

TELEMATICS: Global positioning system, geographical information systems, navigation system, architecture, automotive vision system, road recognition. (9)

SAFETY SYSTEMS: Active and passive safety, airbags, seat belt tightening system, forward collision warning systems, child lock, anti lock braking systems, Autonomous Vehicle System, Lane departure warning system, Adaptive headlight system, Day time running lights (DRL), Automatic wiper system, Traffic Sign Identification. (10)

COMFORT SYSTEMS: Adaptive cruise control system, Active suspension system, power steering, collapsible and tiltable steering column, power windows, and climate control system. (10)

SECURITY SYSTEMS: Anti theft technologies – mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system, number plate coding, Bio metric systems. (8)

Total L: 45

TEXT BOOKS:

REFERENCES:

15AH03 ELECTRIC AND HYBRID VEHICLES

3 0 0 3

ELECTRIC VEHICLES: Architecture of an electric vehicle, essentials and performance of electric vehicles – Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations. (9)

HYBRID VEHICLES: Hybrid electric drivetrains - Concepts, architecture, design, control strategies, merits and demerits. (9)

ELECTRIC PROPULSION SYSTEMS: DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives. (9)
ENERGY STORAGE DEVICES: Electrochemical batteries – Reactions, thermodynamic voltage, lead-acid batteries, nickel based batteries, lithium based batteries, flywheel and ultra-capacitors, Battery management systems. (9)

HYBRID SOLAR VEHICLES: Fuel cell thermodynamics, operating principle, fuel cell technologies, fuel reforming, hydrogen production and storage. Photovoltaic cell, maximum power point tracking, solar powered accessories, hybrid solar vehicles. (9)

TEXT BOOKS:

REFERENCES:

DEPARTMENT OF PRODUCTION ENGINEERING

15PH08 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT


TEXT BOOKS:

REFERENCES:
1. Book specially prepared by NASSCOM as per the MoU.
DEPARTMENT OF TEXTILE TECHNOLOGY

15TH02 SOUND AND THERMAL ISOLATION PRODUCTS AND CHARACTERIZATION

INTRODUCTION TO SOUND: Fundamentals of Sound- Sound Levels and the Decibel- Sound in the Free Field- The Perception of Sound. (4)


SOUND ABSORPTION TEXTILES AND THE ENVIRONMENT: Environmental impact, manufacturing concerns, recycling of materials and components, sustainable product development. SOUND MEASUREMENTS AND STANDARDS: Impedance Tube Method- Reverberant Field Method- Steady State Method. Analysis of sound absorptive characteristics of fabrics tested by these methods. (10)

THERMAL INSULATION PRODUCTS: Need for thermal insulation- Types of thermal insulation materials- Textile structures as thermal insulators- Factors influencing the thermal insulation characteristics. Requirement and design for thermal insulation textiles. End uses of thermal insulation textiles. Improving thermal Insulation in automotive interiors. (8)

Environmental impact of thermal insulation textiles. Development of sustainable products for thermal insulation. Test methods and standards for thermal insulation textiles. (5)

TEXT BOOKS:

REFERENCE:

PROFESSIONAL ELECTIVES

DESIGN STREAM

15M001 COMPUTER AIDED DESIGN

OVERVIEW OF CAD SYSTEMS: Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations.Networking of CAD systems. (5)

INTERACTIVE COMPUTER GRAPHICS AND GRAPHICS TRANSFORMATIONS: Generative, cognitive and image processing graphics. Static and dynamic data graphics. Transport of graphics data. Graphic standards. Generation of graphic primitives - display transformation in Two- and Three – Dimensional graphics concepts, Graphical input technique, Geometric transformations, Visual Realism, Computer animation, customizing graphics software. (9)


PRODUCT DESIGN AND DEVELOPMENT: Automated 2D drafting - basics, Mechanical assembly - bill of materials generation. Mass property calculations. (5)

OPTIMIZATION TECHNIQUES: Optimization-need, objective functions and constraints. Mathematical modeling and analysis. (5)

CASE STUDY: Design and optimisation procedure of shafts, flywheel, gears and journal bearing using computer packages. (7)

Total: L: 45

TEXT BOOKS:

REFERENCES:

15M002 ADVANCED STRENGTH OF MATERIALS

3003

CURVED BEAMS: Circumferential stress at a point in a curved beam, Wrinkler Bach formula-limitations, curved beam with restrained ends. Closed ring subjected to a concentrated load and uniform load. (7)

BEAMS ON ELASTIC SUPPORTS: Beam with a concentrated load. Use of principle of superposition. Beam supported on equally spaced separate elastic supports-UDL over part of the beam. (8)

FLAT PLATES IN BENDING: Plates in which bending action is dominant-small deflections. Stress in a circular plate with UDL, simply supported and fixed edges-concentrated load. Stresses in square and rectangular plates with UDL, concentrated load at center. (7)

ROTATING DISKS: Solid disk, disk with a central hole with external and internal pressures, disks of uniform strength, plastic collapse of rotating disks. Rotating cylinders (circular). Disk of varying thickness. (7)

TORSION OF NON CIRCULAR SECTIONS: Torsion of bar having a rectangular sections, elastic membrane (soap film) analogy hollow thin walled tubes. (8)

THICK WALLED CYLINDERS: Lame solution for principal stresses. Maximum stresses, radial deflection, failure theories, applications. Methods of increasing the elastic strength by pre-stressing, analysis of effects of stresses of shrinking a hollow cylinder made of thin walled laminations, auto frettage. (8)

Total: L: 45

TEXT BOOKS:

REFERENCES:

15M003 FINITE ELEMENT ANALYSIS

3003

INTRODUCTION TO FEM: Engineering design analysis-meaning and purpose. Historical background of FEM – Rayleigh Ritz. Weighted residual method, Variational method, basic concepts of FEM. Applicability of FEM to various problems, Advantages and limitations of FEM, Test for convergence, Commercial finite element packages - advantages and limitations. (8)

STATIC ANALYSIS USING ONE DIMENSIONAL ELEMENTS: General procedure of FEM, Skeletal and continuum structures, Discretization of domain-basic types of elements, Formulation of element stiffness matrices and load vector: 1D spar - linear and quadratic elements, plane truss element, beam element, beams on elastic foundation, treatment of boundary condition, problems using one dimensional elements. (10)

STATIC ANALYSIS USING TWO DIMENSIONAL ELEMENTS: Formulation of two dimensional problems, Isoparametric formulation, 2D triangular and quadrilateral elements, Formulation of element stiffness matrices and load vectors for constant strain
triangular element, problems using two dimensional elements, higher order elements.

DYNAMIC ANALYSIS: Equations of motion for dynamic problems using one dimensional elements, Formulation of element mass matrices, Consistent and lumped mass matrices, Solution of Eigen value problems, Solving Free vibration problems using one dimensional element.

HEAT TRANSFER AND FLUID FLOW ANALYSIS: Basic equations of heat transfer and fluid flow, Finite element formulation, One dimensional heat transfer and fluid flow problems, solving steady state heat conduction and convection problems using one dimensional elements.

TEXT BOOKS:

REFERENCES:

15M004 FAILURE ANALYSIS AND DESIGN

MATERIALS AND DESIGN PROCESS: Factors affecting the behavior of materials in components, effect of component geometry and shape factors, designing with high strength and low toughness materials, designing for hostile environments, the design process, materials selection in design, processes and their influence on design, systematic process selection.

FRACTURE MECHANICS: Ductile fracture, brittle fracture, cleavage-fractography, ductile-brittle transition, fracture mechanics approach to design-energy criterion, stress intensity approach, time dependent crack growth and damage.

LINEAR ELASTIC FRACTURE MECHANICS: Griffith theory, energy release rate, Instability and R-curve, stress analysis of cracks, stress intensity factor, K-threshold, Crack growth instability analysis, crack tip stress analysis.

ELASTIC PLASTIC FRACTURE MECHANICS: Crack tip opening displacement (CTOD), J-integral, relationship between J and CTOD.


DETERMINATION OF FRACTURE TOUGHNESS VALUES: Experimental determination of plane strain fracture toughness, K-R curve testing, J measurement, CTOD testing, Effect of temperature, Strain rate on fracture toughness.

WEAR FAILURES AND ELEVATED TEMPERATURE FAILURES: Types of wear, different methods of wear measurement, analysis wear failures, wear at elevated temperatures, wear on different materials, role of friction on wear, stick slip friction, creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure.

FAILURE ANALYSIS TOOLS: Reliability concept and hazard function, life prediction, life extension, application of poisson, exponential and Weibull distribution for reliability, bath tub curve, parallel and series system, MTBF,MTTR, FMEA definition-Design FMEA, process FMEA, analysis causes of failure, modes, ranks of failure modes, fault tree analysis, microscopic failure analysis, industrial case studies / Projects on FMEA.

TEXT BOOKS:

REFERENCES:
15M005 VIBRATION AND NOISE ENGINEERING

INTRODUCTION: Relevance of and need for vibrational analysis. Mathematical modeling of vibrating systems-discrete and continuous systems-single-degree of freedom systems, free and forced vibrations, various damping models.

TWO DEGREES OF FREEDOM SYSTEMS: Generalized co-ordinates, principal co-ordinates, derivation of equations of motion, co-ordinate coupling, Lagrange’s equation.

MULTI DEGREES OF FREEDOM SYSTEMS: Derivation of equations of motion, influence coefficients, orthogonality principle, calculation of natural frequencies by Raleigh, Stodala, Dunkerley, Holzer and matrix iteration methods, branched system, geared system.

TRANSIENT VIBRATION: Impulse and arbitrary excitation, base excitation, Laplace transform formulation, response spectrum.


NOISE: Properties of sound – sound level meter. Sound isolation- machine enclosures, silencers and mufflers.

TEXT BOOKS:

REFERENCES:

15M006 DESIGN OF ROTATING EQUIPMENT


PUMPS: Different types of pump - characteristic curves. Theory of centrifugal pump impeller-vortex theory, design of impeller, volute and diffusers. Specific speed and design constants.

DESIGN OF MIXED FLOW IMPELLERS: Geometric relationship, axial flow pumps, design. Use of aerofoil data for impeller design, guide vane, pump casing.

FANS: Fan laws, performance coefficients, effect of change in fan speed, density, series and parallel operation, fan design losses, blade shape, casing.

PROPELLER FANS: Cross flow fans, principle of operation, applications, regulation of volume flow, sources of vibration in fans, noise attenuation testing.

BLOWERS: Types, centrifugal blower - design procedure, selection, performance, special applications, control of volume flow.

COMPRESSORS: Different types of compressors - characteristic curves. Centrifugal compressor - multistage arrangement, blade design, types of diffusers, performance, series and parallel operation.

AXIAL FLOW COMPRESSORS: Cascade theory, efficiency, two dimensional cascade, velocity triangles and stage loading, stage reaction, losses, compressor-testing procedure.

DISC STRESSES AND CRITICAL SPEED: Determination of disc stresses – sum and difference curves, Critical speeds of two bearing and three bearing shafts, torsional critical speeds.

TEXT BOOKS:
REFERENCES:

15M007 THEORY OF ELASTICITY AND PLASTICITY

ANALYSIS OF STRESS AND STRAIN: Stress at a point, stress tensor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions. Measurement of strain using strain rosettes

CONSTITUTIVE EQUATIONS: General theory, generalized Hooke’s law, equations of elasticity, Mitchel-Beltrami and Navier equations, formulation of the general elasticity problem, boundary conditions.

SOLUTION OF SOME SPECIAL BOUNDARY VALUE PROBLEMS: Two dimensional problems in rectangular and polar co-ordinates. Airy’s stress function. A few representative 3D problems - torsion and bending of non-circular prismatic bars (Saint-Venant’s solution), membrane analogy.


