# DR. A P J ABDUL KALAM UNIVERSITY,

# INDORE

## SYLLABUS

*of*

## BACHELOR OF ENGINEERING

## Mechanical Engineering

## (Second Year 3rd Semester, Grading System)

# DR. A P J ABDUL KALAM UNIVERSITY, INDORE

## Syllabus for Bachelor of Engineering

## Mechanical Engineering

### List of Subject (Second Year (III SEMESTER), Grading System)


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## Material Science

**Objectives :**
The course introduces several advanced concepts and topics in the rapidly evolving field of material science. Students are expected to develop comprehension of the subject and to gain scientific understanding regarding the choice and manipulation of materials for engineering applications.

**Outcomes :**
1. To acquire basic understanding of advanced materials, their functions and properties for technological applications.
2. To emphasize the significance of materials selection in the design process
3. To understand the principal classes of bio-materials and their functionalities in modern medical science
4. To get familiarize with the new concepts of Nano Science and Technology
5. To educate the students in the basics of instrumentation, measurement, data acquisition, interpretation and analysis

**Unit: 1 Crystal Atoms of Solid:** Structure of atom binding in solids metallic, space lattice and crystal system arrangement of atoms in BCC, FCC and HCP crystal. Mechanical , Electrical , thermal , Magnetic & optical Properties of materials
Types of materials .

**Unit: 2 Plastic deformations of metals**: Point and line defects in crystals, their relation to mechanical properties, deformation of metal by slip and twinning, stress strain curves of polycrystalline materials ,Cold and hot working of metals and their effect on mechanical properties
.

**Unit: 3 Alloy Formation and Binary diagram:** Phase in metal system solution and inter-metallic compounds. Hume-Rottery's rules, solidification of pure metals and alloy equilibrium diagrams of iso-morphous, eutectic, peritectic and eutectoid system Iron carbon equilibrium diagram.

**Unit: 4 Heat treatment of Alloys**: Principles of heat treatment of steel TTT curves Heat treating processes, normalizing, annealing and spherodizing, hardening, tempering, Case hardening aus-tempering, mar-tempering, precipitation
hardening process with reference to AI, Cu alloys.

**Unit: 5 Engineering Materials & their applications :** Ferrous & Non ferrous metals , base alloys, bronze brasses and Duralumin. Study of Advanced materials: Shape memory alloys, Carbon nano tubes, composite materials, Smart materials Powder Metallurgy: Property and application of powder metallurgy, various processes and methods of making products by powder metallurgy techniques. Polymers & Plastics ,their properties & applications in engineering Refractory materials .

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References:**


1. Narula GK, KS and Gupta VK; Material sciemce; Mc Graw Hill Education
2. Askeland , Essentials of Materisl Science & Engineering CENGAGE Learning .
3. R Balasubramaniam , Callister's Material Science ,Wiley Students edition
4. James F Shackelford ;Introduction to Material Science for Engineers PEARSON, Sixthedition.
5. Raghavan V; Material science and Engineering, PHI Publication.
6. Sriniwasan R; Engineering materials and Metallurgy;
7. Agarwal BK Introduction to Engineering Materials , Mc Graw Hills

| Sub Code : ME-302 T | Sub Name : Strength of Materials | Credit: 3 |
|---|---|---|

## Strength of Materials

**Objectives :**

To familiarize the students with the fundamentals of deformation, stresses, strains in structural elements.

**Outcomes :**

At the completion of this course, students should be able to

1. Know the concepts of stress and strain.

2. Analyze the beam of different cross sections for shear force, bending moment, slope and deflection. 3. Understand the concepts necessary to design the structural elements and pressure vessels.

**Unit: 1 Stress and strain**: stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fiber reinforced composite materials, strain energy under axial loads and stresses due to impact of falling weights. Transformation of stress and strain, principal stresses, normal and shear stress, Mohr's circle and its application to two and three dimensional analysis .

**Unit: 2 Bending:** pure bending, symmetric member, deformation and stress, bending of composite sections, eccentric axial loading, shear force and BM diagram, relationship among load, shear and BM, shear stresses in beams, strain energy in bending, deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

**Unit: 3 Torsion in shafts**: Tensional stresses in a shafts, deformation in circular shaft, angle of twist, stepped and hollow transmission shafts .

**Unit: 4 Theories of failures**: maximum normal stress & shear stress theory; maximum normal and shear strain energy theory; maximum distortion energy theory; application of theories to different materials and loading conditions .

