## Suggested plan of study for II Year B.E (Mechanical Engineering)

### III SEMESTER

| Sl No | Course Code | Course Title | Credits |
|---|---|---|---|
| 1 | MA200 | Engg. Mathematics III | 4 |
| 2 | ME200 | Basic Thermodynamics | 4 |
| 3 | ME201 | Basic Manufacturing Processes | 4 |
| 4 | ME202 | Material Science | 4 |
| 5 | ME203 | Strength of Materials | 4 |
| 6 | ME204 | Machine Drawing | 4 |
| 7 | ME205 | Material Science and Material Testing Lab | 1.5 |
| 8 | ME206 | Foundry & Forging Lab | 1.5 |
| **Total Credits** | | | **27** |

### IV Semester

| Sl No | Course No. | Course Title | Credits |
|---|---|---|---|
| 1 | MA250 | Engineering Mathematics IV | 4 |
| 2 | ME250 | Machine Design – I | 4 |
| 3 | ME251 | Mechanical Measurements | 4 |
| 4 | ME252 | Fluid Mechanics | 4 |
| 5 | ME253 | Applied Thermodynamics | 4 |
| 6 | ME254 | Manufacturing Technology | 4 |
| 7 | ME255 | Measurements Lab | 1.5 |
| 8 | ME256 | Machine Shop Practice | 1.5 |
| **Total Credits** | | | **27** |

**III SEMESTER**

| MA200 | ENGINEERING MATHEMATICS-III (Common to all branches) | (4-0-0) 4 |
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1) **Fourier Series** Periodic functions, Fourier expansions even and odd functions. Half range expansions, Complex form of Fourier series, Practical harmonic analysis. **6 Hrs.**
2) **Fourier Transforms:** Finite and Infinite Fourier transforms, Fourier sine and cosine transform properties. Inverse transforms. **6 Hrs.**
3) **Partial Differential Equations (P.D.E)** Formation of P.D.E, Solution of non homogeneous P.D.E by direct integration, method of separation of variables. (First and second order equations). Solution of Lagrange's linear P.D.E. of the type P p +Q q =R **6 Hrs.**
4) **Applications of P.D.E** Derivation of one dimensional wave and heat equations. Various possible solutions of these by the method of separation of variables. D'Alembert's solution of wave equation. Two imensional Laplace's equation various possible solutions. Solution of all these equations with specified boundary conditions. (Boundary value problems**).** **6 Hrs.**
5) **Numerical Methods** Numerical solutions of algebraic and transcendental equations:- Newton-Rap son and Regular- Falsi methods. Solution of linear simultaneous equations:- Gauss elimination and Gauss Jordon methods. Gauss - Seidel iterative method. Definition of eigen values and eigen vectors of a square matrix. Computation of largest eigen value and the corresponding eigen vector by Rayleigh's power method. **6 Hrs.**
6) **Numerical Methods (Continued)** Finite differences (Forward and Backward differences) Interpolation, Newton's forward and backward interpolation formulae. Divided differences- Newton's divided difference formula. Lagrange's interpolation and inverse interpolation formulae. Numerical differentiation using Newton's forward and backward interpolation formulae. Numerical Integration - Simpson's one third and three eighth's rule, Weddle's rule. (All formulae/rules without proofs). **7 Hrs.**
7) **Calculus of Variations** Variation of a function and a functional Extermal of a functional, Variational problems, Euler's equation, Standard variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistochrone problems**.** **6 Hrs.**
8) **Difference Equations and Z-transforms** Difference equations – Basic definitions. Z-transforms – Definition, Standard Z-transforms, Linearity property, Damping rule, Shifting rule, Initial value theorem, Final value theorem, Inverse Z-transforms. Application of Z-transforms to solve difference equations. **7 Hrs.**

**BOOK:**

1) Higher Engineering Mathematics by Dr. B.S. Grewal ( 36th Edition)

2) Higher Engineering Mathematics by B.V Ramana ( Tata-Macgraw Hill).
3) Advanced Modern Engineering Mathematics by Glyn Jame Pearson Education.