PLASTIC STRAIN ANALYSIS: Prandtl-Reuss and Levy-Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviatoric components, plastic potential, plastic instability, work hardening, effective stress and effective strain, strain rates and temperature effects on flow stress. Introduction to slip line field theory

TEXT BOOKS:

REFERENCES:

15M008 MECHANICS OF COMPOSITE MATERIALS

INTRODUCTION: Modern materials in design, types, metals, polymers, ceramics, composites. Polymers-Classification, properties of thermo plastics, properties of thermo setting plastics, applications, merits and demerits. Classification of composites, Honey comb composites, advantages, applications. Matrix and their role, principal types of fibre and matrix materials.


MICRO MECHANICAL BEHAVIOUR OF A LAMINA: Volume and mass fractions, density and void content, evaluation of elastic moduli, ultimate strengths of a unidirectional lamina, coefficients of thermal and moisture expansion.

MACRO MECHANICAL BEHAVIOUR OF A LAMINA: Hook’s Law for a two dimensional unidirectional lamina and angular lamina, evaluation of elastic moduli for unidirectional and angle lamina, engineering constants of unidirectional and angle lamina, strength failure theories, failure theories for composite lamina.

MACRO MECHANICAL BEHAVIOUR OF A LAMINATE: Laminate code, stress - strain behaviour in a laminate, Resultant forces and moments in a laminate, interlaminar stresses in laminates.
15M009 INTRODUCTION TO AIRCRAFT INDUSTRY AND AIRCRAFT SYSTEMS

AIRCRAFT INDUSTRY OVERVIEW: Evolution and history of flight, types of aerospace industry, aerospace industry trends, global and Indian Aircraft Scenario. Functioning aircraft industries Airbus, Boeing and HAL

INTRODUCTION TO AIRCRAFTS: Basic components of an aircraft, structural members, aircraft axis system, aircraft motions, control surfaces and high lift devices. Types of aircrafts – conventional design configurations based on power plant location, wing vertical location, intake location, tail unit arrangements, landing gear arrangements

MECHANICAL SYSTEMS: Environmental control systems (ECS), pneumatic systems, hydraulic systems, fuel systems, landing gear systems, engine control systems, ICE and rain protection systems, cabin pressurization and air conditioning systems, steering and brakes systems, auxiliary power unit. Functioning above systems in Airbus 380 aircraft

ELECTRICAL AND ELECTRONIC SYSTEMS: Electrical and Electronic Systems, Avionics, flight controls, autopilot and flight management systems, navigation systems, communication, information systems, radar system,

BASIC PRINCIPLES OF FLIGHT: Significance of speed of sound, air speed and ground speed, properties of atmosphere, Bernoulli’s equation, forces on the airplane, airflow over wing section, pressure distribution over a wing section, generation of lift, drag, pitching moments, types of drag, lift curve, drag curve, lift/drag ratio curve, factors affecting lift and drag.

AEROFOIL: Aerofoil nomenclature, types of aerofoil, center of pressure and its effects, wing section-aerodynamic center, aspect ratio, effects of lift, drag, speed, air density on drag.

STABILITY AND CONTROL: Degree of stability – lateral, longitudinal and directional stability and controls of aircraft. Effects of flaps and slats and lift coefficients, control tables, stalling, landing, gliding turning, speed of sound, mach numbers, shock waves.

AIRCRAFT PERFORMANCE AND MANEUVERS: Power curves, maximum and minimum speeds of horizontal flight, effects of changes of engine power, effects of altitude on power curves, forces acting on a aeroplane during a turn, loads during a turn, correct and incorrect angles of bank. Visiting aircraft maintenance shop

Total: L: 45

TEXT BOOKS:

REFERENCES:
3. Course Material of Infosys.
AIRCRAFT LOADS: Aerodynamic loads, inertial loads, loads due to engine, actuator loads, maneuver loads, VN diagrams, gust loads, ground loads, ground conditions, miscellaneous loads. (4)

AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES: Material selection criteria, aluminum alloys, titanium alloys, steel alloys, magnesium alloys, copper alloys, nimonic alloys, non metallic materials, composite materials, use of advanced materials smart materials, manufacturing of structural members, overview of types of manufacturing processes for aircraft components. (5)

STRUCTURAL ANALYSIS OF AIRCRAFT STRUCTURES: Theory of plates-analysis of plates for bending, plate deflection under different end conditions, strain energy due to bending of circular, rectangular plates, plate buckling, compression buckling, shear buckling, buckling due to in plane bending moments, analysis of stiffened panels in buckling, rectangular plate buckling, analysis of stiffened panels in post buckling, post buckling under shear, sample exercises. Structural analysis of aircraft structures using FEM software (7)

THEORY OF SHELLS: Analysis of shell panels for buckling, compression loading, shear loading / shell shear factor, circumferential buckling stress, Sample exercises. (5)

THEORY OF BEAMS: Symmetric beams in pure bending, deflection of beams, unsymmetrical beams in bending, plastic bending of beams, shear stresses due to bending in thin walled beams, bending of open section beams, bending of closed section beams. (6)

THEORY OF TORSION: Shafts of non-circular sections, torsion in closed section beams, torsion in open section beams, multcell sections, sample exercises. (4)

AIRWORTHINESS AND AIRCRAFT CERTIFICATION: Definition, airworthiness regulations, regulatory bodies, type certification, general requirements emergency provisions, emergency landing requirements. (5)

TEXT BOOKS:

REFERENCES:

15M011 SYSTEM MODELING AND CONTROL 3003

CONTROL SYSTEM FUNDAMENTALS: Basic elements of control systems – open loop and closed loop control – elements of closed loop control system – SISO, MIMO systems, sampled data, digital control systems. (4)

MATHMATICAL FOUNDATION: Matrix theory, Differential Equations and Laplace Transform (3)

MATHMATICAL BASICS OF CONTROL SYSTEMS: Block diagrams, Block diagram reduction, signal flow graphs, Mason’s gain formula, Transfer function, translational and rotational mechanical transfer function, Electrical and electro-mechanical system transfer functions, DC motor transfer function, Examples of modeling and transfer functions (5)

BASIC CONTROL THEORY: Poles and zeros; 1st order systems, 2nd order systems, More than 2 poles; zeros; nonlinearities and linearization, PID controllers (5)


FREQUENCY DOMAIN ANALYSIS: Frequency response; bode plots, Bode plot examples, Gain margin and phase margin, Design using the frequency response; lead, lag, lead-lag compensators, The state-space representation, Solving the state equations in the time and space domains, State equation examples, Stability and steady-state error in state space (10)

REVIEW: Modeling and transfer functions using mathematical modelling (2)
REVIEW: Root locus, feedback design using mathematical modelling (2)
REVIEW: Frequency domain and design using mathematical modelling (2)

TEXT BOOKS:
REFERENCES:

15M012 PRECISION MACHINE DESIGN

INTRODUCTION TO PRECISION ENGINEERING: Precision manufacturing, Intelligent manufacturing – objectives, Reconfigurable systems.

MOTION ERRORS: Errors and error measurements, Model of measurement, Statistical measurements, Propagation of errors, Motion errors principle – translational body, rotational body, geometric and kinematic errors, other types of errors in machines – thermal, cutting force induced, environmental, common geometric errors – cosine, abbe, dead path errors, Classification of errors – systematic and random errors, synchronous and asynchronous errors, PITE and PDTE, Methodologies of error elimination, Future vision in machine error inspection, CNC machine error assessment – positioning accuracy using Laser interferometer, contouring assessment using kinematic bar system. CNC machine error assessment


MODELING, SIMULATION AND OPTIMIZATION – THERMAL BEHAVIOR: thermal model design fundamentals, simulation and analysis – optimization, Diagnostics, Modeling and compensation, Main trends in improvement of thermal properties.


PARALLEL KINEMATIC MACHINES (PKM): Serial and parallel systems, Precision design of PKM – need of PKM ,low cost, degrees of freedom, workspace volume, high stiffness and agility, repeatability in movement, low inertia, Configurations and characteristic issues – degrees of calculation, Design principles – Kinematic modeling.


VOLUMETRIC POSITIONING ERRORS: Positioning error modeling – rigid body, non rigid body errors, machine configurations and positioning errors, Positioning error compensation modeling – displacement, squareness and straightness, angular, nonrigid body, 3D grid point, thermal expansion, distortion compensation, straightness errors, temperature correlation and linear interpolation. Positioning error measurement using laser interferometer - direct measurement, indirect measurement – body diagonal displacement, vector or sequential step diagonal displacement measurement, Applications – Siemens, Fanuc, Heidenhain, MDSI controllers– offline real time error compensation, Current issues in modeling of machine errors – definitions of 3D volumetric error based on body diagonal errors. Positioning error modeling

Total : L: 45

TEXT BOOK:

REFERENCES:
15M013 BIO-MECHANICS

INTRODUCTION TO BIOMECHANICS: Basic Terminology and Concepts – Mechanical properties of soft tissues, bones and muscles. (11)

BIOMECHANICS OF TISSUES AND STRUCTURES OF THE MUSCULOSKELETAL SYSTEM: Biomechanics of Bone, Biomechanics of Articular Cartilage, Tendons and Ligaments, Peripheral Nerves and Spinal Nerve Roots, Skeletal Muscle. (12)


BIOMECHANICS OF HUMAN MOTION: Linear kinematic and kinetic aspects of human movement, angular kinematic and kinetic aspects of human movement, equilibrium and human moment, biomechanics of Gait. (11)

Total : L: 45

PROJECT BASED LAB SESSIONS:
- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

TEXTBOOKS:

REFERENCES:

MANUFACTURING STREAM

15M020 COMPUTER INTEGRATED MANUFACTURING


PRODUCT DESIGN: Needs of the market, design and engineering, the design process, computer-aided design (CAD), areas of application, benefits of CAD, computer graphics, CAD hardware and software, CAD/CAM workstations. Three-dimensional capabilities - principles of curve generation, representation of 3D surfaces, from CAD to CAM. Computer-aided engineering (CAE) - finite element technique. Transportability - proprietary formats, plot file formats, Kermit, standard formats-IGES, product definition exchange specification. Needs of CIM, CAD/CAM continuum, CAD-CAM link. Reverse engineering, simultaneous engineering. (7)


SHOP-FLOOR CONTROL: Data logging and acquisition - instrument interconnection standards. Automated data collection - bar codes, optical character recognition, vision or image processing, radio frequency identification, magnetic identification, voice


TEXT BOOKS:

REFERENCES:

15M021 MANUFACTURE AND INSPECTION OF GEARS

INTRODUCTION TO GEARS: Types of gears-classification, application of gears, gearboxes, drawings for gears, gear production method an overview, types of blanks and blank preparation.

PRODUCTION OF CYLINDRICAL GEARS: Procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, setting calculations. Rack type gear shaping machine description and application. Internal gear cutting methods, CNC gear hobbing and gear shaping machines.

PRODUCTION OF CONICAL GEARS: Production of straight bevel gears by bevel gear generator, duplex rotary cutter method, Gleason Reva cycle method, spiral and hybrid bevel gear generation. Description of machine, cutter and machine setting.

GEAR MATERIAL SELECTION AND HARDENING METHODS: Properties of gear materials-non-metallic, non-ferrous and plastic gears, selection of material for power transmission, high speed application. Selection of materials for worm and wheel. Hardening by through hardening, case hardening, induction hardening, flame hardening, nitriding and tuftfriding, hardening defects.

GEAR FINISHING METHODS: Gear finishing advantages, finishing of gears by grinding, shaving, lapping and honing methods, cold rolling of gears - description of process, machine, cutters and process parameters setting.