**Unit: 5 Columns & struts** : stability of structures, Euler's formula for columns with different end conditions, Rankine's formula.

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References**:


1. Beer FP, Johnson Mechanics of Materials ,Sixth Edition ;Mc Graw Hills
2 Debabrata Nag & Abhijet Chanda :Strength of Materials : Wiley
3 Rattan; Strength of materials;Second Edition , Mc Graw Hills
4. Nash William; Schaum's Outline Series; forth Edition Strength of Materials;Mc Graw Hills
5. Singh Arbind K; Mechanics of Solids; PHI
6. Sadhu Singh; Strength of Materials; Khanna Pub.
7 R Subramannian , Strength of materials OXFORD University Press ,Third Edition.
8 S Ramamurthum , Strength of materials , Dhanpat Rai

**List of experiments :**

1. Standard tensile test on MS and CI test specimen with the help of UTM
2. Direct/ cross Shear test on MS and CI specimen
3. Transverse bending test on wooden beams to obtain modulus of rupture
4. Fatigue test
5. Brinell Hardness tests
6. Vicker hardness test
7. Izod/Charpy test
8 Rockwell Hardness test

## Theory of Machines & Mechanisms

**Objectives :**
To expose the students to learn the fundamentals of various laws governing rigid bodies and its motions.

**Outcomes :** At the completion of this course, students should be able to know

1. Basic mechanisms, velocity and acceleration of simple mechanisms
2. Drawing the profile of cams and its analysis
3. Gear train calculations , Gyroscopes
4. Inertia force analysis and flywheels
5. Balancing of rotating and reciprocating masses

**Unit: 1 Mechanisms and Machines:** Links, Pairs, Chains, Structure, Mechanism, Machine, Equivalent linkage, Degrees of freedom, Gruebler's & Kutzback's criterion, Inversions of four bar chain, Mechanism with lower pairs Pantograph, Straight line motion mechanisms, Davis and Ackermann's steering mechanisms, Hooke's joint, Numerical problems based on above topics..

**Unit: 2 Motion:** Plane motion, Absolute & Relative motion, Displacement, Velocity and Acceleration of a point, Velocity and Acceleration Analysis by Graphical & Analytical methods, Velocity image, Velocity of rubbing, Kennedy's Theorem, Acceleration image, Acceleration polygon, Coriolis acceleration component, Klein's construction, Velocity and Acceleration Analysis using Complex Algebra (Raven's Approach), Numerical problems based on above topics

**Unit: 3 Gears:** Classification of gears, Helical, Spiral, Bevel, Worm and Spur Gear, Spur Gear Terminology, Law of gearing, Tooth profiles, , velocity of sliding, Path of contact, Arc of contact, Contact Ratio, Interference and Undercutting, , Conjugate action, Numerical problems based on above topics

**Gear Trains :** Simple, compound, reverted and epi cyclic gear trains . Velocity ratio and torque calculation in gear trains

**Unit: 4 Cams:** Classification of Cams and Followers, Radial Cam Terminology, Analysis of Follower motion (uniform, modified uniform, simple harmonic, parabolic, cycloidal), Pressure Angle, Radius of Curvature, Cam Profile for radial and offset followers Synthesis of Cam Profile by Graphical Approach, Cams with Specified Contours.

**Unit: 5 Gyroscope:** Gyroscopic Action in Machines, Angular Velocity and Acceleration, Gyroscopic torque/ couple, Gyroscopic effect on Naval Ships, Stability of Two and Four Wheel Vehicles, Rigid disc at an angle fixed to a rotating shaft.

**Belt Rope & Chain Drive** : Types of Belts, Velocity ratio of a belt drive, Slip in belts, Length of open belt and crossed belt, Limiting ratio of belt-Tensions, Power transmitted by a belt,

Centrifugal tension, Maximum tension in a belt, Condition for maximum power transmitted, Initial tension in a belt, Creep in belt, Applications of V-Belt, Rope and Chain drives.

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**Reference :**

1. Thomas Bevan; Theory of Machines; Pearson Education
2. Rattan SS; Theory of machines; MC Graw Hills

3. Ambekar AG; Mechanism and Machine Theory; PHI. Eastern Economy Edition 2015

4 Uicker & Shigley, Theory of machines & Mechanism Second Edition Oxford University Press

4 Dr.Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi
5 Rao J S and Dukkipati; Mechanism and Machine Theory; New Age Delhi.
6 .Abdulla Shariff , Theory of Machines .

