B.Tech Programme in Mechanical Engineering

Syllabus of B. Tech. in Mechanical Engineering

Semester III

CS1312 NUMERICAL ANALYSIS & COMPUTER PROGRAM (C & C++)
(2-1-0)

I. Numerical Analysis

Approximations and round of errors, Truncation errors and Taylor Series. Determination of roots of polynomials and transcendental equations by Newton-Raphson ,Secant and Barstow's method.

Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss-Siedel iteration methods.

Curve fitting- linear and nonlinear regression analysis.

Backward, Forward and Central difference relations and their uses in Numerical differentiation arid integration. Application of difference relations in the solution of partial differential equations.

Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.

II. Computer Programming

Introduction to computer programming in C and C++ languages. Arithmetic expressions, Simple programs. The emphasis should be more on programming techniques rather than the language itself. The C programming language is being chosen mainly because of the availability of the compilers, books and other reference materials.

Example of some simple C program. Dissection of the program line by line. Concepts of variables, program statements and function calls from the library (printf for example)

C data types, int, char, float etc.

C expressions, arithmetic operations, relational and logic operations.

C assignment statements, extension of assignment to the operations. C primitive input output using getchar and putchar, exposure to the scanf and printf functions.

C statements, conditional execution using if, else. Optionally switch and break statements may be mentioned.

Concepts of loops, example of loops in C using for, while and do-while. Optionally continue may be mentioned.

One dimensional arrays and example of iterative programs using arrays, 2-d arrays. Use in matrix computations.

Concept of Sub-programming, functions. Example of functions. Argument passing mainly for the simple variables.

Pointers, relationship between arrays and pointers. Argument passing using pointers.

Array of pointers, Passing arrays as arguments. Strings and C string library.

Structure and unions. Defining C structures, passing structures as arguments. Program examples.

File I/O. Use of fopen, fscanf and fprintf routines.

ME 1302 MATERIALS SCIENCE (2-1-0)

Introduction: Types of materials from structure to property 1 hour

Crystal Structures: Seven systems and fourteen lattices; lattice direction and planes. 2 hours

Crystal Imperfections: Point line and planar defects. 3 hours

Deformation Mechanism and Mechanical Properties of Materials: Plastic deformation of single crystals and polycrystals; strengthening mechanisms; recovery-recrystallization-grain growth; tensile, impact, fatigue and creep of metals and alloys; deformation behavior of ceramics and polymers; mechanical testing methods 6 hours

Diffusion in Solids: Mechanisms; Fick's laws; factors-affecting diffusion in metals, ceramics and semiconductors 1 hour

Nucleation and Growth: Homogeneous and heterogeneous nucleation kinetics; growth and overall transformation kinetics. 2 hours

Principles of Solidification: Development of microstructures like dendrites, cellular structure, columnor grains etc. 3 hours

Phase Diagrams: Phase rule; isomorphous, eutectic, peretectic, eutectoid and Fe-Cermeutic diagram; Phase diagram of ceramics and electronic materials. 5 hours

Heat Treatment of Materials: TTT, CCT diagrams; hardenability, role of alloying elements; different heat treatment procedures; pearlitic, bainitic and nartensitic transformations. 7 hours

Degradation and Failure of Materials: Wear, corrosion, oxidation, etc. 3 hours

Selection of Engineering Materials: Common engineering materials including metals and alloys, polymers, ceramics, composites, electronic materials and their selection procedures. 12 hours

ME1303 **STRENGTH OF MATERIALS** (3-1-0)

Stress: axial load-safety concept, general concepts; stress analysis of axially loaded bars, member strength of design criteria. (4 lectures)

Strain: Axial strain and deformation; strains and deformation in axially loaded bars, stress-strain relationship, Poison's ratio, thermal strain and deformation, strain concentration. (4 lectures)

Generalized Hooke's law, Pressure vessels, constitutive relationship-generalized concepts, relationship between elastic constants; thin wall pressure vessel. (6 lectures)