GEAR INSPECTION: Type of gear errors-gear quality standards and allowable limits-tooth thickness, base tangent length measurement, pitch error, radial run out, involute profile error measurements methods and analysis, composite error measurement, computerized gear inspection, gear failure reasons and remedies.

MODERN GEAR PRODUCTION METHODS: Gear production by stamping, die casting, powder metal process, injection and compression moulding of plastic gears, cold and hot rolling. Mass production methods, shear speed shaping, gear broaching, Gleason G-TRAC – gear generation methods.

ECONOMICAL AND QUALITY PRODUCTION OF GEARS: Gear production systems – batch production, gear production cells, lean and agile production practices, automobile gear and gear boxes, heavy engineering gear production, gear for instruments and appliances, process and cutter selection for quantity, cost and quality criteria.

TEXT BOOKS:

REFERENCES:
INTRODUCTION: Introduction to fluid power, properties - hydraulic fluids, air. Selection of hydraulic fluids, comparison between hydraulics and pneumatics.

ACTUATORS AND CONTROL VALVES: Actuators-types & constructional details, Pressure, flow and direction control valves – types & constructional details, seals


TYPICAL INDUSTRIAL APPLICATION OF HYDRAULIC SYSTEMS: deceleration circuit, regenerative circuits, feed circuits, sequencing circuits, synchronizing circuits, fail-safe circuits.

PNEUMATIC SYSTEM DESIGN: Design of sequential multi actuator circuits Cascade method, Step counter method and Karnaugh Veitch Map method. Integration of start selection, start restriction, emergency stop modules with multi actuator systems.

TYPICAL INDUSTRIAL APPLICATIONS OF PNEUMATIC SYSTEMS: Metal working, handling, clamping, counter and timer circuits.

PROGRAMMABLE LOGIC CONTROLLERS: Construction, typical specification, programming methods and applications.

ADVANCED TOPICS IN FLUID POWER ENGINEERING: Servo & Proportional valves- types and applications, Hydropneumatics

TEXT BOOKS:

REFERENCES:

INTRODUCTION: Technological and commercial need, classification, performance constraints, selection of NTM, hybrid processes.

MECHANICAL MACHINING PROCESS: Abrasive jet machining, water jet machining, abrasive water jet machining, abrasive flow machining, magnetic abrasive finishing - process parameters, material removal rate, mechanism analysis, process capabilities, abrasive particle size, limitations and applications.

ULTRASONIC MACHINING: Ultrasonic machining system, mechanics of cutting, process parameters, analysis, capability, grain growing model, grain hammering model, limitations and applications.

ELECTRICAL DISCHARGE MACHINING(EDM): Working principle, process parameters, process capabilities, components of system and its functions, flushing techniques, effect of various parameters on material removal rate, application and limitations, electrical discharge wire cutting,wire EDM machine, application and limitations.

LASER BEAM MACHINING(LBM): Types of lasers, process characteristics, working principle, process parameters, process capabilities, components of system and its functions, limitations, application in drilling, cutting, marking and miscellaneous applications.

PLASMA ARC MACHINING (PAM): Working principle, process parameters, process capabilities, components of system and its functions, various plasma arc torches, process capabilities, comparison with oxy fuel cutting, application and limitations.

ELECTRON BEAM MACHINING (EBM): Working principle, process parameters, process capabilities, components of system and its functions, application and limitations.

ELECTRO CHEMICAL MACHINING AND CHEMICAL MACHINING: Working principle, components and functions, effect of process parameters, material removal rate and mechanism, limitations and applications.

HYBRID PROCESSES: Introduction, working principle, equipment, process parameters, process capabilities and applications of electro chemical grinding (ECG), electrical discharge grinding (EDG), electro chemical discharge grinding (ECDG).

TEXT BOOKS:

REFERENCES:

15M024 RAPID PROTOTYPING

INTRODUCTION: Need for the Time Compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems.


RAPID PROTOTYPING PROCESS INVOLVING SOLID SHEETS: Laminated Object Manufacturing: Principle of operation, LOM materials, process details, applications.

CONCEPT MODELERS: Introduction, Types: 3D Systems Thermo jet printer, Sander's model maker II, 3D printer, Stratasys Genisys Xs 3D Printer, JP system 5 and Objet Quadra system.

RAPID TOOLING: Introduction, Indirect rapid tooling - silicone rubber tooling, vacuum casting, aluminum filled epoxy tooling, spray metal tooling, cast Kirksite, 3D Keltool, etc., Direct rapid tooling - direct AIM, quick cast process, rapid tool, copper polyamide, DMLS, prometal, sand casting tooling, laminate tooling, soft tooling Vs hard tooling.

SOFTWARE FOR RP: STL files, overview of solid view, magics, mimics, magics communicator, etc., internet based softwares, collaboration tools.

ALLIED PROCESSES: Surface digitizing, surface generation from point cloud, surface modification, data transfer to solid models.

RAPID MANUFACTURING PROCESS OPTIMIZATION: Factors influencing accuracy, Data preparation-errors due to tessellation, errors due to slicing, Part building errors, Part finishing, Selection of part build orientation.

TEXT BOOKS:

REFERENCES:

15M025 FLEXIBLE MANUFACTURING SYSTEMS

INTRODUCTION: Definition of an FMS - principal objectives – basic component – characteristics of FMS - types of FMS – equipments and its functions. FMC vs FMS. Types of flexibility and performance measures. Economic and technological justification for FMS.
DEVELOPMENT AND IMPLEMENTATION OF AN FMS: Planning phases - integration - system configuration - FMS layouts - simulation - FMS project development steps. Project management - equipment development - host system development - functions of FMS host computer – FMS host and area controller function distribution - planning - hardware and software development. Framework for developing maintenance policy for FMS.

DISTRIBUTED NUMERICAL CONTROL AND PROGRAMMABLE CONTROLLERS: DNC system - communication between DNC computer and machine control unit - hierarchical processing of data in DNC system - features of DNC systems, PLC - control system architecture - elements of programmable controllers: languages, control system flowchart, comparison of programming methods.

AUTOMATED MATERIAL HANDLING AND STORAGE: Functions - types - analysis of material handling equipments. Design of conveyor and AGV systems, storage system performance - AS/RS - carousel storage system - WIP storage system - interfacing handling storage with manufacturing. Tool management of FMS.


PROCESS PLANNING: Approaches to process planning, study of a typical process planning, manufacturing planning and control, overview of production control.

RECONFIGURABLE MACHINES AND SYSTEMS: Challenges, enabling technologies for reconfiguration– system level design issues in RMS – reconfigurable machines – challenges.

FMS APPLICATIONS: Case studies: computer-integrated robotic flexible welding cell – FMS practices at Automotive industries.

TEXT BOOKS:

REFERENCES:
2 M.Baudin: Manufacturing Systems Analysis with Application to Production Scheduling, Yourdon Press, 1990.

15M026 DESIGN AND ANALYSIS OF AUTOMATED SYSTEMS 3 0 0 3

FUNDAMENTAL CONCEPTS OF AUTOMATION: Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Introduction to HMI systems.


MECHATRONIC SYSTEMS DESIGN: Mechatronics, key elements of mechatronic systems, Stages in design, traditional and mechatronic design approaches, possible design solutions. Real time interfacing – introduction, data acquisition systems, overview of I/O process, virtual instrumentation software. Condition monitoring, adaptive control and SCADA systems. Case studies-pick and place robot, engine management system, consumer mechatronic products.

Total : L: 45

Total : L: 45
15M030 COMPUTATIONAL FLUID DYNAMICS

INTRODUCTION: Basic concepts of fluid flow-derivation of the governing equations, conservation of mass, momentum and energy. Mathematical classification of flow - hyperbolic, parabolic, elliptic and mixed flow types.

DISCRETISATION: Finite difference method - forward, backward and central difference schemes, explicit and implicit methods. Properties of numerical solution methods - stability analysis, error estimation, difference between the FDM and FVM methods.

INTRODUCTION TO GRID GENERATION: Choice of grid, grid oriented velocity components, Cartesian velocity components, staggered and collocated arrangements, adaptive grids.
CFD TECHNIQUES: Lax - Wendroff technique - MacCormack's technique, relaxation technique. Artificial viscosity, ADI technique, pressure correction technique, SIMPLE algorithm. Upwind schemes - flux vector splitting. (5)

TURBULENCE MODELING: Turbulence energy equation- one-equation model, the k-ω model, the k-ε model. (7)

CASE STUDIES: Solving practical problems such as heat exchangers, IC engines, electronic equipment cooling, and compressors using CFD packages. (6)

**Total : L: 45**

**Project based lab sessions**
- The course includes at least one assignment with mathematical modeling and / or simulation of a practical situation.

**TEXT BOOKS:**

**REFERENCES:**

**15M031 IC ENGINE DESIGN**

**I C ENGINES:** Introduction - Design of engine based on vehicle characteristics–engine capacity, calculation of bore and stroke length-balancing and vibration -critical speed and damping. Study of mounting methods of IC engines (6)

**FUEL SUPPLY AND IGNITION SYSTEM:** Working principles of simple and modern carburetors with modifications for variable speed, load operation.Superccharging and turbo charging.MPFI system.Diesel fuel pumps and injector-working principle- CRDI system.Battery and coil, Magneto type systems. (5)

**ENGINE LUBRICATION AND COOLING:** Functions of a lubricating system; Types of lubrication systems; mist, wet sump and dry sump systems; properties of lubricating oil; engine performance and lubrication; necessity of engine cooling; disadvantages of over cooling. Cooling systems; air cooling, water cooling: radiators. (4)

**TESTING AND PERFORMANCE:** Testing of IC engines-basics engine measurements: dynamometer; air & fuel flow rate, constant speed and variable speed test, methods of estimating indicated power: Indicator diagram; Willan’s line; Morse test, brake power, volumetric efficiency. Heat balance test. (4)

**COMBUSTION ENGINEERING:** Chemical reactions, Heating values –HCF and LCF analysis. Minimum air flow requirement for combustion- Normal and abnormal combustion process –knocking / detonation, Factors affecting knocking/detonation in SI and CI engines; Fuel ratings: Octane and Cetane numbers. (4)

**ALTERNATE FUELS:** Environmental pollution, Environment friendly fuels: bio fuels, Hydrogen fuel cell. (3)

**PISTON:** Introduction –calculation of gas forces– variation of gas forces. Design of piston – calculation of side thrust – piston pin, rings. (4)

**CONNECTING ROD:** Introduction–design principles, procedure, selection of cross section, materials, manufacturing process - heat treatment. (4)

**CRANKSHAFT:** Introduction, determination of primary and secondary forces– balancing forces, calculation of rotating mass, location of mass. Selection of materials and cross-section, manufacturing process, heat treatment (4)

**VALVE ACTUATING MECHANISM:** Design of valves – valve springs – tappet. Cam design-cam profile generation, cam shaft design. Rocker and rocker arm design considerations, materials, manufacturing process, heat treatments (4)

**FLYWHEELS:** Determination of the mass of a flywheel for a given co-efficient of speed fluctuation. Engine flywheel – stresses of rim flywheels, design of hubs and arms of flywheel, turning moment diagram (3)

**Total : L: 45**
TEXT BOOKS:

REFERENCES:

15M032 REFRIGERATION AND AIR CONDITIONING

Introduction:- Refrigeration cycles & processes, Psychrometry- properties, processes, Cooling load estimation, use of refrigeration & Psychrometric chart., (3)

Refrigeration system components:- Evaporators ,Dx coils, Wet coils ,Flooded liquid cooler, Direct-expansion liquid cooler and liquid overfeed cooler, Condensation and condensers , Water-cooled condensers. Air-cooled, Evaporative condensers, Cooling towers, Thermostatic expansion valves ,Compressors- Reciprocating, Rotary, Scroll, and Screw

(3)

Packaged & chiller units:- Types, Application, Cooling load estimation, Design and Balancing of components, Layout of the components.