| ME200 | BASIC THRMODYNAMICS | (3-2-0) 4 |
|---|---|---|

1) **Introduction:** Brief review of Systems, Thermodynamic equilibrium, Reversible process, Control volume and Control surface, Ideal gas equation of state, Universal gas constant, p-v-t surface of ideal gas **2 Hrs.**
2) **Real Gases** Van der Waal's equation of state, Compressibility factor, Reduced properties, Van der Waal constants in terms of Critical properties, Law of corresponding states, Generalized compressibility chart, Beattie- Bridgeman equation. **4 Hrs.**
3) **Work and Heat** Definition of work according to mechanics and its limitation, Thermodynamics definition of work, Sign Conventions, Displacement work, expression of displacement work for various processes, Other types of work, Heat Transfer, sign convention, specific heat and latent heat, Similarities and difference between Heat and Work. **5 Hrs.**
4) **First Law of Thermodynamics** Joules experiment, Statement of First law, Extension of First law to non-cyclic processes, Internal energy as a property, Definition of Cp and Cv, Molar specific heats, Relation between Cp, Cv and R. Extension of First law to control volume, SSSF energy equation, important applications. **7 Hrs.**
5) **Second Law of Thermodynamics** Limitations of 1st law, Terminology: Heat reservoir, source, sink, direct heat engine, refrigerator and heat pump. Thermocouple as heat engine, schematic representation, Performances – efficiency of engine and COP of refrigerator and heat pump, PMM-I, PMM-II, Kelvin – Plank Statement and Clausius statement, Equivalence of the two statements, Reversible and Irreversible process, causes of Irreversible processes, Reversible heat engine, Carnot cycle, Carnot Theorem and its corollaries. **7 Hrs.**
6) **Pure Substance** Definition, 2- property rule, p-T and p-v diagrams, Triple point and Critical point, Various thermodynamic processes, Use of steam tables, Measurement of dryness fraction. **6 Hrs.**
7) **Entropy:** Clausius inequality, statement & proof, Entropy as a property, Change of entropy for various thermodynamics process of ideal gas & vapour, Principle of increase of entropy, T-s diagram, Carnot cycle on p-v, and T-s diagrams, Thermodynamic processes of vapour on T – s and H- s diagrams, use Mollier chart. **8 Hrs.**
8) **Availability and Irreversibility** Available energy, Available energy referred to a cycle, Quality of energy, Maximum work in a Reversible process, Reversible work

in a Steady flow process and in a closed system, Useful work, Dead state, Availability in steady flow and non flow processes, Irreversibility. **6 Hrs.**

9) **Mixture of Ideal Gases** Mass fraction, Mole fraction, Amagat's Law, Analysis of mixture of gases on mass basis and volumetric basis Gibbs –Dalton law, Evaluation of properties and various processes of mixture of gases. **5 Hrs.**

**BOOKS:**

1) Basic and Applied Thermodynamics by P. K. Nag, TMH Publishing Co. Ltd, New Delhi Revised and enlarged 2nd edition,2002.
2) Fundamentals of Classical Thermodynamics by Garden Van Wylen, Richard Sonntag and Claus Borgenakke, John Wiley & sons, New York,4th edition, 1997.
3) Thermodynamics Data Hand Book by Prof. B. T. Nijaguna and Prof.B.S. Samaga, KREC, Surathkal, 1995 and now published by Sudha Publishers, Avenue Road, Bangalore.
4) Engineering Thermodynamics by D. B. Spalding and E. H. Cole, ELBS / Edward Arnold (Publishers) Ltd., London 3rd edition,1973.
5) Engineering Thermodynamics with Applications by David Burghardt, Harper & Row Publishers, New York, 3rd edition, 1986.
6) Engineering Thermodynamics by R K. Rajput, Laxmi Publications (P) Ltd., Daryaganj, New Delhi – 2, 3rd edition, 2007

| ME201 | BASIC MANUFACTURING PROCESSES | (4-0-0) 4 |
|---|---|---|

1) **Foundry** Casting steps involved, pattern, pattern material types, allowances **4 Hrs.**
2) **Sand** Types, Properties core sand Ingredients in molding sand, core sand **4 Hrs.**
3) **Molding** Hand molding, machine molding, jolt squeeze machine, sand slinger, $CO_2$ molding, Shell molding, investment casting, permanent molding, semi centrifugal and centrifugal casting, continuous casting, shell molding and pit molding. **8 Hrs.**
4) **Melting furnaces** Cupola, Electric arc- direct and indirect, Induction furnace. **3 Hrs.**
5) **Casting defects**- causes and remedies. **2 Hrs.**
6) **Welding** Arc welding, TIG, MIG, SAW, Resistance welding, Thermit, Friction, explosive electron beam, Ultra sound, Laser beam welding. **7 Hrs.**
7) **Metal Forming** Plastic state of metal, Flow curve, Wrought product and cast product, Advantages and disadvantages of metal working processes, Classification of metal working based on force applied and temperature. **3 Hrs.**
8) **Forging** Open die forging, Closed die forging, Forge equipments, defects in forged products. **3 Hrs.**

9) **Rolling** Ingot, bloom, billet, slab, plate, strip, Classification of roll mill, Force & Geometry relationship, Defects in rolled products, Simplified rolling load and power. **4 Hrs.**

10) **Drawing** Draw bench, cross section of drawing die, Wire drawing, tube drawing-sinking, plug and moving mandrel, Porthole die, Mannesman mill, plug roll mill and three role piercing, Extrusion – Direct, Indirect and Impact extrusion. **5 Hrs.**

11) **Powder metallurgy** Basic steps in powder metallurgy – Production of powders, blending, compaction, sintering, pre sintering and secondary operations. **4 Hrs.**

12) **High energy rate forming** Explosive forming, Electro-hydraulic forming, electro-magnetic forming. **3 Hrs.**