Torsion: Torsional stress and deformation in circular members, design of circular members in torsion, closed coil helical spring. (5 lectures)

SFD & BMD: Axial force, shear and bending moment diagram, introduction-direct approach for axial force, shear and bending, bending of beams with symmetrical cross-section. (4 lectures)

Stresses in Beam: Shear stress in beams; introduction-shear flow-shear stress in beams. (4 lectures)

Combine stresses: Transformation of stress and strain; analysis for combined loading, transformation of stress and strain-Mohr's rule for stress transformation. (6 lectures)

Deflection of beams: Introduction-deflection by integration-deflection by moment–area method. (6 lectures)

Stability of column: Introduction-Euler's buckling load formula, Rankin's formula-introduction to beam column. (2 lectures)

ME1304 **FLUID MECHANICS** (3-1-0)

Introduction: Fluid and flow-definition and types, properties of ideal and real fluids, continuum concept, Lagrangian & Eulerian approach. (4 lectures)

Fluid static's: General differential equation, Hydrostatics manometry; Force on plane and curved surfaces, stability of floating and submerged bodies; Relative equilibrium. (4 lectures)

Kinematics of fluid: Steady flow; uniform flow; stream, streak and path lines; continuity equation, stream function; irrational flow; velocity potential; flow nets; circulation, simple flow; flow around half body circular cylinder with and without rotation; lift and drag. (6 lectures)

Dynamics of fluids: Concept of system and control volume; Reynolds transportation theorem, Euler's equation, Bernoulli' equation, Navier Stock's equation to nozzle, venturimeter orifices and mouth pieces; time taken in emptying a vessel; pitot and prandtl tube. (6 lectures)

Flow in pipes: Laminar flow through pipe; total and hydraulic gradient lines; series and parallel connection of pipes; transmission of power through pipes. (4 lectures)

Laminar flow of viscous fluids: Boundary layer concept; boundary layer thickness; displacement, momentum and energy thickness; integral method; drag on flat plate; flow around of airfoil; boundary layer separation; flow; plane flow. (6 lectures)

Turbulent flow: Fluid friction and Reynolds's number; Prandtl mixing length hypothesis velocity distribution in pipes; the universal pipe friction flows; Cole Brook White formula. (5 lectures)

Dimensional analysis: Buckingham's P theorem; Non-dimensional numbers and there application; similitude. (3 lectures)

Compressible fluid flow: Velocity of sound, Mach number; Steady isentropic flow through ducts, choked flow; flow through convergent and convergent-divergent nozzle; Adiabatic flow; Fanno lines; diabetic flow; Rayleigh lines. (6 lectures)

ME1305 APPLIED THERMODYNAMICS (3-1-0)

Introduction to Thermodynamic system: Definition. Familiarity eighth common examples of thermodynamic system such as steam power plant. Vapour compression refrigeration. Automobile engine, air compressor, a rocket engine. (6 lectures)

Review of basic concepts: Working fluid properties (air, steam) for various thermodynamic processes and cycles. First law and second law energy equations for closed and open system under SSSF and USUF condition (4 lectures)

Third law of thermodynamics: Measurement of entropy, zero value of entropy. Absolute zero temperature. (3 lectures)

Thermodynamic (PVT) relations of working fluid: Equations of state for ideal and real gases, Behavior of real gases and compressibility factor, Law of corresponding state, and use of generalised compressibility chart, Helmoltz and Gibb functions. (6 lectures)

Gas power cycle: Carnot, Sterling, Ericssion, Otto Diesel, Dual combustion, Brayton and Atkinsion cycle, Air standard thermal efficiency, Maximum work output, and efficiency. Indicated power, Brake power and mean effective pressure for reciprocating engine (9 lectures)

Vapour power cycle: Carnot and Rankine cycles, reheating and regenerative feed heating rankine cycle, Binary vapour cycle, Thermal efficiency and work ratio. Factor affecting efficiency and work output. (9 lectures)

Refrigeration cycle/ process: Brayton air refrigeration cycle, Vapour compression Cycle, Vortex and pulse tube, refrigeration, thermoelectric refrigeration (7 lectures)

MH1302 MATHEMATICS-III (3-1-0)

Fourier series: Fourier series, Half-range series, Harmonic analysis.