(4)

Cold Storage systems:- Types, Application, Cooling load estimation, Design and Balancing of components, Layout of the components.

(5)

Air conditioning system components :- Fans- Types & selection, Coils- Characteristics, Types & Coil Accessories, Condensate control, and freeze-up protection, Air filters, Electronic air cleaners, Activated Carbon, humidification and humidifiers, Selection of humidifiers and design. (3)

Air condition systems:- Classification, Air Heating, and Cooling Systems, Designation, Air conditioning system, Subsystem, and main components selection, Applications and building occupancies indoor air quality, Types - Packaged terminal air conditioning Systems, Evaporative cooling and evaporative cooling systems, Space air conditioning systems, Packaged systems and Desiccant-based Systems, Central systems and clean room systems, Thermal Storage Systems, Chilled water system

(9)

Air systems: Equipment— Air-handling units and Packaged units, Functions of AHU, classifications, main components, selection of AHU, Packaged units – types, performance and selection of Packaged units, Fan room – types, layout considerations

(6)

Air duct design:- Basics of airflow in ducts, characteristics of airflow in ducts, Types, Construction, duct heat gain, heat loss and duct insulation, frictional losses, dynamic losses, flow resistance, principles considerations and procedure in air duct design, layout, methods, computer-aided duct design and drafting, duct liner and duct cleaning, space air diffusion

(6)

Commissioning and Maintenance :- HVAC&R Commissioning , , Testing, Adjusting, and Balancing, HVAC&R Maintenance, Monitoring and Fault Detection, Diagnostics Assisting Predictive Maintenance,

(3)


(3)

TEXT BOOKS:
1. ISHRAE, “HVAC Handbook” 2014

REFERENCES:
4. Web and video material of NPTEL, Prof. Ramgopal, IIT Kharagpur.

Total L: 45
15M033 BIOGAS ENGINEERING


INCINERATION: Process, combustion controls, refuses characteristics, schematics of incineration plants, furnace & boiler in incineration plant.


TEXT BOOKS:

REFERENCE BOOKS:

15M034 AUTOMOBILE ENGINEERING

AUTOMOBILE ARCHITECTURE AND PERFORMANCE: Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

ENGINE ARCHITECTURE AND PERFORMANCE: Types of engine, multi valve engine, in-line engine, vee-engine, Petrol engine-direct, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles, Engine Control Unit.

TRANSMISSION SYSTEMS: Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchromesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling

WHEEL AND TYRES: Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres.

SUSPENSION SYSTEM: Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems.

STEERING SYSTEM: Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.

BRAKING SYSTEM: Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes, anti lock braking system.

TEXT BOOKS:

REFERENCES:

15M035 AUTOMOTIVE ELECTRONICS

AUTOMOTIVE ELECTRICALS AND ELECTRONICS: Basic electrical components and their operation in an automobile - starting systems - charging systems - ignition systems- electronic fuel control - environmental legislation for pollution - overview of vehicle electronic systems - power train subsystem - chasis subsystem - comfort and safety subsystems. (7)

INTRODUCTION TO EMBEDDED SYSTEMS: Embedded systems definition-components of embedded systems - microprocessor, classification of microprocessors, microcontrollers, and memory peripherals. Introduction to an embedded board (TMS470/ARM9 based) for hands on lab sessions (RISC processor based with standard peripherals/interfaces and I/O). (8)

OPERATING SYSTEM IN EMBEDDED ENVIRONMENT: Introduction to OS - General purpose of OS, RTOS - Kernel - Pre-emptive and non-pre-emptive, scheduler, interrupt - interrupt latency and context switch latency - board support package - task, multi-tasking, task synchronization, inter-task communication - features of a typical embedded RTOS (μC/OS-II). (8)

INTEGRATE DEVELOPMENT ENVIRONMENT: Introduction to integrated development environment (IDE) - getting started, HW / SW configuration (boot service, host - target interaction) - booting reconfiguration - Managing IDE - target servers, agents, cross development, debugging - introduction to an IDE for lab board - RTOS, PC based debugger. (8)

EMBEDDED SYSTEM IN AUTOMOTIVE APPLICATIONS: Engine management systems - Gasoline/diesel systems, various sensors used in system - vehicle safety system - electronic control of braking and traction - introduction to control elements and control methodology - electronic transmission control - body electronics - infotainment systems - navigation systems - system level tests - software calibration using engine and vehicle dynamometes - environmental tests for electronic control units. (10)

EMBEDDED SYSTEM COMMUNICATION PROTOCOLS: Introduction to control networking - communication protocols in embedded systems -SPI, I2C, USB - vehicle communication protocols - introduction to CAN, LIN, FLEXRAY, MOST, KWP2000 - DETAILS OF CAN. (4)

TEXTBOOKS:

REFERENCES:

Total L: 45

15M036 ADVANCED FLUID DYNAMICS

HISTORY OF FLUID MECHANICS,Properties of fluids – Viscosity, Compressibility, Stress in a fluid and Relation to Pressure , Stability of Floating and Immersed Bodies (2)

FLUID KINEMATICS:Lagrangian and Eulerian Analysis Velocity Field, Stream Lines, Streak Lines, Path Lines, (4)


VISCOUS FLOW:Derivation of Navier-Stokes Equation, Closed form solutions, Plane Poiseuille flow, Couette flow, Hagen-Poiseuille Flow, Darcy-Weisbach and Fanning friction factors, Frictional Loss, Modified Bernoulli equation, Moody Chart, Losses in pipe fittings (6)

BOUNDARY LAYER THEORY: Prandtl’s boundary layer equations, Blasius solution, Karman-Pohlhausen Integral momentum
equation, boundary layer separation and control, streamlined and bluff bodies - flow around circular bodies and aerofoils, calculation of lift and drag (6)

TURBULENCE: Introduction, Derivation of Time Averaged Equations, Turbulence Models, Simple Analysis of the Turbulent Boundary Layer Velocity Profile (3)

INTRODUCTION TO GAS DYNAMICS: Mach Number and Compressibility, Isentropic Flow, Velocity of Sound and Pressure Disturbances, Subsonic and Supersonic Flows, Choking, Introduction to Shocks, Fanno Flows and Rayleigh flows (6)

TEXT BOOK:

REFERENCES:

15M037 RENEWABLE ENERGY

SOLAR ENERGY: Basic concepts, solar radiation, potential of solar energy, Solar Collectors, Flat Collectors, Evacuated Tubes, Concentrators, Solar Plant Configurations, Photovoltaic Converters environmental aspects of solar energy, (7)

WIND ENERGY: Principles of wind power, wind turbine operation, site characteristics, horizontal and vertical axis types, aerodynamics of wind turbine, performance and wake analysis, design principles of wind turbine, tower design, new developments, small and large machines, Magnus effect, storage systems. (10)


BIOMASS AND WASTE TO ENERGY: Concepts and systems, biomass production, energy plantations, short rotation species, forestry system, biomass resource agro forestry wastes, municipal solid wastes and agro processing industrial residues, environmental factors and biomass energy development, combustion, Pyrolysis, gasification and liquefaction, modeling, appliances and latest development. Bioconversion: biogas, fermentation and wet processes, chemicals from biomass and biotechnology. Bio-diesel, ethanol, methanol, manufacture and properties. (12)


OTHER ENERGY SOURCES: Geothermal energy, Magneto Hydrodynamic system (MHD), thermionic and thermo electric generator, micro-hydel systems. Hybrid systems and applications. (5)

TEXT BOOKS:

REFERENCES:

15M038 SOLAR ENERGY CONVERSION SYSTEMS AND DESIGN


**ELECTRICAL ENERGY CONVERSION:** Solar photovoltaics, Basics, Types of Cell, Materials, Parameters and Performances, Tracking, Balance of System, Applications, PV power plants, Types, Plant Design. (9)

**ENERGY STORAGE:** Thermal Energy Storage, Types, Design of System, Thermal energy transfer system design. Mechanical energy storage, Types and system design, Electrical energy storage types and system design. (9)

**ENERGY ECONOMICS:** Plant economy, Energy Delivery Factor, Profitability Index, Cost of Energy. (3)

**TEXT BOOKS:**

**REFERENCES:**

**15M039 ENERGY CONSERVATION AND MANAGEMENT**


**ELECTRICAL SYSTEMS:** 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 Encon in Illumination. (12)

**THERMAL SYSTEMS:** Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories. (12)

**ENERGY CONSERVATION IN MAJOR UTILITIES:** Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – D.G. sets. (8)

**ECONOMICS:** Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing – ESCO concept. (5)

**TEXT BOOK:**

**REFERENCES:**

**15M051 ADVANCED HEAT AND MASS TRANSFER**

**REVIEW OF BASIC HEAT AND MASS TRANSFER:** Conduction, convection, radiation, thermal conductivity, Fourier Law, Fick’s Law, Newton’s Law, Stefan Boltzmann’s Law, viscosity, heat transfer coefficient, mass transfer coefficient. (3)

CONVECTION HEAT AND MASS TRANSFER: Derivation of the full energy equation, Boundary layer approximations for momentum, heat and mass transfer, Similarity of Boundary Layers, Momentum, heat and mass transfer analogy, Blasius Similarity Solution, Karman-Pohlhausen Integral Solution, Forced Convection Heat and Mass transfer cylinders and spheres, Internal flow – Fully Developed flow for constant heat flux and constant temperature boundary conditions, Developing Flow, Graetz Problem. Free convection, heat transfer from vertical and horizontal surfaces, Similarity Solution

BOILING AND CONDENSATION: Pool boiling heat transfer, Nucleate Boiling and bubble growth, Critical heat flux, Film Boiling and Leidenfrost point, Convective Boiling, Condensation, filmwise condensation and drop wise condensation, Nusselt Model

DESIGN OF HEAT AND MASS TRANSFER EQUIPMENT: Selection and design of Heat Exchangers, Cooling Towers, Scrubbers, Cyclones and Bag Filters - LMTD & Effectiveness method (NTU) to study performance of heat exchangers.

RADIATION HEAT TRANSFER: Rayleigh and Wien Distribution, Planck’s Distribution, and Derivation of the Stefan Boltzmann Law, Spectral, Total, Hemispherical and Directional Emission, Irradiation, Reflection, Absorption and Transmission, Emissive power, Black Body and Grey body Definition, Radiation heat transfer between surfaces, shape factor, radiation shield, Introduction to Gas radiation

TEXT BOOKS:
2. Boundary Layer Theory, H. Schlicting

REFERENCES:

15M054 ENERGY AND CLIMATE CHANGE

ENERGY AND ECONOMY: Energy production, consumption and economic growth, current energy scenario, Trends in energy use of oil, coal and gas, Peak Oil, economics of depletable resources, energy balance, sankey diagram, Electricity Markets

ENERGY AND ENVIRONMENT: Fossil fuels and Carbon emissions, air pollution, global warming, Non-CO2 GHGs, thermal pollution, environment impact assessment, Need for energy efficiency and conservation, energy paradox, Energy, Economy and Environment interaction.