**BOOKS:**

1) Manufacturing Technology: Foundry Farming and Welding - P. N. Rao, 2nd edition, TMH 2003
2) Manufacturing Technology - Serope Kalpakjian, Steven R. Schmid, Pearson Education Asia, 4th Edition, 2000.
3) Mechanical Metallurgy - S I Metric Edition, George E Dieter, McGraw Hill, 2000.
4) Manufacturing Science - Amitabh Ghosh & A. K. Mallik, East West Press, 2001.
5) Principles of metal casting - Heine, Loper, Phillip Rosenthal, TMH, 2000.
6) Elements of workshop technology volume-I Manufacturing processes S K Hajra Choudhary & A K Hajra Choudhary
7) Production technology Volume- I By Dr. O. P. Khanna

| ME202 | MATERIALS SCIENCE | (4-0-0) 4 |
|---|---|---|

1) **Introduction & Crystal Structure** Classification of materials, BCC, FCC & HCP crystal structures, imperfections in crystals-point, line & surface. **5 Hrs.**

2) **Atomic Diffusion** Fick's laws of diffusion, Factors influencing diffusion, Industrial applications of diffusion. **2 Hrs.**

3) **Mechanical Properties of Metals** Plastic deformation, Tensile, Hardness, Fatigue & creep tests, Recovery & Recrystallization, Fracture of metals – Brittle & Ductile, Fatigue of metals, Creep behavior of metals. **8 Hrs.**

4) **Solidification** Homogeneous & Heterogeneous solidification. **2 Hrs.**

5) **Solid Solutions & Phase Diagrams** Types of solid solutions, Hume – Rothery rules, Classification and construction of phase diagrams, Isomorphous, Eutectic & Peritectic systems, Iron-carbon diagram. **8 Hrs.**

6) **Heat Treatment** Purposes, Types of heat treatment processes – Annealing, Normalizing, Hardening, Tempering; TTT & CCT diagrams, Surface treatment – carburizing, nitriding , cyaniding, induction hardening, flame hardening. Age (work) hardening of Aluminum alloys. Real life examples for each process to cited **10 Hrs.**

7) **Ferrous Alloys** Types of Cast Irons – Gray cast iron, white iron, malleable iron & S. G. Iron, BIS & AISI classification of steel. Types of steels – Plain carbon, alloy, tool & die and special purpose steels- their composition, properties & industrial applications **6 Hrs.**

8) **Non Ferrous Alloys** Important alloys of Aluminum and copper – their composition, properties & applications. Super alloys. **3 Hrs.**

9) **Composite Materials** Classification of composites, types of composites- MMCs, CMCs, FRPs & Sandwich structures- manufacturing methods, advantages, limitations & industrial applications. **6 Hrs.**

**BOOKS:**

1) Principles of Materials Science Engg. – 3rd International Edition – William F. Smith –McGraw Hill Publishing Co.

2) Materials science & Engg. – An Introduction – 7th Edition– William D. Callister – John Wiley & Sons. Inc.2002.

3) Materials Science & Engg. – 4th Edition – V Raghavan, Prentice – Hall of India, 2002.

4) Engg Physical Metallurgy - Y Lakhtin – Mir publishers – Moscow, 1980.

| ME203 | STRENGTH OF MATERIALS | (3-2-0) 4 |
|---|---|---|

1) **Stress and Strain** Introduction, mechanical properties of materials, Linear elasticity, Hooke's law, Poisson's ratio, stress-strain relationship, Extension and shortening of a bar, bars with varying cross section in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, factor of safety, thermal stresses. Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain **10 Hrs.**

2) **Bending moment and shear forces in beams:** Introduction, types of beams, loads and reactions, shear force and bending moments, sign convention, relationship between shear force and bending moment, shear force and bending moment diagrams for different beams subjected to uniformly distributed load, concentrated load, and couples. **6 Hrs.**

3) **Stresses in beams** Introduction, theory of simple bending, Euler's equation of bending, shear stresses in beams, shear stresses across rectangular, circular, symmetrical I and T sections. **8 Hrs.**
4) **Torsion of circular shaft** Introduction, pure torsion, assumptions, torsion equation, pure torsion equation, power transmitted in circular shaft. **4 Hrs.**
5) **Compound stresses** Introduction, Plane stress, stresses on inclined sections, analytical and graphical (Mohr's Circle) methods, Principal Stresses, Maximum shear Stress. **6 Hrs.**
6) **Deflection in beams** Introduction, equation for deflection, slope and moments, double integration method, Macaualy's Method. **6 Hrs.**
7) **Columns** Introduction to columns, Euler formula for different end conditions, its limitations, Rankine formula. **5 Hrs.**
8) **Thick and thin cylinders:** Stresses in thin cylinders, changes in dimensions of thin cylinders, thick cylinders subjected to internal and external pressure. **5 Hrs.**

**BOOKS:**

1) Strength of Materials - Singer & Pytel, Harper and Row publications.
2) Strength of Materials –Dr. S. S. Bhavikatti, II edition, Vikas Publishing House Pvt. Ltd., 2003.
3) Mechanics of materials – Ferdinand Beer & Russel Johnston, SI edition, Tata McGraw Hill, 2003.
4) Mechanics of Materials – Egor P Popov, Pearson Education, India, II edition, 1998.

| ME204 | MACHINE DRAWING | (0-0-8) 4 |
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**Part A**

1) **Introduction-** Dimensioning, sectioning conventions, conversion of pictorial views into orthographic projections of machine elements with section (BIS conventions to be followed for the drawings) **9 Hrs.**
2) **Fasteners:** ISO Metric thread forms (internal & external), hexagonal headed bolt and nut with washer assembly (with slotted nut and split pin), stud assembly. **9 Hrs.**
3) **Types of keys and screws:** parallel key, taper key, gib head key, counter sunk head screw, grub screw, allen screw. **3 Hrs.**
4) **Limits, fits and tolerances.** **6 Hrs.**