**List of Experiments:**

1 To finds out gyroscopic couple .

2 To Find out velocity & acceleration of slider crank mechanism by Klin"s Construction

3 To find out velocity ratio of various gear trains

4 To study various types of belt drives & find out the velocity ratio of the drive .

5 To Draw the cam profile .

6 Study of working models of various popular mechanisms like quick return mechanism etc .

7 .To draw Involute profile of a gear by generating method .

8.Study of the mechanisms like Pantograph mechanism , Davis & Ackerman's steering mechanisms etc .

## Thermodynamics

**Objectives** : To develop ability and gain insight into the process of problem-solving, with emphasis on thermodynamics .Specially in following manner:
· apply conservation principles (mass and energy) to evaluate the performance of simple engineering systems and cycles, · evaluate thermodynamic properties of simple homogeneous substances, · analyze processes and cycles using the second law of thermodynamics to determine maximum efficiency and performance, · discuss the physical relevance of the numerical values for the solutions to specific engineering problems and the physical relevance of the problems in general, and · critically evaluate the validity of the numerical solutions for specific engineering problems.

**Outcomes :** At the completion of this course, students should be able to
1. find values of thermodynamic properties in tables;
2. draw thermodynamic processes on pressure-temperature, pressure-volume, or temperature-volume diagrams;
3. use compressibility charts;
4. calculate expansion or compression work in a closed system;
5. use conservation of mass to determine the change in mass of a system

**Unit: 1 Basic Concepts :** Basic concepts: Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Heat and work transfer.

**Unit: 2 Law's of thermodynamics**- First law of thermodynamics first law applied to various systems steady flow process, limitations of first law of thermodynamics.
Second law of thermodynamics, heat engine, heat reservoir, Refrigerator, heat pump, Carnot's cycle, statements of second law Reversible and irreversible processes, consequence of second law, Clausious
Inequality , Entropy, T-S diagrams, Available & Unavailable energy Availability Concept .

**Unit: 3 Properties of Steam :** Pure Substance, Phase, Phase-transformations, formation of steam, properties of steam, PVT surface, HS,TS,PV,PH,TV diagram, processes of vapor measurement of dryness fraction, Use of steam tables and Mollier chart.

**Unit: 4 Air standard cycles**: Carnot, Otto, Diesel, Dual cycles and their comparison, Brayton cycle, Non reactive gas mixture, PVT relationship, mixture of ideal gases, properties of mixture of ideal gases, internal energy, Enthalpy and specific heat of gas mixtures.

**Unit: 5 Fuels & combustion** : Actual & theoretical Combustion processes , Enthalpy of formation & enthalpy of reaction, first law analysis of reacting systems, Adiabatic flame temperature , Basic concept of Third Law of thermodynamics .
Steam Tables Mollier Charts & tables connected to reactive systems are allowed in Examination hall.

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References:**

1. P.K.Nag; Engineering Thermodynamics; Mc Graw Hills Fifth Edition
2 Cengel Y; Thermodynamics; MC Graw Hills ,Eight Edition
3 Kross & Potter Thermodynamics for Engineers CENGAGE Learning
4 Moran, Shapiro ,Boettner Principles of Engineering Thermodynamics Wiley student edition
5 P Chattopadhya , Engineering Thermodynamics Second Edition,OXFORD University Press
5 Zemansky Heat & Thermodynamics , Eight Edition , Mc Graw Hills India Education
6. Achuthan M; Engineering Thermodynamics by, PHI India.
7 R Yadav Applied Thermodynamics , Central Publishing house Allahabad

## Manufacturing Process

**Objectives :**
To make the students aware of different manufacturing processes like casting, metal forming, metal cutting and gear manufacturing.

**Outcomes :**
1. Concepts of casting Technology.
2. Mechanical working of metals.
3 Concepts of welding process
4 Concept of forging methods
5 Understanding press working .

**Unit: 1 Casting :** Types of casting process **.**Molding and Foundry core sands and their properties, gating, runners, risers, solidification, defects and elimination, molding machines, centrifugal casting, dye casting, shell molding; Lost wax molding; continuous casting; cupola description and operation.

**Unit: 2 Welding:** Types of welding ,Gas welding method, flames, gas cutting, Electric arc welding, AC and DC welding machines and their characteristics, flux, electrodes, submerged arc welding, TIG & MIG welding; pressure welding; electric resistance welding spot, seam and butt welding; Thermit chemical welding; brazing and soldering, welding defects & remedies .safety precautions .

**Unit: 3 Pattern Making**: Types of patters, Pattern and pattern making, pattern allowances; pattern design considerations, core, core boxes .