MITIGATION POLICY: Kyoto protocol; UNFCCC; IPCC; Geopolitics of GHG control; Carbon market - CDM and other emission trading mechanisms; Relevance for India and developing countries

TEXT BOOKS:

REFERENCES:
INDUSTRIAL ENGINEERING STREAM

15M040 LEAN MANUFACTURING

INTRODUCTION: Origins and objectives of lean manufacturing-Lean process, 3M concept, key principles and implications of lean manufacturing-traditional vs lean manufacturing characteristics-roadmap for lean implementation and lean benefits. Study of Ford and Toyota production system, JIT manufacturing, Lean building blocks. (7)

LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination – seven types of waste- pull production - different models of pull production - The Kanban system - continuous flow - The continuous improvement process / Kaizen-Worker involvement. Design of kanban quantities, Leveled production, tools for continuous improvement. (7)


VALUE STREAM MAPPING: The value stream – benefits, mapping process. The current state map–mapping icons, mapping steps. VSM exercises, Takt time calculations. (7)


TOTAL PRODUCTIVE MAINTENANCE: Goals and benefits – Hidden factory, the six big losses, types of maintenance, Overall equipment effectiveness, Pillars of TPM and implementation. Changeover and setup time reduction techniques. Temple of quality, OEE calculations. (7)

RECONCILING LEAN WITH OTHER SYSTEMS: Study of lean six sigma and lean design – lean and ERP- lean with ISO9001:2000, administrative lean. (3)

Total L: 45

TEXT BOOKS:

REFERENCES:

15M041 VALUE ANALYSIS AND VALUE ENGINEERING


TECHNIQUES: General techniques: brain storming – gordon technique - feasibility ranking – morphological analysis – ABC analysis – probabilistic approach – make or buy technique. (5)


CASE STUDIES: Water treatment plant – engineering management - pump component, motor component, wet grinder - automobile parts – hospital service (7)

TEXT BOOKS:

REFERENCES:

15M042 SUPPLY CHAIN MANAGEMENT

INTRODUCTION TO SUPPLY CHAIN MANAGEMENT: Definition, global optimization, objectives of SCM. Logistics networks- data collection, model and data evaluation, solution techniques. (7)

INVENTORY MANAGEMENT AND FORECASTING: Introduction to inventory and multi order opportunities, Inventory policy- Periodic review policy, Continuous review policy, Effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting-The Role of Forecasting in a Supply Chain, Risk Management in Forecasting, case studies. (8)

VALUE OF INFORMATION: Bullwhip effect, information and supply chain technology. Supply chain integration- push, pull and push-pull system. Demand driven strategies, impact of internet on SCM, distribution strategies. (8)

STRATEGIC ALLIANCES: Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor-integration, procurement and out servicing strategies. (8)

INTERNATIONAL ISSUES IN SCM: Introduction, risks and advantages- design for logistics, supplies integration into to new product development, mass customization. Issues in customer value. (7)

INFORMATION TECHNOLOGY FOR SCM: Goals, standardization, infrastructure, DSS for supply chain management. (7)

TEXT BOOKS:

REFERENCES:

15M043 INDUSTRIAL DESIGN AND APPLIED ERGONOMICS

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. (6)

INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications. (6)

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. (6)

WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, fatigue. (6)

ENVIRONMENTAL CONDITIONS: Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. (6)
BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

BIOThERMODYNAMICS AND BIOENERGETICS: Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA’s approach, virtual environments.

TEXT BOOKS:

REFERENCES:

15M044 OPTIMIZATION TECHNIQUES FOR ENGINEERING SYSTEMS


NETWORK MODELS: Shortest path problems, Minimum spanning tree problems, Maximum flow problems, Minimum cost problems, Network simplex method.

NON TRADITIONAL OPTIMIZATION: Tabu search, Particle swarm optimization, Genetic Algorithm, Simulated annealing, Teaching-Learning Behaviour Optimization (TLBO).

REFERENCES:

15M045 QUALITY ENGINEERING

CONCEPT OF QUALITY ENGINEERING: Quality value and engineering- overall quality system-quality engineering in product design - quality engineering in design of production processes - quality engineering in production - quality engineering in service.


ON-LINE QUALITY CONTROL: On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production.

ON-LINE QUALITY CONTROL ATTRIBUTES CHARACTERISTICS: Checking intervals- frequency of process diagnosis.

ON-LINE QUALITY CONTROL METHODS FOR PROCESS IMPROVEMENTS: Production process improvement method- process...
diagnosis improvement method- process adjustment and recovery improvement methods. 

QUALITY ENGINEERING AND TPM: Preventive maintenance schedules- PM schedules for functional characteristics- PM schedules for large scale systems. Quality tools- fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems. 

TEXT BOOKS: 

REFERENCES: 

15M046 MANAGERIAL FINANCE 

INTRODUCTION TO MANAGERIAL FINANCE: Definition, Managerial Finance function, Goal of the firm, Governance and Agency. 


CASH FLOW AND FINANCIAL PLANNING: Depreciation Methods, Strategic and operating financial plans, Preparing and Evaluating the Cash Budget, Preparing the Cash Budget, Types of Costs and Expenses. 

TIME VALUE OF MONEY: Future Value versus Present Value, Types of Annuities, Mixed Streams, Loan Amortization. 

STOCK VALUATION: Differences between Debt and Equity, Common and Preferred Stock, Market Efficiency, Common Stock Value. 

CAPITAL BUDGETING TECHNIQUES: Overview of Capital Budgeting, Payback Period, Net Present Value (NPV), Internal Rate of Return (IRR), Conflicting Rankings. 


TEXT BOOKS: 

REFERENCES: 

15M047 ENGINEERING ECONOMIC ANALYSIS 


117
PROJECT MANAGEMENT: Nature, scope, different phases of project – phased manufacturing plan (PMP), totally integrated project management techniques. (5)

INTEREST AND TIME VALUE OF MONEY: Simple interest, compound interest, uniform series payments, interest factors, use of interest tables, nominal and effective interest rates, continuous compounding, uniform continuous payment- uniform gradient (7)

METHODS FOR EVALUATION OF TANGIBLE ALTERNATIVES: Present worth comparison - equal, unequal lived assets - study period – assets with infinite life - capitalized cost, bond valuation. Equivalent uniform annual cost comparison – situations for EUAC - Rate of return comparisons IRR – MARR IRR misconceptions (10)


REPLACEMENT ANALYSIS: Items deteriorating with time and items that fail completely, not accounting for time value of money and with accounting for time value of money, replacement policy for new and old machine with infinite horizon, group replacement (6)

RISK ANALYSIS: Risk in economic analysis, measuring risk investment, risk profiles, decision trees, formulation of discounted decision tree, simulation. (6)

TEXT BOOKS:

REFERENCES:

15M048 INDUSTRIAL MANAGEMENT

3 0 0 3

INTRODUCTION : Principles of management - Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Social Responsibility of Engineers. (8)

ORGANIZATIONAL BEHAVIOUR AND HUMAN RESOURCE MANAGEMENT: Significance of OB, HR - Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development – Forms of Business organization. Objectives of job evaluation, Methods of job evaluation, Characteristics of a good wage and incentive systems, Methods of wage payments. Labour welfare schemes - Factories Act 1948. (9)

METHOD STUDY: Evolution of Industrial Engineering, Productivity definition, means of increasing productivity, Productivity and work study. work study - Definition, aims, procedure for method study, selection of jobs, recording techniques, micro motion study, therbligs, cyclograph and chronocycle graph, principles of motion economy, design of work place layout, analysis in the form of chart, operation chart, flow process chart, flow diagram, string diagram, man machine chart, two handed chart, SIMO chart (9)

TIME STUDY : Time study equipment, performance rating, allowances, number of cycles to be studied, determination of standard time. Work place design - Ergonomics. (6)

LAYOUT DESIGN: Manufacturing facility layouts – product, process, fixed position and cellular layouts. Group technology-Introduction, part classification and coding, assigning machines to groups- binary ordering algorithm. (5)

ASSEMBLY LINE BALANCING: Assembly lines, Approaches to line balancing – largest candidate rule, Kilbridge and wester method, Ranked positional weight heuristic, COMSOAL. (8)

Total: L: 45

TEXT BOOKS:
1. ILO, —Introduction to work study, Universal Publishing Corporation, Bombay, 1986.

REFERENCES:
2. Ralph M. Barnes, —Motion and Time study, John Wiley and sons, 1990.
15M049 ENTERPRISE RESOURCE PLANNING


**ERP IMPLEMENTATION:** Traditional approach to information system design – New approach to system development – ERP Design and Implementation – Requirement analysis for ERP – Alternatives for ERP – lifecycle – implementation methodology Selection of an ERP package – Hidden Costs – Case Studies


**ERP CASE STUDIES:** HRM, Finance and Costing, Production, Materials Management, Sales and Distribution, and combination of modules

**REFERENCES:**

**TEXT BOOKS:**

15M050 SIX SIGMA IN MANUFACTURE AND SERVICE

**INTRODUCTION:** Basic concepts - Six sigma definition – Need for Six sigma approach – five laws of six sigma – COPQ – Types of six sigma: DMAIC vs DMADV

**FOUNDATION PHASE:** Six sigma as strategic initiative, internal communication strategy and tactics, formal launch, organizational structure, six sigma training plan, project selection. Project management processes, selection of team members, team stages, characteristics of effective teams.

**DEFINE PHASE:** Overview – Types of Customers, Problem identification – Voice of customer – importance, collect VOC data, Applications of Seven QC tools – SIPOC – QFD - CTQ - Project charter.

**MEASURE PHASE:** Overview – Types of measures – Types of data - Data collection – Choosing statistical software – Quality cost - Cost of poor quality. Introduction to Measure tools - Measurement system analysis –Process capability calculations

**ANALYSE PHASE:** Overview – Process analysis – Selection of statistical testing - ANOVA, – Failure mode and effects analysis - Gap analysis – Root cause analysis.


**REFERENCES:**

**TEXT BOOKS:**
REFERENCES:

15M052 QUALITY MANAGEMENT

INTRODUCTION: Definitions of the terms – quality planning , quality control, quality assurance, quality management . total quality management as per ISO 8402 – overview on TQM – the TQM axioms – Commitment – scientific knowledge – involvement Consequences of total quality. (8)


CROSBY AND THE QUALITY TREATMENT: Crosby’s diagnosis of a troubled company - Crosby’s quality vaccine - - Crosby’s fourteen steps for quality improvement - Crosby in service industry case study. (9)

KAIZEN : Meaning – kaizen and innovation – the kaizen management practices – total quality control (TQC) — small group activities – quality circles – Comparison of kaizen and Deming’s approach with illustration. (7)


Total: L: 45

TEXT BOOKS :
1. Logothetics N ., ―Managing for total quality – From Deming to Taguchi and SPC ― , Pretence hall Ltd, New Delhi, 1997.