**Part B**

1) **Assembly drawings**
   a. Screw Jack **6 Hrs.**
   b. Machine vice **6 Hrs.**

c. Plummer block **6 Hrs.**

2) **Introduction to Solidedge software:** Tools, Library, object recovery from library. Assembly techniques, Animation techniques. **6 Hrs.**
3) Drawing of the following assemblies using CAD software
   a) Drill jig **6 Hrs.**
   b) Machine vice **6 Hrs.**
   c) Milling fixture **6 Hrs.**
   (Both part modeling and assembly modeling)

**Note**: Bill of materials for each assembly is to be provided.

**TERM WORK**:

Sheet 1- Minimum three problems on conversion from pictorial to orthographic
Sheet 2- Hexagonal nut bolt assembly with washer connecting two plates, Free hand sketches of keys and screws
Sheet 3 - Screw Jack assembly.
Sheet 4 - Machine vice assembly.
Sheet 5 - Printout of 3D and 2D drawings of drill jig assembly.
Sheet 6 - Printout of 3D and 2D drawings of Machine vice.
Sheet 7 - Printout of 3D and 2D drawings of milling fixture assembly.

**BOOKS:**

1) Machine Drawing – N. D. Bhat & V. M. Panchal – Charotar Publications – Anand, Gujarat, 2002.
2) Machine Drawing – K. R. Gopalkrishna – Subhash Stores, Bangalore, 2002.
3) Machine Drawing – Siddeshwar et al – Tata McGraw Hill, New Delhi, 2002.
4) Solidedge help manual.

**Note:** Assembly and detailed drawings of above topics should be drawn in A1 sheets and submitted to the department in bound form.
Solid modeling 3D and 2D computer printouts of drill jig, connecting rod and milling fixture have to be attached along with term work sheets.

**Evaluation method**

a) Term work 15 marks based on three assemblies drawn manually, 15 marks for CAD exercises.
b) One in semester test – 20 marks
c) End semester theory examination - 50 marks.

**End semester test:**

**Part A -** should consist of 2 questions taken one from chapter 1, with internal choice, one from chapter 2 & 3, with internal choice

**Part B -** one question to be set for 60 marks on any one assembly drawing. Duration of the paper should be 4 Hours and set for 100 marks. Drawing sheets of A1 size need to be supplied to the students in the examination. Marks obtained shall be reduced for 50 marks.

| ME205 | MATERIALS SCIENCE AND MATERIAL TESTING LABORATORY | (0-0-3) 1.5 |
|---|---|---|

1) Preparation of specimen for metallographic examination of engineering materials and study the microstructure of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze.
2) Heat treatment: Annealing, normalizing (demonstration only), hardening and tempering of steel & to study their Rockwell hardness. Conducting tensile, shear, compression, torsion and bending tests of a Mild Steel specimen using a Universal Testing Machine. Conducting Izode and Charpy impact tests on Mild Steel Specimen.
3) Experiment on Wear Study.
4) Brinell, Rockwell and Vicker's Hardness tests.
5) Fatigue Test - (demonstration only).
6) Non-destructive test experiments (demonstration only):
   (a) Ultrasonic flaw detector,
   (b) Magnetic crack detector,
   (c) Dye penetrant testing.

| ME206 | FOUNDRY AND FORGING LABORATORY | (0-0-3) 1.5 |
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1) **Testing of Moulding sand and Core sand:**
   - Compression test, shear test and tensile test
   - Permeability test
   - Core hardness & Mould hardness tests
   - Grain fineness test
   - Clay content test
2) **Foundry Practice** Use of foundry tools and other equipments. Preparation of moulds (ready to pour) using two boxes, use of split pattern, match plate pattern and Cores. Preparation of one casting using Aluminium or cast iron (demonstration only).
3) **Forging Models** Preparing minimum three models involving upsetting, drawing and bending operations.

# IV SEMESTER

| MA250 | Engineering Mathematics-IV (Common to all branches) | (4-0-0)4 |
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1) **Numerical Methods** Numerical solutions of first order and first degree ordinary differential equations - Taylor's series method, Modified Euler's method, Runge – Kutta method of fourth order, Milne's and Adams-Bashforth predictor and corrector methods (No proofs). **6 Hrs.**
2) **Complex Variables** Function of a complex variables, Limit, Continuity Differentiability – Definitions. Analytic functions, Cauchy –Riemann equations in Cartesian and polar forms, Properties of analytic functions. Conformal Transformation Definition Discussion of transformations. $w = z^2$, $w = e^z$, $w = z + (1/z)$ ($z$ not equal to 0 ), Bilinear transformations. **6 Hrs.**
3) **Complex Integration** Complex line integrals, Cauchy's theorem, Cauchy's integral formula. Taylor's and Laurent's series (Statements only) Singularities, Poles, Residues, Cauchy's residue theorem. **6 Hrs.**
4) **Bessel's Equation** Series solution of Bessel's Equation leading to first kind Recurrence formulae, Generating function orthgonlity, Bessel's integral formulae. **6 Hrs.**
5) **Legendre's equation**: Series solution of Legendre's D.E Recurrence formulae, Rodriges formula Generating function, Orthogonality. **6 Hrs.**
6) **Statistical Methods:** Curve fitting by the method of least squares: $y = a + bx$, $y = a + bx+cx^2$, $y = ax^b$ $y = ab^x$, $y = ae^{bx}$, Corrélation and Régression. **6 Hrs.**
7) **Probability:** Addition rule, Conditional Probability, Multiplication rule, Baye's theorem. Discrete and Continuous random values, P.D.F, C.D.F., Binomial, Poisson, Normal and Exponential distributions. Mean & standard deviation of these distributions. **7 Hrs.**
8) **Concept of joint probability** - Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient Probability vectors, stochastic matrices, fixed points, Regular stochastic matrics, Markov chains, Higher transition probabilities. Stationary distribution of regular Markov chains and absorbing states**.** **7 Hrs.**