Solution in Series: Differentiation and integration of Infinite series. Series solution of differential equations; Bessel and Legendre equations, their series solution, elementary properties of Bessel functions and Legendre polynomials.

Complex Variables: Functions of a complex variable, Exponential, trigonometric, hyperbolic and logarithmic functions, Differentiation, Analytic functions, Cauchy-Riemann equations, conjugate functions, Application to two dimensional potential problems, Conformal transformations, Schwartz-Christoffel transformation, Cauchy's Integral theorem, Taylor's and Laurent's expansions. Branch points, zeros, poles and residues, Simple problems on contour integration.

Boundary Value Problems: Equations for vibrations of strings, heat flow and electrical transmission lines; Laplace's equation in Cartesian, cylindrical polar and spherical polar coordinates; Solution by separation of variables.

Integral Transforms:
Fourier integral theorem, Fourier transforms, Convolution theorems, Inversion theorem for Fourier and Laplace transforms, Simple applications of these transforms to one-dimensional problems

CS1302-P NUMERICAL ANALYSIS & COMPUTER PROGRAM (C & C++) LAB (0-0-3)

Development of computer program for

- Numerical integration by Trapezoidal and Simpson's rule
- Gauss-Siedeliteration method
- Various matrix operatio.l"l-and their use as sub-routines

ME1307-P MATERIAL SCIENCE LAB (0-0-3)

List of Experiments

1. To study the lattice structure of various types of unit cells, observe the miller indices for various planes & directions in unit cells.
2. To study the microstructure of cast iron, mild steel, brass, solder underancaled, cold work, forged, rolled condition.
3. To verify Hall effect.
4. To verify the fracture, characteristics of ductile & brittle materials.
5. To determine the chemical composition of a few common alloys
6. To determine the percentage of carbon & sulphur contents in a alloy with Fe as main constituent.

ME1308-P STRENGTH OF MATERIALS LAB (0-0-3)

List of Experiments

1. Tensile Test: To prepare the tensile test upon the given specimen (Mild Steel).
2. Compression Test: To determine the compressive strength of the given specimen.
3. Torsion Test: To perform the Torsion test on given specimen.
4. Impact Test: To determine the impact toughness of the given material.
5. Brinell Hardness Test: To determine the hardness of the given specimen.
6. Vicker's Hardness Test: To determine the hardness of the given specimen.
7. Rockwell Hardness Test: To determine the hardness of the given specimen.

ME1309-P FLUID MECHANICS LAB (0-0-3)

List of Experiments

1. Verification of Bernoulli's theorem.
2. Determination of co-efficient of discharge for a venturimeter.
3. Determination of loss of head of water flowing in a pipe, through different climaters.
4. Determination of loss of head due to friction.
5. Determination of co-efficient of discharge for Orificemeter.
6. Determination of met accenteric height of a boat model.
7. Verification of Reynolds law.
8. Viscosity determination of a liquid by Capillary tube method

ME1310-P APPLIED THERMODYNAMICS LAB (0-0-3)

List of Experiments

1. To study the construction & operation of a Cochran Boiler.
2. To study the construction & operation of a Bobcock Boiler.
3. To study the construction & operation of a Lancashire Boiler.
4. To study the construction & operation of a Vertical Water Tube boiler.
5. To study about 2 Stroke Petrol Engine.
6. To study about 4 Stroke Petrol Engine.
7. To study about C. I. Engine (Diesel Engine).
8. Study of Simple & Compound Steam Engine.

HS1303-P GENERAL PROFICIENCY III (0-0-0)

Debate, Elocution, Extempore, Group Discussion, Panel Discussion, Presentation – Paper & oral, Allegation & clarification, Quiz / Brain Teaser, Survey Report / Project Report / Case Study, Dissertation, Mock Interview, Expository / Argumentative Report & National Service Scheme (NSS).