ONE CREDIT COURSES

OFFERED BY THE DEPARTMENT

15MF01 PROCESS ENGINEERING AND COSTING

PROCESS ENGINEERING: General Manufacturing process and its types, Selection of manufacturing process-size and dimensional accuracy. (4)

SELECTING AND PLANNING THE PROCESS OF MANUFACTURE: Fundamental rules of the manufacturing process, Basic design of the product, Influence of process engineering on product design, Rechecking specifications, how materials selected affects the process cost, using materials more economically, the material cost balance sheet, Process planning and its types. (6)

SELECTION OF PROPER TOOLING: Classification, sources of tooling, tool holders, work piece holders, molds, patterns, core boxes, dies and gages. Availability of equipment, Effects of process parameters on performance and economy. (5)

Total L: 15

REFERENCES:
15MF02 STRATEGIC AND HUMAN RESOURCES MANAGEMENT

STRATEGIC HUMAN RESOURCES: Introduction, challenges in strategic HRM, managing work flows and conducting job analysis, planning/recruiting, recruiting/retaining, managing diversity (5)

HUMAN RESOURCES DEVELOPMENT APPROACHES: Performance management, self motivation, employee relations, rights and discipline, safety and health (5)

TRAINING AND DEVELOPING A COMPETITIVE WORKFORCE: Knowledge management practices, external and organizational environments, team building (5)

REFERENCES:

Total L: 15

15MF03 MEASUREMENT OF VIBRATION AND SOUND

INTRODUCTION: Fundamental of vibrations – undamped free vibrations - damped free vibrations - forced vibrations - Transient vibrations – Non-linear vibrations – random vibrations. (3)


CASE STUDIES IN VIBRATION (2)

REFERENCES:

Total : L: 15

15MF04 CHALLENGES IN IMPLEMENTING LEAN MANUFACTURING

VALUE STREAM MAPPING: Sections of VSM - symbols of VSM- application of VSM for an industrial process. (2)

CONTINUAL IMPROVEMENT (KAIZEN): Understanding the current status of the industry -establish metrics - identifying the wastes - applying lean principles (PDCA) - measure productivity. (2)

FMEA: Applying the principles of FMEA- understand severity, detection and occurrence - develop FMEA based on process flow-prioritize the activities to reduce RPN (4)

CONTROL PLAN: Applying the principles of control plan (CP)- understand sections of CP - establish parameters driven by product and process- verification needed before start of process- constant monitoring for stability of process- reaction plan. (4)

ERROR PROOFING (POKA-YOKE) - Understanding error proofing Vs mistake proofing (MP) - when EP and MP should be applied-develop EP and MP for a process- cost implications (3)

REFERENCES:

Total L: 15
15MF05 COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER ANALYSIS OF MECHANICAL SYSTEMS

INTRODUCTION: Basic concepts of fluid mechanics, Properties of fluids, Classification of fluid flow, Basic of heat transfer - conduction, convection and radiation, steady state diffusion, convection-diffusion, Introduction to CFD

GOVERNING EQUATIONS: Application of physical principles, Deriving governing equations in conservation form - Continuity, Momentum and Energy equation, Classification of equations in PDE form.


CASE STUDIES: Solving practical fluid flow and heat transfer problems such as compressor, IC engine, pumps, and gear boxes analytically and using CFD software.

REFERENCES:

Total L: 15

15MF06 THERMAL ANALYSIS OF MECHANICAL SYSTEMS USING FINITE ELEMENT METHOD

INTRODUCTION: Introduction to heat transfer- heat flow, conduction, convection, radiation, Importance of temperature gradient.

FINITE ELEMENT METHOD: Concept of finite element method, Basic differential equation of heat transfer, Finite element formulation of governing equation.

HEAT TRANSFER ANALYSIS: Steady state one dimensional heat flow-conduction, Steady state two dimensional steady state heat transfer involving conduction and convection.

TRANSIENT HEAT TRANSFER ANALYSIS: One and two dimensional heat transfer involving conduction and convection.

CASE STUDIES: Solving practical problem using software.

REFERENCES:

Total L: 15

15MF07 CREATIVE AND INNOVATIVE METHODS FOR DESIGN AND DEVELOPMENT


CREATIVITY: Definition, Need for creativity, Generating creative ideas – the seven Da-Vincian principles, Typology of idea generation activities, Principles of creativity, Creativity and serendipity.

CREATIVITY TOOLS/TECHNIQUES: Use of creative techniques, Lateral thinking vs. breakthrough thinking, Nine creativity tools – brainstorming, morphological analysis, analogic approach, bio-mimicry, TRIZ, contra-think, serendipity, technology forecast, six thinking hats.

BRAINSTORMING AND TRIZ: Brainstorming – definition, steps to do brainstorming, evaluation of ideas, TRIZ – levels of invention, physical contradictions, Contradiction matrix – standard features and inventive principles, Evaluation of technical trends, S-field analysis.

INNOVATIVE DESIGN: Design rules, Evaluation, Audit, and Innovative design case studies.

Total L: 15
REFERENCES:
2. Brain Clegg, "Creativity and Innovation for Managers", Butterworth Heinmann publishers, 2005

15MF08 CONCEPTS OF PRODUCT DESIGN

INTRODUCTION: Design briefing or product brief statement, Product Design Specification (PDS) and constraints vs. limits. (2)

SKILL SETS EVALUATION: Sketching skills and other skill sets evaluation, Design documentation (1)

CONCEPT DESIGN: Definition, Concept design, Concept generation and evaluation (4)

DETAILED DESIGN: Design factors – manufacture, sales, purchase, cost, transport, and disposal. (2)

ERGONOMICS AND ANTHROPOMETRICS (2)

DESIGN PROCESS: Material selection, Manufacture, Marketing and evaluation of the final design. (4)

REFERENCES:

15MF09 COOLING OF ELECTRONIC EQUIPMENT

INTRODUCTION TO ELECTRONICS COOLING: Needs, Goals, Levels. Fundamentals of heat transfer: Extended surfaces, contact resistance. (4)

AIR FLOW MANAGEMENT: Fan characteristics, System characteristics, Fan performance (2)

HEAT ANALYSIS: System level analysis, Board level analysis, and package level thermal analysis. Heat sink technologies: air cooled components and boards, experimental methods. (2)

HEAT EXCHANGES AND COLD PLATES: Thermal design process, analytical techniques, thermal design of multi-chip module. (2)

HEAT SINK DESIGN AND OPTIMIZATION: Free convection, liquid cooling, advanced cooling. (2)

NUMERICAL METHODS: Case studies. (2)

REFERENCES:

15MF10 VALUE ANALYSIS AND VALUE ENGINEERING

OVERVIEW: Meaning of Value engineering(VE), Difference from other initiatives, Value and its types, Relationship between value
vis-à-vis person, time and environment, History of Value engineering/Value analysis/Value management, World bodies of Value engineering & their activities, Multi-disciplinary team approach in Value engineering study

**VALUE ENGINEERING JOB PLAN:** Introduction, comparison of job plans of various value engineering authorities, components of VE job plan

**ORIENTATION PHASE:** training associates in Value Analysis and Value Engineering (VAVE), different trainings and certifications available in VAVE, Method to conduct VAVE studies

**INFORMATION PHASE:** information needed for VAVE, Method to collect and analyze information, ABC Analysis, Pareto Analysis, Breakeven analysis

**FUNCTION ANALYSIS PHASE:** Breakdown item into elements and sub-elements, questions to be asked, introduction to functions, practice session, types of functions (use and sell function), levels of function (basic and secondary), identify various functions, elements of cost, procedure for cost allocation, cost allocation to function, concept of worth, process flow for determining Worth, discussions on Worth, meaning of FAST, use of FAST, development history of FAST, different types of FAST. Ground rules of FAST, FAST diagram.

**CREATIVE PHASE:** Definition of creativity, misconceptions about creativity, introduction to creative techniques like TRIZ, 3P, lateral adoption and others

**EVALUATION PHASE:** Selection of criteria, feasibility analysis, weighted evaluation methods, decision matrix

**RECOMMENDATION PHASE:** Need for recommendation, method to make presentation, impact analysis and justification report, implementation plan, presentation skills.

**IMPLEMENTATION PHASE:** Detailed design, verification and validation, certification, change implementation.

**AUDIT PHASE:** Need for audit, types of audit, how to do audit.

**REFERENCES:**

**15MF11 AIR CONDITIONING SYSTEM**

**COMPRESSORS IN AIR CONDITIONERS:** Reciprocating, Scroll, Screw compressors, Rotary vane compressors, components and its purpose, operation, performance and selection

**THERMAL & OIL MANAGEMENT IN COMPRESSORS:** High side, low side compressors, performance parameters, oil circulation ratio, oil missibility

**ENERGY EFFICIENT OPERATION:** Variable speed motors (VFD), EC motor (Electronically commutated motors), Electronic Expansion Valves, smart air conditioners

**ENERGY MANAGEMENT & CONTROL SYSTEM:** AHU Controls, Dry cooler / Adiabatic Control Panels, Cassette Unit Controls, Building management systems (BMS)

**ENERGY RATINGS:** Star rating calculation, Rating regulations & standards, Minimum Energy Performance (MEPS) requirements

**REFERENCES:**
15MF12 SKILLS DEVELOPMENT FOR CREATIVITY AND INNOVATION

1001

BASIC UNDERSTANDING OF CREATIVITY AND INNOVATION: Definitions of and differences between Creativity and Innovation; Few Creative Thinkers and common traits of Creative Persons; Characteristics of Creative Ideas; Analytical thinking vs. creative thinking; left and right brain activities; Role of Innovative products and services in Life and in Business; Analysis of three typical Innovative Products

CREATIVE WORKING: Three main attributes of creativity; Five different methods; Advantages and Disadvantages; Ideating

NEGATIVE ATTITUDES AND MENTAL BLOCKS: Seven negative attitudes to be removed; Four mental blocks to overcome

MYTHS ABOUT CREATIVE THINKING: Understanding five myths connected with creativity; how to break the myths and overcome hurdles

POSITIVE ATTITUDES & APPROACHES: Six different attitudes to nurture; identifying each attitude in known creative personalities.

REFERENCES:

15MF13 CORROSION SCIENCE AND ENGINEERING

1001


FORMS OF CORROSION: Definition, factors and control methods of various forms of corrosion : uniform, galvanic, pitting, inter granular, crevice, dezincification, stress corrosion, corrosion fatigue, hydrogen embrittlement.

CORROSION CONTROL METHODS: Atmospheric corrosion – classification, factors influencing atmospheric corrosion, temporary corrosion preventive methods ; organic coating, corrosion inhibitors, cathodic protection, anodic protection.

CORROSION MONITORING: Electrochemical methods of corrosion rate measurements by Gravimetric, Tafelpolarization, linear polarization, impedance spectroscopy, harmonics andNDT techniques- ultrasonics, radiography eddy current.

REFERENCES:

15MF14 SIMULATORS FOR INTEGRATED PRODUCTS

1001

INTRODUCTION:- introduction to simulator; definition, objectives of simulator

TYPES OF SIMULATOR:- product simulator; process simulator;

SIMULATOR COMPONENTS:- elements of a simulator; functional simulator / training simulator; Environmental simulation

SIMULATOR DESIGN:- design principles of a simulator; tools; hardware and software; resources; configuring a simulator to a specific application
INTEGRATION OF SIMULATOR: integrated product development approach; interfaces - mechanical, electrical, electronic and software; testing; trouble shooting (3)

APPLICATION OF SIMULATOR: importance / advantages / cost reduction in various areas viz, training, operations, testing; safety and entertainment; use in academic / research and defense field – case studies – examples (3)

REFERENCES:
4. Sankar Sengupta, System Simulation and Modeling

15MF15 OVERVIEW OF DIGITAL MANUFACTURING

1001

FUNDAMENTALS: Boundary representations (wireframe modeling), Solid representations (CSG/Boolean mathematics), Function representations (Parametric Modeling), Mesh Modeling/Digital Sculpting, Voxel representations/Medical Imaging/Modeling. (4)

ALGORITHMIC DESIGN: NURBS Modeling/Bezier Surfaces, Parametric Modeling, Generative modeling, Mesh/Voxel Modeling (2)

MACHINE CONTROL: Gantry Control (cartesian), Delta Machine Control, Polar Machines Control, STL/AMF Slicing (2)

SOCIAL IMPACTS: Safety, Liability and intellectual property, Environmental impact, On-demand fabrication models and mass customization (2)


MATERIAL PROPERTIES: Mechanical properties of printed materials, Post processing, Multi-materials manufacturing (2)

REFERENCES:

OFFERED BY THE DEPARTMENT OF HUMANITIES

15OF01 EXPORT - IMPORT MANAGEMENT

1001

INTRODUCTION: Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES: Obtaining an Export License – Export Credit Insurance – Procedures and Documentation. (4)

FOREIGN EXCHANGE: Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES: Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES: Incentives – Institutional Support. (2)