**BOOKS:**

1) Higher Engineering Mathematics by Dr. B.S. Grewal (36th Edition)
2) Higher Engineering Mathematics by B.V Ramana ( Tata Macgraw Hill)
3) Advance Modern Engineering Mathematics by Glyn James Pearson Education
4) Probability by Seymour Lipschutz (Schaum's series) Chapter 5 & 7

| ME250 | MACHINE DESIGN-1 | (3-2-0) 4 |
|---|---|---|

1) **Fundamentals:** System Design, Design process, problem formulation and calculation, Factor of safety, Design codes, design for strength, deflection, fatigue and Vibration loading, combined stresses, stress concentration, numericals. **10 Hrs.**
2) **Load determination:** Introduction, loading class, free body diagrams, load analysis, Two dimensional static loading, case studies /problems on dynamic loading, impact loading. **8 Hrs.**
3) **Static Failure theories:**Introduction, failure of materials under static loading- Von-Mises's, maximum stress, maximum normal stress, comparison of failure theories and applications, static failure-case studies/problems. **8 Hrs.**
4) **Fatigue failure theories** Introduction, Mechanism of Fatigue Failure- design for high cycle fatigue, for fully reversed and fluctuating stresses, surface failures. **8 Hrs.**
5) **Design of machine components** Design of shafts, keys, cotter joint, design of screw fasteners, weld (no boiler joints) and rivet joints. **12 Hrs.**
6) **Design for manufacture**, assembly, ease of maintenance, vibrational aspects. **6 Hrs.**

**BOOKS:**

1) Machine Design - an integrated approach, Robert L Norton. Pearson Education Asia, University Press, 2001.
2) Machine Design; Black and Adams. McGraw Hill, 1968.
3) Design Data Hand book: Balaveera Reddy / Mahadevan.
4) Machine Design; Joseph Edward Shigley. TMH, 6th Edition 2006.
5) Theory and Problems of Machine design: Hall, Hollowenko and Langhlin. TMH 2002.

| ME251 | MECHANICAL MEASUREMENTS | (4-0-0) 4 |
|---|---|---|

1) **Standards of measurement:** Definition and Objectives of metrology, Standards of length - International Prototype metre, Imperial Standard yard, Wave length standard, subdivision of standards, line and end standard, transfer from line standard to end standard, calibration of end bars (simple numericals), Slip gauges M-87, M-112 sets, Numerical problems on building of slip gauges. **4 Hrs.**
2) **System of Limits, Fits, Tolerances and gauging** Definition of tolerance, Principle of interchangeability and selective assembly, limits of size, Indian standards, compound tolerance, accumulation of tolerances, types of fits and

their designation, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's Principles), wear-allowance on gauges, types of gauges – plain plug gauge, snap gauge, limit gauge, gauge materials. **7 Hrs.**

3) **Comparators:** Introduction to Comparators, characteristics, classification of comparators, mechanical comparators- Sigma Comparator, Dial indicator, Optical comparators - Zeiss Ultra Optimeter, Electrical and Electronic Comparators - principles, LVDT, Pneumatic Comparators - Solex comparator. **5 Hrs.**
4) **Angular Measurements and Interferometer:** Bevel protractor, Sine bar, Sine center, angle gauges (Numericals on building of angles), Clinometers, principle of Interferometry, Optical flats, Autocollimator. **4 Hrs.**
5) **Screw thread and Gear measurement:** Terminology of screw threads, measurement of screw thread parameters by three wire method, Gear terminology. Measurement with gear tooth vernier. **4 Hrs.**
6) **Measurements and Measurement systems:** Definition, Significance of measurement, generalized measurement system, definition and concept of accuracy, precision, sensitivity, calibration, threshold, hysterisis, repeatability, linearity, loading effect, system response, time delay, errors in measurement, Classification of errors. **5 Hrs.**
7) **Transducers:** Transfer efficiency, primary and secondary transducers, mechanical, electrical, electronic transducer, advantages of each type of transducers. **4 Hrs.**
8) **Intermediate modifying devices:** Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. **3 Hrs.**
9) **Terminating Devices:** Mechanical devices, Cathode Ray Oscilloscope, Oscillographs, X-Y Plotters. **2 Hrs.**
10) **Measurement of Force and Torque:** Principle, Analytical balance, Platform balance, Proving ring, Torque measurement, Prony brake, Hydraulic dynamometer. **3 Hrs.**
11) **Pressure Measurements:** Principle, Bridgeman gauge. McLeod gauge, Pirani Gauge **3 Hrs.**
12) **Temperature Measurement:** Resistance thermometers, Thermocouples, laws of thermocouples, materials used for construction, Optical Pyrometer. **3 Hrs.**
13) **Strain Measurement :** Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. **3 Hrs.**
14) **Introduction to online measurement and Data acquisition systems 2 Hrs.**