**Unit: 4 Forging:** types of forging operations Theory and application of forging processes description, drop and horizontal forging machines .

Press working Description and operation of processes, process of shearing, punching, piercing, blanking, trimming, perfecting, notching, lancing, embossing, coining, bending, forging and drawing; press, tool dies, auxiliary equipment, safety devices, stock feeders, scrap cutters, forces, pressure and power requirements .

**Unit: 5 Rolling**: Types of Rolling operations ,General description of machines and process; rolling of structural section plates and sheets; hot and cold rolling techniques

Metal Machining Basics of Lathe machines , operations & components ,working principle of Shaper & planner ,Introduction to milling ,grinding and drilling machines .

**List of Experiments :**
1. Study of tools used for various manufacturing processes , study includes application & live demonstration of hand and machine tools .
2. Hands on Exercise on Pattern Making
3. Performance on Metal Casting of Simple component
4. Performance on Welding of simple work piece (Example Arc and Resistance Welding)
5. Exercise Problems on Welding
6. Exercise problems on Casting
7 Study of forging machine & demonstration of various operations of forging .
8 Study of Hydraulic ,Pneumatic presses & demonstration of piercing, slitting, deep drawing operations on press machine .

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References:**

1. Anderson and Tetro; Shop Theory; Mc Graw Hills
2. Kaushish JP; Manufacturing Processes; PHI Learning.
3 Kalpakjian Producting Engineering PEARSON Education
4. Chapman; Workshop Technology
5. Philip F Ostwald ; Manufacturing Process & systems : John Wiley
6. Raghuvanshi; Workshop Technology ; Dhanpat Rai.
7 Hajra Choudhary; Workshop Technology:, Vol I

## Communication Skills

**Unit: 1** Introduction: Communication, definition and role of communication.

**Unit: 2** Process of communication, Importance of professional communication,

**Unit: 3** Levels of communication, Types of communication, Challenges in communication.

**Unit: 4** Non –verbal communication – Body language, personal appearance, posture, gesture and hand movement, eye contact, facial expressions, paralinguistic features - proxemics, haptics, chronemics. .

**Unit: 5** Oral presentations. Case studies.

**Books recommended:**

1. Business Communication, Mc Graw Hill Education, Matthukutty M. Monippally.
2. Effective Business Communication , Mc Graw Hill Education, Neera Jain, Shoma Mukherji.
3. Technical Communication , Cengage , P. Subba Rao, B. Anita Kumar, C. Hima Bindu.
4. Business Correspondence & Report Writing , Mc graw Hills. , R.C. Sharma & Krishna Mohan .
5. Technical Communication – Principles & Practice , Oxford , Meenakshi Raman.
6. Business Communication- Mc graw Hills , Peter Cordom.
7. Communication Skills , Oxford , Sanjay Kumar & Pushpa TMH.
8. Effective Technical Communication , M. Ashraf Rizvi ,Mc Graw Hill Education.

## Language Lab II

Module 1 : Reading comprehension
Module 2 : Role plays
Module 3 : Debate
Module 4 : Group discussion
Module 5 : Resume writing
Module 6 : Interview skills
Module 7 : Body language
Module 8 : Oral presentations

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# SYLLABUS

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## BACHELOR OF ENGINEERING

## Mechanical Engineering

## (Second Year - 4th Semester), Grading System)

# DR. A P J ABDUL KALAM UNIVERSITY, INDORE

## Syllabus for Bachelor of Engineering

## Mechanical Engineering

### List of Subject (Second Year (IV SEMESTER), Grading System)


| S. No. | Subject Code | Subject name | Page No. |
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| 2 | ME-402 T | Machine Drawing & CAD | 5 |
| 3 | ME-403 T | Energy Conversion | 7 |
| 4 | ME-404 T | Machine Design-I | 9 |
| 5 | MA-220T | Mathematics-III | 11 |
| 6 | ME-405 T | Engineering Tribology | 12 |
| 7 | HU-223 P | NSS/NCC | 14 |
| 8 | ME-401 P | Fluid Mechanics | - |
| 9 | ME-402 P | Machine Drawing & CAD | - |
| 10 | ME-403 P | Energy Conversion | - |
| 11 | ME-406 P | Creo Parametric | - |

## Fluid Mechanics

**Objectives :**
To be familiar with all the basic concepts of fluids and fluid flow phenomenon, conservation equations and their applications to fluid flow problems.
**Outcomes : :** At the completion of this course, students should be able to
. understand the properties of the fluid.
. understand and solve the fluid flow problems.
understand the mathematical techniques of practical flow problems.
. understand the energy exchange process in fluid machines.

**Unit: 1 Fluid Static's** : Review of Basic concepts &properties of the fluid . Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, manometers, Forces on plane and curved surfaces ; buoyant force, Stability of floating and submerged bodies, Relativeequilibrium.

**Unit: 2 Kinematics of Flow :** Types of flow-ideal & real , steady & unsteady, uniform & non-uniform, one, two and three dimensional flow, path lines, streak-lines, streamlines and stream tubes; continuity equation for one and three dimensional flow, rotational & irrotational flow, circulation, stagnation point, separation of flow, sources & sinks, velocity potential, stream function, flow net & its applications , method of drawing flow nets.

**Unit: 3 Dynamics of Flow:** Euler's equation of motion along a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, energy correction factor, linear momentum equation for steady flow; momentum correction factor. The moment of momentum equation, forces on fixed and moving vanes and other applications. Fluid Measurements: Velocity measurement ( Pitot tube, current meters etc.); flow measurement (orifices, nozzles, mouth pieces, orifice meter, nozzle meter, venturi-meter, weirs and notches).

**Unit: 4 Dimensional Analysis** : Dimensional analysis, dimensional homogeneity, use of Buckingham-pi theorem, calculation of dimensionless numbers
**Flow through Pipes :** Reynolds experiment & Reynolds number, laminar & turbulent flow, Introduction to Navier Stokes' Equation, relation between shear & pressure gradient, laminar flow through circular pipes, friction factor, laminar flow between parallel plates, hydrodynamic lubrication

**Unit: 5 Introduction to boundary layer**, Boundary layer development on a flat plate and its characteristics - Boundary layer thickness, displacement thickness, momentum thickness, energy thickness. Momentum equation for boundary layer by Von karman, drag on flat plate, boundary layer separation and its control. Aerofoil theory, lift and drag coefficients, streamlined and bluff bodies.

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References: -**

1.Streeter VL, Wylie EB, Bedford KW; Fluid Mechanics; Mc Graw Hills
2FOX , McDonald Pritchard , Fluid Mechanics Wiley students edition
3. White ; Fluid Mechanics ; Mc Graw Hills
4. Cengal; Fluid Mechanics; Mc Graw Hills
5 R Mohanty; Fluid Mechanics; PHI
6 K L Kumar Fluid Mechanics
7 Fluid Mechanics & hydraulic Machines , Modi & Seth
8 CS Jog , Fluid Mechanics Volume II CAMBRIDGE IISc Series , Third Edition

**List of Experiments** :

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Orifice meter and Venturi meter
4. Determination of Cc, Cv, Cd of Orifices
5. Calibration of Nozzle meter and Mouth Piece
6. Reynolds experiment for demonstration of stream lines & turbulent flow
7. Determination of meta-centric height
8. Determination of Friction Factor of a pipe
9. To study the characteristics of a centrifugal pump.
10. Verification of Impulse momentum principle.

## Machine Drawing & CAD

**Objectives :**
To enable the students to prepare a detailed assembly drawing for machine components.

**Outcomes :**
1. Understand Indian standards for machine drawing.
2. Understand Fits and Tolerances in technical drawing.
3. Prepare assembly drawing of joints, couplings and machine elements.
4. Design and prepare Jigs and fixtures for given components.

**Unit: 1 Drawing conventions**; IS codes, sectional views and sectioning, surface finish and tolerances representation of machine parts such as external and internal threads, slotted heads, square ends, and flat radial ribs, slotted shaft, splined shafts, bearings, springs, gears, Rivet heads and Riveted joints, Welded joints, Drawing of Threaded fasteners .

**Unit: 2 Assembly Drawing :** Assembly Machine Drawing ,Basic concept of assembly drawing ,bill of materials, Assembly drawing of Cotter and Knuckle joints, pedestal and footstep bearings, Engine parts- crosshead and stuffing box, IC engines parts - piston and connecting rods; lathe machine parts-Tool post and Tail Stock.

**Unit: 3 CAD** : software and hardware required to produce CAD drawings Software: operating systems; CAD software packages e g AutoCAD, AutoCAD/Inventor, Micro station, Catia, Pro/ENGINEER, Solid works; minimum system requirements. Preparing & interpreting CAD drawing, orthographic projections; Commands: absolute/relative/polar coordinates; features eg line types, grids, snaps, circle, text, hatching, dimensioning, layers/levels, colour; viewing e g zoom, pan; inserting other drawings e g symbols, blocks; modifying e g copy, rotate, move, erase, scale, chamfer, fillet Interpret: determine properties of drawn objects e g list, distance, area, volume use CAD software to produce 2D & 3D assembly drawings and views.

**Unit: 4 3D environment**: 3D views e g top, front, side, isometric 3D models: 3D techniques e g addition and subtraction of material, extrude, revolve, sweep, 3D coordinate entry (x, y, z), wire frame drawing, 2D to 3D (thickness, extrusion); surface models; solid.

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References**:

1. Bhatt, ND; Machine Drawing; Charotar Publication
2. K C John ,Machine Drawing , PHI
3. Singh A; Machine Drawing; TMH publication
4. Narayana and Reddy; Machine Drawing; New age, Delhi.
5. Shigley JE et al; Mechanical Engineering Design, TMH

**List of Experiments**:

Assembly Drawing and design problem as per given syllabus

## Energy Conversion

**Objectives :**
On completion of this course, the students are expected to understand the fundamental principle, operation, performance of IC Engines, auxiliary systems, combustion of SI & CI engines, various fuels used and engine emissions.

**Outcomes :**
Acquire the knowledge of engine components and fuel air cycles
.Understand the working of engine auxiliary systems.
Understand the combustion aspects of SI Engines
Understand the combustion aspects of CI Engines.

**Unit: 1 Internal Combustion Engine:** S.I. and C.I. engines of two and four stroke cycles, real cycle analysis of SI and CI engines, determination of engine dimensions, speed, fuel consumption, output, mean effective pressure, efficiency, factors effecting volumetric efficiency, heat balance, performance characteristics of SI and CI engines, cylinder arrangement, firing order, power balance for multi-cylinder engines .

**Unit: 2 Combustion in SI engines:** Flame development and propagation ,Pressure-Crank Angle diagram, Stages of Combustion ignition lag, effect of air density, temperature, engine speed, turbulence and ignition timings, physical and chemical aspects , abnormal Combustion , effect of engine and fuel variables on abnormal combustion , pre-ignition, its causes and remedy, salient features of various type combustion chambers.

**Unit: 3 Combustion in C.I. Engines:** Times base indicator diagrams and their study, various stages of combustion, delay period, diesel knock, knock inhibitors, salient features of various types of combustion chambers .

**Unit: 4 I.C. Engine System:** Fuels, ignition systems, cooling, exhaust/scavenging and lubrication system. Fuel metering in SI engine: Fuel injection in SI engine (MPFI, TBI,CRDI ), Theory of carburetion, Solex Carburetor, simple problems on carburetion. Fuel metering in CI engines: Fuel injection in CI engine ,Working Principle of fuel pump & fuel injectors , types of nozzles , simple numerical problems . Cooling & lubrication of SI & CI Engines.

**Unit: 5 Supercharging & Turbo charging :** Methods of supercharging,& turbo charging Effects of super charging and turbo charging . Engine Modifications for supercharging, supercharging of two stroke engines. micro processor controlled supercharging .

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References**:

1. J.B. Heywood. Internal combustion Engines , Wiley
2. Ganeshan V; Internal Combusion engines; TMH
3. Mathur M L & Sharma RP; A. Course in IC engines; DhanpatRai
4. R Yadav , Internal Combustion Engines
5 Halderman JD and Mitchell CD; Automotive Engines theory and servicing; Pearson
6 DomKundwar; Internal Combustion Engines ; Dhanpat RaiPublications
7 Taylor GF; Internal Combustion Engines Theory & Practice; MIT Press
8 Richard Stone; Introduction to IC Engines; Society of Automotive Engr (Palgrave Mc Millan)

**List of Experiments :**

1. Determination of Valve timing diagram
2. Load test on Petrol Engine
3. Heat Balance of SI engine
4. Heat Balance of CI Engine
5. Study of Battery Ignition system and Electronic Ignition System
6. Study of Diesel fuel pump
7. Study of Diesel fuel injectors
8. Study of a Carburetors
9. Study of Fuel Injection system in SIEngine
10. Study of lubricating system in CIEngine

## Machine Design – I

**Objectives :**
To study the basic design principles and apply the principles to the design of various elements encountered in Mechanical machines and structures.

**Outcomes :**
To determine the strength of the components
To determine the failure conditions and apply them to real life Problems
To design simple joints, fasteners, levers and springs.

**Unit: 1 Mechanical Engineering design** - Design considerations, Design Procedure Material selection Modes of failure - Theories of failure , causes of stress concentration; stress concentration in tension, bending and torsion; reduction of stress concentration, theoretical stress concentration factor, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg equation, Gerber parabola, design for finite life, cumulative fatigue damage

**Unit: 2 Design of Fasteners** : Design of cotter and knuckle joints.. Fasteners and keys , Design of welded joints , Fillet and butt welds , Design of riveted joints. Design of bolted joints . Power screws .

**Unit: 3 Selection & Design of bearings** : Reynold's equation, stable and unstable operation, heat dissipation and thermal equilibrium, boundary lubrication, dimensionless numbers, Design of journal bearings, Rolling-element Bearings*:* Types of rolling contact bearing, bearing friction and power loss, bearing life; Radial, thrust & axial loads; Static & dynamic load capacities; Selection of ball and roller bearings; lubrication and sealing.

**Unit: 4 Design of Springs** : Design of helical compression & tension spring , design of leaf spring & torsion springs , fatigue loading of springs ,surge in springs ,spiral springs .

## EVALUATION

Evaluation will be continuous an integral part of the class as well through external assessment.

**References :**

1Robert C Juvinal, Kurt M Marshek Machine Component design Wiley Student edition
2 C S Sharma & Kamlesh Purohit , Design of machine elements PHI
3 Sharma & Agarwal Machine design .
4 Pandya & Shah , Charottar .
6 J E Shingley Machine design Mc Graw Hills
7 Gope P C , Machine Design , PHI Learning . 2015
8 P Kannaiah , Machine Design , SCITECH .
9 Nortan RL , Machine Design , Pearson , Fifth Edition

## Mathematics-III

### Unit I Functions of complex variables

Analytic functions, Harmonic Conjugate, Cauchy-Riemann Equations, Line Integral, Cauchy's Theorem, Cauchy's Integral Formula, Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for evaluation of real integrals.

### Unit II Numerical Solution of Algebraic and Transcendental Equations

Errors & Approximations, Solution of Algebraic & Trancedental Equations (Regula Falsi , Newton-Raphson, Iterative, Secant Method), Solution of simultaneous linear equations by Gauss Elimination, Gauss Jordan, Crout's methods , Jacobi's and Gauss-Siedel Iterative methods

### Unit III Interpolation, Numerical differentiation & Integration

Difference Operators, Interpolation (Newton Forward & Backward Formulae, Central Interpolation Formulae, Lagrange's and divided difference formulae), Numerical Differentiation and Numerical Integration.

### Unit IV Functions of Complex Variables

Solution of Ordinary Differential Equations(Taylor's Series, Picard's Method, Modified Euler's Method, Runge-Kutta Method, Milne's Predictor & Corrector method ), Correlation and Regression, Curve Fitting (Method of Least Square).

### Unit V Transformation

Fourier Transform: Definition and properties of Fourier transform, Sine and Cosine transform.

Z-transform .Testing of Hypothesis :Students t-test, Fisher's z-test, Chi-Square Method

### References:

1. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley India.
2. B.S. Grewal: Higher Engineering Mathematics , Khanna Publication.
3. Engineering Mathematics By Samnta Pal and Bhutia, Oxford Publication
4. Ramana: Advance Engg. Mathematics, TMH New Delhi
5. Numerical Methods for Engineers by Steven C. Chapra, McGraw Hill Education
6. Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Pvt. Ltd.
7. Numerical Methods By Shrimanta Pal, Oxford

System Engineering

**COURSE OBJECTIVE**

This course in systems engineering examines the principles and process of creating effective systems to meet application demands. The course is organized as a progression through the systems engineering processes of analysis, design, implementation, and deployment with consideration of verification and validation throughout.

**COURSE CONTENT**

**Unit:1** What is System Engineering, Origin, Examples of Systems requiring systems engineering,Systems Engineer Career Development Model, Perspectives of Systems Engineering, Systems Domains, Systems Engineering Fields, SystemEngineering Approaches.
Structure of Complex Systems, System Building Blocks and Interfaces, Hierarchy of Complex Systems, System Building Blocks, The System Environment, Interfaces and Interactions, Complexity in Modern Systems.

**Unit:2** Concept Development and Exploration, Originating a New System, Operations Analysis, Functional Analysis, Feasibility, System Operational Requirements, Implementation of Concept Exploration.

**Unit:3** Engineering Development, Reducing Program Risks, Requirements Analysis, Functional Analysis and Design, Prototype Development as a Risk Mitigation Technique, Development Testing, Risk Reduction.

**Unit:4** Integration and Evaluation, Integrating, Testing, And Evaluating The Total System, Test Planning And Preparation, System Integration, Developmental System Testing, Operational Test And Evaluation, Engineering For Production, Transition From Development To Production, Production Operations.

## COURSE OUTCOME

After successful completion of the course, students would be able to Plan and manage the systems engineering process and examine systems from many perspectives (such as software, hardware, product, etc.) Students can distinguish critical functions, diagnose problems, and apply descoping strategies and judge the complexity of production and deployment issues.

## EVALUATION

Evaluation will be a continuous and integral process comprising classroom and external assessment.

COURSE CONTENT

Unit:1 Introduction: Friction, Wear and Lubrication.

Unit:2 Engineering Surfaces- Properties and Measurement; Typical surface layers, Measurement Methods (Surface Profilometry, Optical Microscopy, Electron Microscopy), Surface Contact.

Unit:3 Friction: Measurement Methods, Adhesion, Deformation, Friction Theories, Stick-slip, Rolling Friction, Friction of Metals, Friction of Non-Metallic Materials.

Unit:4 Wear: Types of Wear and its Mechanisms (Adhesive Wear, Abrasive Wear, Erosive Wear, Corrosive/Oxidative Wear, Fatigue Wear), Wear of Metals, Wear of Ceramics, Wear of Polymers, Wear Test (Pin on Disc Tribometer, Reciprocating Tribometer), Wear reduction methods.

Unit:5 Lubricants and Lubrication: Lubricants and their types, Purpose of Lubrication, General Properties of Liquid Lubricants, Animal and Vegetable Oils, Mineral oils, Synthetic oils, Blended Oils, Lubricant Additives, Semi Solid Lubricant or Greases, Solid Lubricants, Testing of Lubricants (Viscometer, Four Ball Tester).

**Textbooks**

1.Engineering Tribology, Gwidon W. Stachowiak and Andrew W. Batchelor, 4 th Edition,2014

2. Tribology: Friction and Wear of Engineering Materials, Ian Hutchings and Philip Shipway, 2nd Edition, 2017

**References**

1. Introduction to Tribology, Bharat Bhushan, Wiley, 2nd Edition, 2002

2. Engineering Tribology by. Prasanth Sahoo, Prentice Hall India Learning Private Limited, 2005

3. Fundamentals of Tribology, Ramsay Gohar and Homer Rahnejat, Imperial College Press, 2nd Edition, 2012

**Part-A: Part modelling and assembly**
Module 01 Introduction to Creo 2 modelling and basic concepts.
Module 02 Using the creo 2 interface.
Module 03 Selecting and Editing.
Module 04 Sketcher geometry.
Module 005 Creating datum Features: Planes and Axes.
Module 06 Creating extrudes, Revolves and Ribs.
Module 07 Creating sweeps and blends.
Module 08 Creating holes, shells and drafts, Creating rounds, chamfers.
Module 09 Copy and mirror tools.
Module 10 Creating patterns.
Module 11 Assembling with constraints.
Module 12 Exploding assemblies.
Module 13 Using layers.
Module 14 Managing design intent.
Module 15 Resolving failures and seeking help.

**Part-B: Surface modelling**
Module 1 Surface modelling overview.
Module 2 Advance selection.
Module 3 Basic Surfacing tools.
Module 4 Helical Sweep.
Module 5 Creating and editing solids using quilts.

**Part-C Sheetmetal Design**
Module 1 Introduction to Sheetmetal design process
Module 2 Sheetmetal model fundamentals
Module 13 Creating primary and secondary Sheetmetal, Wall features
Module 4 Modifying Sheetmetal models
Module 5 Sheetmetal Bends
Module 6 Setting the Sheetmetal environment

**Part-D Detailing of Drawings**
Module 1 Introduction to drawings
Module 2 Creating new drawings and views
Module 3 Adding details to drawings
Module 14 Adding notes to drawings
Module 5 Adding tolerance and symbols
Module 6 Using layers in drawings
Module 7 Creating reports (BOM)

**Lab assignments :**

1. Design and execute a ‘C’ program for multiplying two nXn matrics.
2. Design a ‘C’ program to calculate Average of ‘n’ numbers.
3. Design a ‘C’ program to add two numbers using callby value parameter passing mechanism.

4. Design a ‘C’ program to swap the contents of two variables using call byreference parameter passing mechanism.
5. Design a ‘C’ program to open a file and add contents to modify the file