REFERENCES:
**15OF02 INSURANCE & RISK MANAGEMENT**

**INTRODUCTION TO RISK MANAGEMENT:** Risk in Our Society. (2)

**INSURANCE AND RISK:** Client Side – Components of the Costs of Risk. (2)

**PRINCIPLES OF INSURANCE:** Insurance Company Operations – Documents. (4)

**MASS CONTROL:** Insurance Intermediaries – Insurance Companies and their Role in Deducting Business / Role Risks. (4)

**FINANCIAL RISKS:** Shift of Risks – Risk Derivatives. (3)

**REFERENCES:**

**Total L:** 15

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**15OF03 VALUES AND ETHICS AT WORK PLACE**

**HUMAN VALUES AND ETHOS:** Meaning and Significance of Values – Sources of Individual Values - Value crisis in the Contemporary Indian Society –Moral and Ethical Values. (4)

**APPLICATION OF VALUES:** Relevance of Values in Management – Personal Values and Values at Work place – Values for Managers. (2)

**WORK ETHICS:** Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership – Ethical dilemma - Case Study. (4)

**SHARE VALUES IN THE ORGANIZATION AND ITS IMPACT:** Need to identify and share values – the Value Construct and How to Promote Shared Values. (2)

**UNIVERSAL VALUES:** Cross Cultural Values - Impact of Culture on Organizations and Managing Workforce Diversity. (3)

**REFERENCES:**

**Total L:** 15

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**15OF04 DEVELOPMENT OF INDUSTRIALISATION**

**EVOLUTION OF MODERN ECONOMY:** Colonialism, Capitalism and economic development. (2)

**AMERICAN HISTORY:** Before and After European arrival. (4)

**ROLE SLAVERY and trade in America.** (4)

**INDIAN ECONOMY** – Pre and Post Independence, (3)

**INDUSTRIALIZATION IN ASIA AND AFRICA** – Colonialism – anti-colonialism and Socialism. (2)

**REFERENCES:**

**Total L:** 15
15OF05 CREATIVITY AND SOCIAL ENTERPRISE

CREATIVITY- Understanding the creative skills
WAYS TO IMPROVE creativity and exercises.
INNOVATION – Process of Innovating new ideas - Importance of Innovation.
ENTREPRENEURIAL skills and development – Intrapreneurship.

REFERENCES:

Total L: 15

15OF06 SOCIAL AND PSYCHOLOGICAL WELL BEING

DEFINING SOCIAL PSYCHOLOGY and social influences on behavior.
ANALYSIS OF SOCIAL and psychological problems and the solutions to address social problems.
ROLE OF SPORTS AND GAMES, yoga practices, tracking and outdoor activities in addressing social and psychological problems.
ORIGINS OF PSYCHOLOGICAL DISORDER – roots of social anxiety - prevention of psychological disorders.
NATURE OF INTERVENTIONS – Evaluation of Interventions and implementing the interventions.

REFERENCES:

Total L: 15

15OF13 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

TYPES OF SECURITY: Trading – Orders, Margin Trading – Clearing and Settlement Procedures.
SECURITY ANALYSIS: Industry Analysis – Company Analysis.
PORTFOLIO: Measuring Risk and Returns and Treatment in Portfolio Management.

REFERENCES:

Total L: 15

15OF14 IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM

INTRODUCTION – Need for Quality – Definitions of Quality – Dimensions of Product and Service Quality – Basic Concept of TQM – Contributions of Deming, Juran and Crosby – Barriers to TQM.

REFERENCES:

Total L: 15


REFERENCES:

15OF15 FINANCIAL MANAGEMENT

INTRODUCTION: Meaning of finance - Definition of financial management - Scope of Financial Management - Functions of Financial Manager. (2)

OBJECTIVE OF FINANCIAL MANAGEMENT: Profit Maximization and Wealth Maximization. (4)

CAPITAL STRUCTURE: Designing of Capital Structure - Profitability and Liquidity Aspects. (4)

DIVIDEND POLICY: Determinants of Dividends- Bonus share – Tax aspects. (3)

CORPORATE RESTRUCTURING: Merger and Acquisition (M&A) - Case Studies. (2)

REFERENCES:

15OF16 PERSONALITY DEVELOPMENT THROUGH TRANSACTIONAL ANALYSIS

EXPLORING THE PERSONALITY - Structural Ego states - Functional Ego states. (2)

MOTIVATION – Strokes Maslow’s Hierarchy of Needs. (4)

INTERPERSONAL RELATIONSHIP - Time Management – Transactions - Time Structuring. (4)

STRESS MANAGEMENT - Working Styles – Contamination. (3)

ASSERTIVENESS AND LEADERSHIP SKILLS - Life positions – Competency. (2)

REFERENCES:
15OF10 CORPORATE COMMUNICATION

1001

INTRODUCTION: Basics of Corporate Culture, Etiquette, Code governing manners and conduct, Personal Grooming, People relationship, Worthy goals/ideals. (3)

ORAL COMMUNICATION: Communicating in Organizational Settings - Recognizing effective Communication - Mastering Listening and Nonverbal Communication Skills - Overcoming Barriers to Communication - Communicating in Teams and adapting to Cross Cultural Communication contexts. (4)

WRITTEN COMMUNICATION: Planning, Writing, and completing business messages - Writing messages for Electronic Media - Creating effective E-mail messages - Writing routine and positive and negative messages - Writing persuasive messages – Training on writing Reports and proposals – Mastering the Format and layout of Business Documents. (5)

Presentation and Negotiation Skills. (3)

Total: 15

REFERENCES:

15OF11 - INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION

1001

UNDERSTANDING ORGANIZATIONAL COMMUNICATION: Communication Networks in an Organization; Intra-organizational communication; Inter-organizational communication; Flow Nomenclature; Workplace diversity and intercultural aspects of communication (4)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS: Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION: Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS: Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence. (4)

Total L: 15

REFERENCES:

15OF12 – HUMAN VALUES THROUGH LITERATURE

1001


DRAMA: Karnad, Girish, Tughlaq – Statesmanship and friendship (3)

ONE-ACT PLAY: Chekhov, Anton. The Bear – Love (1)

SHORT STORY: Maugham, Somerset. “Mr. Know-All” – Empathy, Desai, Anita. “Devoted Son” – Family Bond. (2)

NOVEL: Murthy, Sudha. Gently Falls the Bakula – Gender equality (2)

Total L: 15 hrs
REFERENCES:
3. Additional readings on individual texts

OFFERED BY THE DEPARTMENT OF MATHEMATICS

15OF21 PRINCIPLES OF BUSINESS ANALYTICS

PREDICTIVE ANALYTICS: CLASSIFICATION AND DISCRETE CHOICE PROBLEMS: Simple linear regression - multiple linear regression model development and diagnostics - analysis of transactional data using binary logistic and multinomial logistic regression models - discrete choice models, non-linear regression. Classification Trees, Classification and Regression Tree (CART) - forecasting.


Total L: 15

REFERENCES:
15M100 INDUSTRIAL TRAINING I

MODULE 1 – INTRODUCTION TO INDUSTRIAL ENVIRONMENT AND PRACTICES: Definition of Industry, types of industry – product, process, hybrid, different scale of operations, large, medium, small, tiny industry definitions and examples. Organization structure and different departments and functions within an industry. Equipment and personal industrial safety (general and electrical) and discipline of outside industries.

(10)

MODULE 2 – DRAWING PRACTICE – Freehand sketches and 2 view pictorial drawings of machines, accessories, various industrial components. Identification of electrical and electronics schematic symbols, block diagrams, Understanding of Engineering materials, processes and cutting tools used, with examples of basic engineering drawings and symbols.

(20)

MODULE 3 – SIMPLE ASSEMBLY & DISMANTLING – Different hand tools used for taking apart (dismantling) and putting back together (assembling) of various assemblies and sub-assemblies. Sketch and measure the individual components as needed. Use of various hand tools needed for doing this. Dismantle and study functioning of a simple equipment like electrical iron box / ceiling fan / TV, bicycle, Tubelight, and understand the various operating mechanisms. Understand the application areas of these assembly units within the industry.

(10)

MODULE 4, 5 – BASIC METROLOGY AND BASIC ENGINEERING MATERIALS – Use of simple measuring instruments and gauges like vernier callipers, micrometer, height gauge, preparation of production drawing. Ferrous and non ferrous metals, non metallic materials, alloys, polymers, ceramics, composites.

(20)

MODULE 6 – INTRODUCTION TO STANDARD SPECIFICATIONS AND BASIC MACHINE ELEMENTS – Understand how to specify various electrical parameters like ampere rating, voltage rating, Hp rating. Understand how to specify various engineering components like bolts, nuts, washer, keys, springs, circlips, screws, fasteners, rivets, bearings, gears, couplings, oring, sealants, ball screws, belt drives.

(10)

MODULE 7,8,9- MANUFACTURING PROCESS– Various machining processes, Usage of requisite hand tools like hand drill, tapping attachment, sheet metal bending, filing, milling, Toolroom lathe etc. to fabricate a simple component. Understanding of fundamental foundry processes and practices – melting, pouring, pattern making, machining, testing and inspection.

(30)

MODULE 10, 11 - MACHINE TOOLS – Lathe, drilling machine, milling machine, boring machine, tool cutter grinder.

(20)

MODULE 12, 13 – SIMPLE PROCESS DRAWING – Reading and understanding a basic process drawing and stage drawing.

(20)

MODULE 14 - INDUSTRIAL SAFETY- Procedures, equipments, safety programme, safety standards, OSHA act, first aid, safety symbols.

(10)

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests.

(10)

TEXT BOOKS:

REFERENCES:

15M200 INDUSTRIAL TRAINING II

MODULE 1, 2 – INTRODUCTION TO MOTOR PARTS MANUFACTURING:
Components List, Component drawing and function. Stator fabrication, Rotor fabrication (Die-casting), Rotor balancing, Winding, Insulation used and its class, Varnishing, End connection, Painting, Inspection, Packing and Finishing. Parts list, Materials, Machines used, Sequence of Operations done, Measuring instruments and gauges used.

(20)

MODULE 3, 4 – INTRODUCTION TO MONOBLOCK PUMP PARTS MANUFACTURING:
Types, Components List, Component drawing and Function Painting, Inspection, Packing and Finishing Parts list, Materials, Machines used, Sequence of Operations done, Measuring instruments and gauges used.

(20)

MODULE 5, 6 – INTRODUCTION TO SUBMERSIBLE MOTOR PARTS MANUFACTURING:
Components List, Component drawing and Function. Stator fabrication, Rotor fabrication, Rotor balancing, Winding, Insulation used and its class, End connection, Painting, Inspection, Packing and Finishing. Parts list, Materials, Machines used, Sequence of Operations done, Measuring instruments and gauges used.

(20)
MODULE 7, 8 – INTRODUCTION TO SUBMERSIBLE PUMP PARTS MANUFACTURING: Types, Components List, Component drawing and Function, Impeller balancing, Painting, Inspection, Packing and Finishing Parts list, Materials, Machines used, Sequence of Operations done, Measuring instruments and gauges used.

MODULE 9 – MOTOR ASSEMBLY: Assembly drawing of Induction motor and Submersible motor.

MODULE 10 – PUMP ASSEMBLY: Assembly drawing of monoblock pump, submersible monoblock pump and submersible pump sets.

MODULE 11 - SIMPLE MECHANISMS - Methods of converting rotary motion into translatory motion – putting together simple models and devices.

MODULE 12 - POWER TRANSMISSION - Basics of power transmission elements (Belt drive, Chain drive, Gear drive, Shaft with coupling and their types).

MODULE 13- FOUNDRY PRACTICES- understanding of fundamental foundry processes and practices – melting, pouring, pattern making, machining, testing and inspection.

MODULE 14 – HEAT TREATMENT PROCESS – Induction hardening, surface hardening, annealing, normalizing, flame hardening Brinell hardness testing machine.

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests.