**BOOKS:**

1) Mechanical Measurements by Beckwith, Marangoni and Lienhard, Pearson Education, Asia, 5th edition, 2001.

2) Engineering Metrology by I.C. Gupta, Dhanapatrai and Sons Pvt. Ltd. New Dehli, 4th Edition, 1994.
3) Mechanical Measurements by Sirohi and Radhakrishna, Wiley Eastern Ltd. 1980.
4) Mechanical Systems, Applications and Design by Earnest O. Doblin, TMH, 2002 Edition.
5) Metrology for Engineers by J.F. Galyer and C.R. Shotbolt, Cassel Publications, London, 1964.
6) Industrial Instrumentation by Alsutko and Jerry D Faulk, Thomson Asia PVT. Ltd. 2002.
7) Engineering Metrology by R K Jain, Khanna Publishers. New Dehli, 1994.

| ME252 | FLUID MECHANICS | (3-2-0) 4 |
|---|---|---|

1) **Properties of Fluids:** Introductory concepts and definitions, properties of fluids, classification of fluids and regimes of flow. **5 Hrs.**
2) **Fluid Statics:** Pascal's law, pressure variation in a static fluid, manometers, hydrostatic force on submerged plane surfaces and curved surfaces, Buoyancy and stability criteria. **10 Hrs.**
3) **Fluid Kinematics:** Fluid flow concepts, lines of flow, stream function and velocity potential function for 2D flow, Relationship between them and flow nets, Ideal flow concepts (Uniform flow, Source and sink flow, Doublet, Flow past the cylinder). **5 Hrs.**
4) **Dimensional Analysis:** Dimensions of physical quantities, dimensional homogeneity-Buckingham's pi theorem, the Rayleigh's method, important dimensionless numbers, similitude. **5 Hrs.**
5) **Fluid Dynamics:** Continuity Equation, Navier Stokes Equation (Cartesian coordinates only), Bernoulli's equation. **8 Hrs.**
6) **Fluid flow Measurements:** Venturimeter, orifice meter, pitot tube, V- notch, Rota meter, Hot wire Anemometer. **4 Hrs.**
7) **Flow through Pipes:**Hagen Poisuille's equation, minor and major losses in pipe flow - Energy line and hydraulic gradient line, Darcy and Chezy equations. **5 Hrs.**
8) **Boundary layer theory:** Reynold's number, critical Reynold's number, Hydrodynamic & thermal boundary layer, boundary layer thickness, displacement, momentum & energy thickness, (Qualitative discussions and No derivations) Flow over a flat plate, Flow inside a pipe. Flow past immersed Bodies: Lift and Drag force, skin friction, Introduction to compressible Flow: Sonic velocity, Mach Number, isentropic flow, speed of sound wave. **8 Hrs.**
9) **Methods of fluid flow analysis (qualitative treatment only) 2 Hrs.**

**BOOKS**:

1) "Fluid Mechanics" by Yunus Cengel - Mc Graw Hill 2005
2) "A Text Book of Fluid Mechanics and Hydraulic Machines" by Dr. R K. Bansal, Laxmi Publication (P) Ltd., New Delhi. 2000
3) "Fluid Mechanics and Hydraulics" by Dr. Jagadishlal, Metropolitan Book Co. Pvt. Ltd., New Delhi, 1995.
4) "Fluid Mechanics" by White, 5th ed., Tata Mc Graw Hill 2003.
5) "Fluid Mechanics "by Streeter - Mc Graw Hill 7th Edition, 1995.

| ME253 | APPLIED THERMODYNAMICS | (3-1-0) 4 |
|---|---|---|

1) **Gas Power Cycles : Air standard cycles:** Otto, Diesel and Dual cycles, Analysis - Air standard efficiency & Mean effective pressure. Comparison of Otto, Diesel and Dual Cycles. Brayton cycle – Analysis, Effect of Regeneration, Inter cooling and Reheating. Comparison of closed cycle and open cycle gas turbine plants. **8 Hrs.**
2) **Vapour Power Cycles:** Carnot cycle, Simple Rankine cycle and Analysis, Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on the performance of Rankine cycle, Actual vapour power cycles. Regenerative Rankine cycle, Reheat Rankine cycle. **6 Hrs.**
3) **Reciprocating Air Compressors:** Operation of a single stage compressor. Work input, Effect of clearance, volumetric efficiency. Adiabatic, isothermal and mechanical efficiencies. Multi-stage compression, saving in work, optimum intermediate pressure, inter cooling, minimum work for compression. **6 Hrs.**
4) **Combustion Thermodynamics:** Stochiometric air requirement for combustion of fuels, Excess air, mass balance, actual combustion, Exhaust gas analysis, A/F ratio. Energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, Combustion efficiency **5 Hrs.**
5) **Refrigeration :** Vapour compression refrigeration system; units of refrigeration, refrigeration effect, refrigeration capacity, COP, V.C.R. cycle and Analysis, Use of refrigeration tables and p-h chart. Classification of Refrigerants. Desirable properties of refrigerants, Applications of refrigerants Ammonia Vapour absorption refrigeration system, Comparison of vapour compression and vapour absorption systems, Air refrigeration system, Bell Coleman cycle and analysis, comparison of Air and V. C. R. systems **8 Hrs.**
6) **Air-conditioning :** Atmospheric air and Psychrometric properties; Dry bulb temperature, wet bulb temperature, dew point temperature; specific humidity and relative humidity, Use of Psychrometric chart, Psychrometric processes and analysis; Adiabatic mixing of two streams of air. Summer, Winter and Year round A/C Systems, Cooling load calculations. **9 Hrs.**

7) **I. C. Engines.** Performance testing of two-stroke and four-stroke I. C. engines- Measurement of speed, air flow, fuel consumption, Measurement of Brake Power and Indicated Power, Performance curves, Heat Balance sheet, Morse test. **8 Hrs.**

**BOOKS:**

1) Basic and Applied Thermodynamics by P. K. Nag, TMH Publishing Co. Ltd, New Delhi, 2nd edition, 2002.
2) Internal Combustion Engines by V Ganesan, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1994.
3) Refrigeration and Air Conditioning by C P Arora, Tata-Mc Graw-Hill publishing Co. Ltd. New Delhi, 2nd Edition, 2004.
4) Tables and Charts on Refrigerants and Psychometric Properties (S. I. Units) by P. N. Maskara and Satish Chand, Technical Publishers of India, Subhas Nagar, Allahabad, 1994.
5) Thermodynamics Data Hand Book (S. I. Units) by Prof. B. T. Nijaguna and Prof.B.S. Samaga, Sudha Publishers, Avenue Road, Bangalore
6) Thermal Engineering by R. K. Rajput, Laxmi Publishers (P) Ltd., New Delhi, 6th Edition, 2006.
7) Refrigeration and Air Conditioning by Manohar Prasad, Wiley Eastern Ltd, New Delhi, 2nd Reprint, 1991.

| ME254 | MANUFACTURING TECHNOLOGY | (4-0-0) 4 |
|---|---|---|

1) **Fundamental of machining**: Definition and concepts, requirements of machine tools – elements of machine tools, structure (bed, column, frame), slides, slide ways. Primary and secondary motions – tool and work movements for producing flat, cylindrical surface and holes. **4 Hrs.**
2) **Theory of metal cutting** – single point cutting tool geometry and nomenclature – machine reference (ASA) & normal rake system (NRS). Mechanics of chip formation, types of chips, orthogonal and oblique cutting, relationship between chip thickness ratio, shear angle and rake angle in orthogonal machining. Velocity relationships. Merchant's analysis, Merchant's theory. **8 Hrs.**
3) **Tool wear**- Types, mechanism, tool life criterion. Taylor's tool life equation. **3 Hrs.**
4) **Cutting tool materials**- Desired properties, types; HSS, carbides, coated carbides, ceramics, cBN, diamond, cermets. CVD and PVD (principle in brief). Cutting fluids- desired properties, types, selection. Machinability and factors affecting Machinability, machining strategies to reduce cutting time (forces, tool life, surface finish, tool geometry) with empirical formulae. Broad classification of carbide tools (PMK classification). **8 Hrs.**

5) **Lathe-** Introduction,. Description and function of lathe parts in brief. Operations on lathe in brief, taper turning methods. Thread cutting, calculation of change wheels. Machining time calculation in plain turning. **3 Hrs.**
6) **Capstan and turret lathes** - Constructional features, tool and work holding devices, tool layout in brief. **4 Hrs.**
7) **Milling machine** - Types, principal parts, milling cutters- types. Nomenclature of plain milling cutter, milling operations, up and down milling, machining time calculations. **5 Hrs.**
8) **Drilling machine** - Types, constructional features, drilling and related operations, types of drill and drill nomenclature. Machining time calculations. **4 Hrs.**
9) **Grinding** - Classification, surface, centreless and internal grinders. Abrasives- bonds, grit, grade and structure of wheels. Designation of wheels. **5 Hrs.**
10) **Broaching machines**, Gear hobbing and gear shaving machines- principles. **2 Hrs.**
11) **Modern machining processes**-Principles, equipment, operations and applications of electric discharge machining, plasma arc machining, abrasive jet machining and laser beam machining. **4 Hrs.**

**BOOKS :**

1) Metal cutting Theory and Practice by A. Bhattacharya. New central book agencies (P) ltd. Calcutta.
2) Manufacturing Technology**:** Serope Kalpakjian Steuen R Schmid pearson Education Asia,4th Edition, 2000.
3) Manufacturing Science by Amitabh Ghosh & A. K. Mallik, East West Press, 2001.
4) Production Technology – HMT, Tata McGraw Hill, 2000.
5) Workshop Technology, by Chapman Part 2. 4th edition. ELBS
6) Elements of workshop technology, by Hajra, Choudhary Vol II: Machine tools. Published by MRP.

| ME255 | MEASUREMENTS LABORATORY | (0-0-3) 1.5 |
|---|---|---|

1) Calibration of Pressure Gauge.
2) Calibration of Thermocouple.
3) Calibration of LVDT.
4) Calibration of Load cell.
5) Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6) Measurements of cutting tool forces using Lathe tool Dynamometer and Drill tool Dynamometer.
7) Measurements using Optical Projector /Tool maker's Microscope.

8) Measurements of angle using Sine Center / Sine bar / bevel protractor.
9) Measurements of alignment using Autocollimator / roller set.
10) Measurements of Screw thread parameters using two wire / three wire method.
11) Measurements of Surface roughness using Talysurf / mechanical Comparator.
12) Measurements of gear tooth profile using gear tooth vernier / gear tooth micrometer.
13) Calibration of a micrometer using slip gauges.
14) Measurement using Optical Flats.

| ME 256 | MACHINE SHOP PRACTICE | (0-0-3) 1.5 |
|---|---|---|

1) **Lathe**: Plain Turning, Taper Turning. Step Turning, Thread Cutting. Facing, Knurling, Eccentric Turning. ( 4 Jobs) **Milling machine.:** Cutting of key way and gear teeth using horizontal and vertical milling machines. (1 + 2 =3 Jobs)
2) **Shaping machine:** Cutting of V-groove / Dovetail /Rectangular groove. (1 Job)
3) Demonstration of Cylindrical and Surface grinding.

**Note:** Students are required to prepare process sheets including machining time calculation.

## Evaluation System

**1) Theory courses:**

- **Maximum Marks: 100**
- **Continuous Internal Evaluation (CIE):**
  - Maximum Marks: **50**
  - Assignment, Case study, Problem solving, Report writing, Class room interaction etc., } **10** marks (to be awarded by the Course instructor)
  - **CIE Tests: 40 Marks**

| Sl. No. | Timing of the tests | Particulars | Max. Marks | Remarks |
|---|---|---|---|---|
| **1** | 6th week (Sat, Mon, Tue) | **CIE Test – 1**<br>Duration of Test: 1 Hour<br>Portion: First 25% of the syllabus | **20** | 1) Sum of best scores of any two tests to be considered for **40** marks.<br>2) Two papers per day. |
| **2** | 10th week (Thu, Fri, Sat) | **CIE Test – 2**<br>Duration of Test: 1 Hour<br>Portion: Second 25% of the syllabus | **20** | |
| **3** | 14th week (Sat, Mon, Tue) | **CIE Test - 3**<br>Duration of Test: 1 Hour<br>Portion: Third 25% of the syllabus | **20** | |

- Students are expected to attend all the tests.
- Students are required to score a minimum of **20** marks to be eligible for **Semester End Examination (SEE).**
- **Question paper pattern for CIE tests:**

| Parts | Questionnaire details | Max. Marks | Remarks |
|---|---|---|---|
| PART – A | Multiple choice, Fill in the blanks, Match the following, True/False and Make corrections | **05** | **No choice** |
| PART – B | Analytical and problem oriented questions involving short steps but demanding thorough knowledge and appreciation of the course. | **05** | **No choice** |
| PART – C | Standard questions that are objectively evaluated (describe, explain, short notes to be avoided) | **10** | **One choice** |

❖ **Semester End Examination (SEE):**

- Maximum Marks: **50**
- Conducted in the 18th week of the semester for a maximum mark of **100** and the duration of the exam will be 3 hours.
- Marks obtained for 100 will be proportionally reduced to **50** marks.
- Attendance to the exam is compulsory.
- **Question paper pattern for SEE:**

| Parts | Questionnaire details | Question No. | Max. Marks | Remarks |
|---|---|---|---|---|
| PART - A | Multiple choice, Fill in the blanks, Match the following, True/False and Make corrections | **1 2** | Each question carries **10** marks | **No choice** |
| PART - B | Analytical and problem oriented questions involving short steps but demanding thorough knowledge and appreciation of the course. | **3 4** | | **No choice** |
| PART - C | Standard questions (maximum three sub divisions), which can be objectively evaluated (describe, explain, short notes to be avoided) on the entire syllabus. | **5 to 12** | | **6 questions out of 8** |

❖ **Total score = CIE + SEE**

❖ Relative grading using statistical approach will be done on this total score.

**2) Practical courses:**

❖ **Maximum Marks: 100**

❖ Interaction, preparation, journal writing etc., in each practical session spread over the entire semester carries **50** marks and this is to be awarded by the course instructor. Students are required to score a minimum of **20** marks to be eligible for the practical examination.

❖ **Practical examination:**

- Maximum Marks: **50**
- To be conducted in the **15th and/or 16th** week.
- Practical batch for the exam shall have a maximum of 15 students.
- Duration of the examination: **3 hours.**
- Two examiners are to be nominated by the HOD.
- Attendance to the exam is compulsory.
- Total score will be the sum of the above components.
- Relative grading using statistical approach will be done on this total score.