Total : P: 150

TEXT BOOKS:

REFERENCES:

15M300 INDUSTRIAL TRAINING III

MODULE 1 – V- BELTS and V - PULLEYS: V belts and pulleys for given power and velocity ratio, timing belts, V belts of 3V and 5V types - specification of V belts

MODULE 2 – POWER SCREWS: Forms of threads, force analysis, trapezoidal thread, design of power screws (for screw jack, lathe etc.), selection of ball screws.

MODULE 3 – GEARS: Types of gears, application of gear, gear boxes, procedure of cutting gears and obtainable quality in hobbing and gear shaping, cutter selection and work holding methods, rack milling machine.

MODULE 4 – GEAR MATERIALS: Properties of gear materials, ferrous and non ferrous, selection of material for power transmission, selection of material for worm and worm wheel, hardening by through hardening, case hardening, induction hardening, flame hardening, hardening defects.

MODULE 5 – SINGLE POINT CUTTING TOOL: Nomenclatures, types and styles, inserts tools and tool holders for CNC applications.

MODULE 6 – MULTI POINT CUTTERS: Nomenclature of drills, reamers, taps, dies, milling cutters, broaches, hobs and gear shaper cutters, grinding wheels specification and selection.

MODULE 7 – JIGS: Degrees of freedom, principles of location and clamping, principles of jig design, fool-proofing, elements of jigs, classification of jigs, design of jigs for drilling and reaming.

MODULE 8 – FIXTURES: Locators and different types of clamps, elements of fixtures, design of fixtures for milling, turning, boring, grinding operations.

MODULE 9, 10 – HYDRAULICS AND PNEUMATICS: Hydraulics : Pump and motor -type-characteristics-cylinder-type, typical construction detail-values for control of direction-values for control of direction, flow and pressure type- typical construction detail power pack element
Pneumatics: Compressor, type, selection, symbols of pneumatic element, cylinders, type, typical construction details valves, direction control, flow, pressure, typical construction details, and applications. (20)

MODULE 11,12 – CNC: Mechanical systems:- Constructional elements, structure, guideways, spindle, bearing, screw rod/ball screw, feed drive, belt, circlips, keys, pulleys, oil seals, turret, ATC, tool magazine, APC, Gcode, M code, lathe programming, machining centre programming, coolant pump, filtering equipment, Chip conveyor, Dust extraction, automatic lubrication control, door closing, safety windows, preventive, breakdown maintenance, TPM. (20)

MODULE 13, 14 – WELDING: Basics, applications of welding, types, fusion/pressure welding process, arc welding, gas welding process, TIG welding process, electrode as per Indian standards, welding defects, basic welding position and joint type, welding symbols, residual stress and distortion, design weldments, HAZ, Temperature distribution in welding, pre and post heat treatment, welding defects, remedies, destructive test, methods, NDT of weldments, advantages and disadvantages. (20)

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests. (10)

Total: P: 150

TEXT BOOKS:

REFERENCES:

15M400 INDUSTRIAL TRAINING IV

MODULE 1 – Pattern Shop: Types of Pattern, Pattern allowance-Shrinkage allowance, rapping allowance, draft allowance, Pattern Materials-properties—selection factor considered to select the pattern material-instruments and gauges used, use of Auto cast software, colour coding system of pattern, Sampling data in pattern shop. (10)

MODULE 2 – Gating System: design of gates and types of gates, Elements of gating System, Casting yield, Target, Gating ratio, Design of feeders, Feeding of metal/alloys, Casting defects-remedies. (10)

MODULE 3 - Metallurgy Of Steels: Effect of normal elements and alloying elements in steels. Compositional aspects and properties of alloy steels. (10)

MODULE 4 - SOLIDIFICATION OF METALS AND ALLOYS: Solidification of castings, Effect of moulding material, Rate of solidification. Shrinkage of castings and directional solidification. (10)


MODULE 6 – Core Shop: Core, Types of core, Core Material, and properties, Core Reinforcement, Core Print, Core Balancing, Cold box, Core Shooter, Core Making Process (Oil core, CO2 core, NH3 Core). (10)

MODULE 7 – Melting: Alloys used in foundries, Foundry practices for Cast Iron, SG iron and Ni-hard iron, Selection of Furnaces, Pouring methods, Flow of molten metal inside the mould, Metal charging calculations, Charge details, Spectrometer Analysis, Slag removal, Scrap Bundling Machine, Pollution Control measures followed in melting section, Pyrometer, Ladle, Different grades of Flake Graphite (FG) iron and Spheroidal Graphite (SG) iron. (10)

MODULE 8 – Machine Moulding & Heavy Moulding: Moulding Process, Sand Mould Making procedures, Chills, Chill materials, Chaplets, Insulating Sleeves, Exothermic sleeves, Box Clamping methods, Resin moulding, Brand names of oils and other additives. (10)

MODULE 9 - Sand flow process (DISA Sand Plant) and automated machine moulding - : Sand Flow Process, Automated Mould Making procedures (10)

MODULE 11, 12 – Shot Blasting, Fettling, Machine Shop: Shot Blasting Machine, Door Opening and Closing Mechanism, Component Loading Bin, Hanger rotating Mechanism, Impellar, Steel Balls and Sand Dust Separation System, Machine Specification. Gate Cutting Machine, Types of Grinding, Painting, Preparation for Painting, Thinner, Primer, Paint mixing, Spray Gun, Compressor, Air Pressure, Brush Painting VS Spray Painting, Machining the casting components. (20)

MODULE 13, 14 – CASTING DEFECTS: Identification, analysis and Remedies of actual production defects. (20)

MODULE 15 – ASSIGNMENT TOPICS and GENERAL EVALUATION - Viva, student presentations, and tests. (10)

Total : P: 150

TEXT BOOKS:

REFERENCES:

15M500 INDUSTRIAL TRAINING V

MODULE 1 – Standards and Specifications - BIS specification for motor and pumps sets- list of testing instrument- function-foot mounting- motor dimensions as per IS :1231- Importance of name plate and identification of name plate detail- trouble shooting of induction motor. (10)

MODULE 2,3,4,5 – Testing - Type of routine test of induction motor as per IS: 7538 (performance calculation) - measuring of stator resistance –High voltage test- measurement of insulation resistance- reduced voltage test-no load test-full load test –locked rotor test-starting torque and starting current- pull up torque-momentary over load test- temperature rise test- pump performance test calculation- OCC curve. (40)


MODULE 7 , 8 - Fits and tolerances between components- geometrical dimensioning and tolerancing- MMC, LMC, true position tolerance-projected tolerance zone, fixed and floating fastener zone- pattern location- tolerance zone frame work(PLTZF) -Feature relating tolerance zone form work-composite tolerance- multiple tolerance- process capability – functional gauge- form design of casing. (20)

MODULE 9,10 – Maintenance and its types - Preventive Maintenance, breakdown maintenance, TPM. (20)

MODULE 11, 12, 13, 14 - IPT Mini project. (40)

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests. (10)

Total : P: 150

TEXT BOOKS:

REFERENCE:

15M600 INDUSTRIAL TRAINING VI


MODULE 2, 3 – PROCESS CONTROL ELEMENT: Single-Minute exchange of dies - Total Productive Maintenance - Poka-Yoke (Fail Safe) - 5S (Housekeeping) – Visual controls – visual work instructions. (20)

MODULE 4, 5 – QUALITY TOOLS AND DESIGN OF EXPERIMENTS (DOE): Production process diagnosis and improvement method, histogram and Pareto analysis, cause and effect diagram, scatter diagram, applications, Introduction to DOE, orthogonal array, levels, ANOVA techniques, software use. (20)


MODULE 9, 10 – ENGINEERING APPROACHES: Taguchi methods, QFD, FMEA, Design for six sigma, DFMA, design for safety, reliability and environment, axiomatic design. 

MODULE 11, 12 – REVERSE ENGINEERING: Scanning methods, cloud points, NURBS surfaces, reengineering, tear down approach, bench marking. 

MODULE 13, 14 – DIGITAL AND PHYSICAL PROTOTYPES: Prototype development, digital prototyping, physical prototyping, rapid prototyping, assembly and testing. 

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests.

Total : P: 150

TEXT BOOKS:

REFERENCES:

15M700 INDUSTRIAL TRAINING VII

0 0 10 5

Course Contents:
The students of 7th Semester will do Internship during May, June and July as detailed below.
Industry – Can be anywhere in India or overseas.
No of working Hours - 8 hours a day or as instructed by the industry – students will strictly follow the Industry norms and timings.
The student will study the following with respect to the industry, with specific emphasis on work allocation as provided by the Industry supervisor.
Types of industry
General Evaluation of the Internship will be carried out by means of Faculty visits to Industry combined with Viva, Student Presentations, and Tests.

As this is an Industry-oriented course, students will be governed by the regulations of the Industry they are assigned to, and hence no specific Text and Reference books are prescribed.

15M800 INDUSTRIAL TRAINING VIII

0 0 10 5

Course Contents: Modules will be cyclically covered in smaller batches.
The students of 8th Semester will be deputed to various local External Industries where they will be carrying out their Training in assigned areas 3 hrs / day.
The following modules will be used to serve as a guideline only, and specific fine-tuning will be done in discussion with the concerned Industry supervisor.


MODULE 4 - Study of Purchase Department – Various activities involved – Tender procedures – documents maintained at Stores – Inventory control – Sampling methods – Rejection and acceptance certificates – Vendor development. (10)

MODULE 5 - Quality systems – TQM - ISO - BIS - House Keeping and Industrial Safety – Continuous Improvement – 5 S (10)

MODULE 6 - Power House Management systems – Transformer rating – Distribution – Utilization – Power Tariff calculations

Generator Facility – Fuel consumption – Per unit Cost - Maintenance and servicing of Generator. (10)

MODULE 7 - Study of Software system used in the Industry – ERP – EDI- Attendance system – basic knowledge of representative software packages used within the Industry - PLC and concepts of Programming. (10)


MODULE 9 - Study of Finished Product stores – Packaging system – packaging materials – Despatch and Logistics methods

Documents required during the above procedures – Study of Export and Import procedures. (10)

MODULE 10 - Sales and Marketing – Pre Sales and post sale activities – Product Promotion methods – Advertisements and Brand Image. (10)

MODULE 11,12 – Supervisory aspects of the Industry – report preparation and understanding of Management Information Systems – managing multiple lines and work allocation – line balancing and capacity planning. (20)


General Evaluation of the External Industries Training will be carried out by means of Faculty visits to Industry combined with Viva, Student Presentations, and Tests.

MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests. (10)

Total : P: 150

As this is an Industry-oriented course, students will be governed by the regulations of the Industry they are assigned to, and hence no specific Text and Reference books are prescribed.

15M900 INDUSTRIAL TRAINING IX

Course Contents: Modules will be cyclically covered in smaller batches if needed, depending on the module and the type of teaching methodology, which will include case studies, group discussions, mock role-plays and scenarios drawn from real life.

Module 1- Managerial Skills: Managerial Roll, Skill, Decision making, Organizational structure, Goal setting, Planning, Org-development, Training & Development, Team Work. (10)


Module 3 - Generating & creating innovative ideas: Creativity process – Creative individuals - & basic character – Creative problem solving – innovative idea. (10)

Module 4 - SWOT analysis: Meaning- strength-Weak-Opportunity-Threat. -Model –Exercise. (10)

Module 5 - Executive Skills: Trust building – Communication – Co-operative – Understanding issues – giving solution to problem – influence & inspire - develop team management. (10)


Module 11 - Stores & inventory mgmt: EOQ, lot size, make or buy decision – stores management – types of material handling system – ABC – VED – HMC – FSN and SDE analysis.


MODULE 15 – ASSIGNMENT TOPICS and General Evaluation - Viva, student presentations, and tests.

TEXT BOOKS:

REFERENCES: