B.TECH. DEGREE COURSE

SYLLABUS

MECHANICAL ENGINEERING BRANCH
### 3rd Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course No.</th>
<th>Subject</th>
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<th>Duration of Uty. Exam. (Hrs.)</th>
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At the beginning of the seventh semester, students must submit a brief outline of the proposed project work. They must submit an interim report at the end of the semester. They will complete the project in the eighth semester.

### 8TH SEMESTER

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Sessional marks for seminar will be out of 25. Sessional marks for project will be out of 75, in which 35 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation board consisting of a minimum of 3 faculty members including the guide. Sessional marks for workshops and laboratories will be based on day to day performance assessed by faculty members. In each semester for workshops and
laboratories, 60% of the sessional marks will consist of class performance, lab record and viva conducted by faculty members day to day. Out of the remaining 40%, 20% will be for attendance and 20% for final examination.

THIRD SEMESTER
Module 1  Vector Differential Calculus  

Module 2  Vector Integral Calculus  
Line, surface and volume Integrals – work done by a force along a path – Application of Green’s theorem, Stokes theorem and Gauss divergence theorem.

Module 3  Function of Complex Variable  
Definition of analytic functions and singular points – derivation of C.R. equations in Cartesian co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal transformation of function like $z^n$, $e^z$, $1/z$, $\sin z$, $z+k^2/z$ – bilinear transformation – cross ratio – invariant property – simple problems.

Module 4  Finite Differences  
Meaning of $\Delta$, $\nabla$, $E$, $\mu$, $\delta$ - interpolation using Newton’s forward and backward formula – central differences – problems using stirlings formula – Lagrange’s formula and Newton’s divided difference formula for unequal intervals.

Module 5  Difference Calculus  

References  
MACHINE DRAWING - I
M 302              0+0+4

Conversion of pictorial views into orthographic views-dimensioning techniques-preparation of drawing- screw threads-different forms-conventional representation-sketching-orthographic views of hexagonal bolts and nuts-dimensional drawing-squareheaded bolts and nuts-sketching of different types of lock nuts and locking devices and foundation bolts.

Forms of rivet heads-riveted joints-lap and butt joints with single and multiple riveting in chain and zig-zag arrangements-dimensional drawing. Sketching of conventional representation of welded joints.

Fully dimensioned and sectional drawings of the following: -
Joints-cottered joints (spigot and socket, sleeve and cotter, gib and cotter) - knuckle joint.
Shaft couplings - types of keys - plain and protected types of flanged couplings - bushed pin type flexible coupling - Oldhams coupling.

Pipe joints-spigot &socket joint - flanged joint - union joint –Amstrong (hydraulic) joint.
Shaft bearings and supports - journal bearing, plummer block - footstep bearing-wall bracket - ball bearings.

Steam engine parts - stuffing box - cross head - connecting rod - eccentric.
I.C.Engine parts-piston, connecting rod.

References


FLUID MECHANICS
M 303                           2+2+0

Module 1
Introduction-Proprties of fluids- pressure, force, density, specific weight, compressibility, capillarity, surface tension, dynamic and kinematic viscosity-Pascal’s law-Newtonian and non-Newtonian fluids-fluid statics-measurement of pressure-variation of pressure-manomometry-hydrostatic pressure on plane and curved surfaces-centre of pressure-buoyancy-floating-stability of submerged and floating bodies-metacentric height-period of oscillation.
Module 2
Kinematics of fluid motion-Eulerian and Lagrangian approach-classification and representation of fluid flow- path line, stream line and streak line. Basic hydrodynamics-equation for acceleration-continuity equation-rotational and irrotational flow-velocity potential and stream function-circulation and vorticity-vortex flow-energy variation across stream lines-basic field flow such as uniform flow, spiral flow, source, sink, doublet, vortex pair, flow past a cylinder with a circulation, Magnus effect-Joukowksi theorem-coefficient of lift.

Module 3
Euler’s momentum equation-Bernoulli’s equation and its limitations-momentum and energy correction factors-pressure variation across uniform conduit and uniform bend-pressure distribution in irrotational flow and in curved boundaries-flow through orifices and mouthpieces, notches and weirs-time of emptying a tank-application of Bernoulli’s theorem-orifice meter, ventury meter, pitot tube, rotameter.

Module 4

Module 5
Flow of a real fluid-effect of viscosity on fluid flow-laminar and turbulent flow-boundary layer thickness-displacement, momentum and energy thickness-flow through pipes-laminar and turbulent flow in pipes-critical Reynolds number-Darcy-Weisback equation-hydraulic radius-Moody’s chart-pipes in series and parallel-siphon losses in pipes-power transmission through pipes-water hammer-equivalent pipe-open channel flow-Chezy’s equation-most economical cross section-hydraulic jump.

References
3. Fluid Mechanics - B.S.Massey
6. Hydraulics and Fluid Mechanics - Mody and Seth

METALLURGY AND MATERIAL SCIENCE
M 304 3+1+0
Module 1


Module 2

*Cold working*, strain hardening, recovery, re-crystallization, grain growth, grain size and its effects on mechanical properties-- Hot working, super plasticity -- Reasons for alloying, phase transformation phase rules, single phase, multi phase equilibrium diagrams, solid solutions, inter metallic compounds – Equilibrium diagram reactions: monotectic, eutectic, eutectoid, peritectic, peritectoid -- *Polymorphism* – Detailed discussion of Iron-Carbon diagram with microstructure changes in ferrite, austenite, cementite, graphite, pearlite, martensite, bainite.

Module 3

Definition and aims of *heat treatment*– Annealing, spheroidizing, normalizing, hardening, tempering, austempering, martempering with microstructure changes -- *Surface treatment:* Diffusion methods: carburizing, nitriding, cyaniding -- Thermal methods: flame hardening, induction hardening – Deposition methods: hot dipping and coating, impregnation, metal spraying, metal cladding – *Various strengthen mechanisms in metals:* work hardening, grain boundary hardening, grain size reduction, solid solution hardening, dispersion hardening.

Module 4

*Alloy steels:* Effects of alloying elements on: dislocation movement, polymorphic transformation temperature, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties -- Nickel steels, chromium steels, etc – Effects on steels, containing molybdenum, vanadium, tungsten, cobalt, silicon, copper and lead – high speed steels - - *Cast irons:* classifications, gray, white, malleable and spheroidal graphite cast iron, composition, microstructure, properties and applications - *Principal non ferrous alloys* like aluminum, beryllium, copper, magnesium, nickel, study of composition, microstructure, properties and applications- Reference shall be made to the phase diagrams whenever necessary.

Module 5

References


THERMO DYNAMICS

M 305 2+2+0

Module 1

Module 2

Module 3
Second law of thermo dynamics-Various statements and their equivalence-Reversible process and reversible cycles – Carnot cycle-Corollaries of the second law-Thermo dynamic temperature scale- Clausius inequality-Concept of entropy-Calculation of
change in entropy in various thermo dynamic processes- Reversibility and irreversibility-
Available and unavailable energy – Third law of thermo dynamics.

Module 4
Thermo dynamics relations- Combine first and second law equations- Helmholtz and
Gibbs functions – Maxwell relations- equations for specific heats, internal energy,
enthalpy and entropy – Clausius- Clapeyron equation – applications of thermo dynamic
relations.

Module 5
Properties of pure substances – PVT, PT and TS diagrams, Mollier diagrams- Mixture of
gases and vapours-mixture of ideal gases-Dalton’s law-Gibbs law – Thermo dynamic
properties of mixture-mixtures of ideal gases and vapours-Psychrometric principles-
Psychrometric chart-Applications.

References
1. Engineering Thermodynamics - P.K.Nag
3. Engineering Thermodynamics - Spalding and Cole
4. Engineering Thermodynamics - M.Achuthan
5. Thermodynamics - Keenan
6. Thermodynamics - Obert
7. Thermodynamics - Holman
8. Heat and Thermodynamics - M.N.Zemansky
9. Thermodynamics - Rogers, Pearson

STRENGTH OF MATERIALS AND STRUCTURAL ENGINEERING
M306 3+1+0

Module 1
1 Stress and strain - Bars of varying cross-sections – composite sections - temperature
stresses. Principal stresses and planes-Mohr's circle representation of plane stress.

Module 2
Shear force and bending moments-Cantilever-simply supported and overhanging beams-
concentrated and U. D. loadings analytical method. Relation between load. SF and BM.
Theory of simple bending- bending and shear stress distribution rectangular, circular and
1-sections.

Module 3
Slope and deflection of simply supported beams and cantilevers- Double integration-
Module 4
Torsion of circular shafts-solid and hollow shafts- power transmitted by shafts. Close-coiled and open coiled spring- leaf spring. Thin cylinders and jhick cylinders subjected to internal and external pressures- compound pipes -wire wound pipes-strain energy-axial loads, gradually and suddenly applied load-impact loads.

Module 5

References
7. Ryder G.H., Strength of Materials, ELBS.

FLUID MECHANICS LABORATORY
M 307 0+0+3
1. Study of plumbing tools and pipe fittings
2. Study of taps, valves, gauges, pitot tubes, watermeters and current meters
3. Determination of metacentric height and radius of gyration of floating bodies.
4. Hydraulic coefficients of orifices and mouthpieces under constant head method and time of emptying method.
5. Calibration of venturimeter, orifice meter and water meter
6. Calibration of rectangular and triangular notches
7. Determination of Darcy’s and Chezy’s constant for pipe flow
8. Determination of critical velocity in pipe flow.
9. Determination of minor losses in pipe flow
10. Experimental verification of Bernoulli’s theorem
11. Determination of Chezy’s constant and Mannings number for open channel flow.
12. Determination of discharge coefficient for Plug-Sluices

STRENGTH OF MATERIALS LABORTAORY
1. Tests on springs (open and close coiled)
2. Bending Test on Wooden Beams using U. T. M.
4. Torsion Pendulum (M.S. wires. Aluminum wires and brass wires)
5. Torsion test using U. T. M. on M. S. Rod, torsteel and High Tensile steel.
6. Torsion Test on M. S. Rod
7. Shear Test on M.S. Rod.
8. Fatigue Test
9. Impact Test (Izod and Charpy)
10. Hardness Test (Brinell, Vicker's and Rebound)
11. Strut Test.

Note
All tests should be done as per relevant BIS
FOURTH SEMESTER
Module 1

**Ordinary Differential Equations:** Linear Differential equations with constant coefficients
- Finding P.I. by the method of variation of parameters – Cauchys equations- Linear Simultaneous eqns- simple applications in engineering problems.

Module 2


Module 3


Module 4

**Probability and statistics:** Fundamentals of probability, Bayes theorem - Binomial law of probability - The binomial distribution, its mean and variance - poisson distribution as a limiting case of binomial distribution - its mean and variance - fitting of binomial & poisson distributions - normal distribution - properties of normal curve - standard normal curve - simple problems in binomial, poisson and normal distributions.

Module 5

**Population & Samples:** Sampling distribution of mean (σ known) –Sampling distribution of variance, F and Chi square test – Level of significance - Type 1 and Type 2 errors – Test of hypothesis – Test of significance for large samples – Test of significance for single proportion, difference of proportions, single mean and difference of means (proof of theorems not expected)

References

7. Probability and statistical inferences – Hogg and Tanis, Pearson Education Asia
Module 1

Kinematics: Links, pairs, chain, mechanisms, machines, inversion of single and double slider crank, quadric cycle chains-kinematic diagram-expression for degree of freedom-equivalent curves- coupler curves-spatial mechanisms-manipulations- velocity analysis by instantaneous center method-Kennedy’s theorem- velocity and acceleration of various mechanisms by analytical and graphical method-Coriolis component of acceleration-analytical treatment of slider crank and four bar chain-Klein’s construction-locating instantaneous center-velocity and acceleration image.

Module 2

Linkage Synthesis: Precision points-graphical synthesis of slider crank mechanisms, rocker mechanisms, four bar linkage-overlay method-number synthesis-basic features of mechanical synthesis-graphic and analytical methods of dimensional synthesis-kinematic synthesis-approximate and exact synthesis.

Module 3

Mechanisms: Pantograph, approximate straight line, straightline mechanisms- engine indicator mechanisms-steering gear-Davis and Ackerman type-quick return- Whitworth, slider crank mechanism-Hooke’s joint, Scott-Russel, Watt and grasshopper mechanisms.

Module 4

Brakes and clutches: Shoe, double block, long shoe, internally expanding shoe, band, band & block, hydraulic, mechanical, air and powerbrakes-braking of a vehicle-cone, single plate, multiple, centrifugal clutches.

Dynamometers: Pony brake. rope brake, epicyclic train, belt transmission and torsion dynamometers-effort and power.

Module 5

Gears: Condition for constant velocity ratio-law of gearing-conjugate teeth action-tooth forms-standard modules and tooth proportions-contact ratio-interference-spur, helical, bevel, spiral, and hypoid gears- gear forces.

References

1. Theory of Machines - Thomas Bevan
4. Theory of Machines - V.P.Singh, Pearson
5. Theory of Machines - P.L.Bellaney
Module 1


Module 2

Euler’s turbine equation: velocity triangles – impulse and reaction turbines – Pelton wheel, Francis turbine Kaplan turbine – construction features and performance characteristics – non dimensional parameters for comparative study of turbine performance – unit speed, unit power, unit quantity, run away speed, geometric similarity – model laws – effect of specific speed on speed, runner size, flow type etc. – theory of draft tube – speed regulation of turbines – selection, type and speed of turbines.

Module 3


Module 4

Module 5


References

1. Abdulla Sheriff - Hydraulic machines, standard publishers.
2. Govinda Rao N. S. - Fluid flows machines, TMH.
4. Pippinger. - Industrial hydraulics.
5. Centrifugal and axial flow pumps - Wiley & sons. – Stepanoff John A. J.

MACHINE TOOLS

Module 1

Types and classification of lathes: Specifications-method of holding work and tool, accessories, attachments-operations and types of tools for each operation-tool room lathe-duplicating lathe-Capstan and Turret lathe-horizontal and vertical automatics-single spindle and multi-spindle screw machines-manufacture of cylindrical bolts, stepped bolts, shafts-profile turning. Drilling and boring machines:- types and specifications-description of tool and work holding devices-boring tools and reamers-drilling of holes, countersinking and counterboring operations-boring of cross holes-manufacture of bushes.

Module 2


Module 3

Module 4

**Numerical Control (NC) machine tools:** Elements, classification (basics only)-NC tooling-design of NC/CNC tooling-automated chip less process.

**Automatic machines:** Semiautomatic multi tool central lathes-automatic cutting of machines- Swiss type automatic screw machines, multi spindle automatic special purpose machine tools- program controlled machine tools-copying machines.

Module 5

**Computers in production technology:** CIM-computer simulation of manufacturing process and systems-cellular manufacturing-FMS - just in time production-management of toolroom-machining centers-automatic tool changing-manufacture of ICs, PCBs, Ceramic circuit boards, and advanced PCBs-expert systems in manufacturing-unmanned machining- trends in automated factory.

References

1. Production Technology - R.K.Jain
2. All about Machine tools - Gerling
3. Workshop Technology: Vol. 1,2 and 3 - W.A.J.Chapman
4. Production Technology - H.M.T.
5. Machine Tools: Vol. 1, 2, 3 and 4 -Acherkan
7. Manufacturing Engineering &Technology -S.Kalpakjian, S.A.Schmidt

**ELECTRICAL TECHNOLOGY**

**Module 1**


**D.C. motors:** Back emf - speed and torque equation - starting and speed control - testing of D.C. motors - brake test - swinburn's test.

**Module 2**

**Alternators - construction details:** Type - emf equation (winding factor need not be derived) - synchronous impedance - regulation by emf and mmf method. Synchronous Motors: Principle of operation - method of starting.

**Three phase induction motor:** Production of rotating magnetic field equivalent circuit-torque equation - torque slip characteristics - no load and blocked rotor tests - starting and speed control.

**Single phase motor:** Double revolving theory - capacitor start capacitor run induction motors – applications.
Module 3

Module 4

Module 5

References
1. Performance and design of D C machines – Clayton
2. Performance and design of A C machines – M G Say
3. Electrical Traction – Dover A T
4. Industrial and Power electronics – Harish C Rai
5. Electronic principles S K Sahdev
MACHINE DRAWING - II

Assembly and working drawings of the following: -

1. **Valves**: - Feed checkvalve, stop valve, spring loaded safety valve, Ramsbottom safety valve, lever safety valve, deadweight safety valve, blow off cock.
2. **Pulleys**: - Fast and loose pulleys, speed cone or stepped pulley.
3. **Clutches**: - Single plate clutch, cone friction clutch.
4. **Machine elements**: - lathe spindle, screw jack, machine vice, lathe tool post.

References


HYDRAULIC MACHINES LABORATORY


Experiments

Performance characteristic tests on Pelton wheel (Load test & best speed).  
Performance characteristic tests on Francis turbine (Load test & best gate opening).  
Performance characteristic tests on Kaplan turbine (Load test & best gate, vane angle opening).  
Performance characteristic tests on single stage, multi stage centrifugal pumps at constant speed & at variable speed. Actual & predicted curves.  
Performance characteristic tests on self-priming pump, Jet pump, Airlift pump and deep well pump.
Performance characteristic tests on axial flow pump.
Performance characteristic tests on Hydraulic ram.
Vibration measurement and computer aided fault diagnosis of a centrifugal / self-priming / Gear / Reciprocating pump.
Performance characteristic tests on reciprocating pump at constant speed.
Performance characteristic tests on Gear pump.
Performance characteristic tests on Screw pump.

References

1. Abdulla Sheriff. - Hydraulic machines, standard publishers.
2. Govinda Rao. N. S - Fluid flows machines, TMH.
4. Pippinger - Industrial hydraulics.

ELECTRICAL & ELECTRONICS LABORATORY

M408 0+0+4

ELECTRICAL MACHINES LAB

1. Efficiency and regulation of single phase transformer by direct loading.
2. Equivalent circuit of transformer from open and short circuit test-calculation of efficiency and regulation at various loads and power factors.
3. Regulation of alternator by emf and mmf methods.
5. No load and blocked rotor test on slip ring induction motor - equivalent circuit - torque-slip characteristics.
   b) External and internal characteristics of D C shunt generator.
7. Load test on D. C. series motor.
8. Swinbume's test - Pre determination of efficiency.

ELECTRONICS LAB

1. Diode characteristics
2. Transistor characteristics- C.B, C.E configurations
3. Pulse circuits
4. Rectifier circuits
5. Sweep generator
6. R C Coupled amplifier
7. R C Oscillator, L C Oscillator
8. Astable multivibrator
FIFTH SEMESTER
Module 1

Module 2

Module 3

Module 4

Module 5

References
7. Operations research – Panneer Selvam, PHI
Module 1
Patterns: - pattern allowances and materials-moulding-core and core prints-types of cores- pattern construction-layout and colour coding-tools-processes-moulding sand constituents, types and testing-moulding machines-moulding procedure-sand conditioning-gating system-cupola operation-pouring and cleaning of castings-defects in castings-inspection and quality control-casting machines-design of dies-centrifugal, continuous, investment, squeeze casting and shell- mould casting- -comparison of casting with other production processes.( include necessary figures)

Module 2

Module 3
Rolling: - principles-types of rolls and rolling mills-semifinished and rolled products-rolling of tubes, wheels, axles, I-beam-thread and gear rolling-friction and lubrication in metal forming-hot and cold rolling-rolling machines-heating and cooling in rolling-strip velocity and roll velocity-roll and roll pass design -Theories of rolling and effect of parameters-load calculation-High velocity forming - energysources - material behaviour - pneumatic, mechanical, electrohydraulic, electromagnetic, and explosive forming.

Module 4
Press working: - types of presses and pressworking operations involving shearing, bending, drawing, squeezing-Extrusion: - methods, machines-analysis of rod extrusion-Wire and wire drawing operations-analysis-die angles-simple, progressive and compound dies-plastic and rubber processing-Calendering-transfer, injection and compression moulding.

Module 5
Forging: -classification-process-equipments-drawing, deep drawing, punching, blanking-tube piercing-spinning and coining-elastic and plastic deformation-hot forging, die forging- machinery for forging-operation-heating in forging-manufacture of drop forging dies, presses-design of forgings and dies-upsetting-forging defects-forging analysis-quality assurance for forging-non destructive testing.
References

1. Workshop Technology - Raghuvanshi
2. Manufacturing Engineering & Technology - S.Kalpakjian and S.A.Schmidt
3. Manufacturing Processes - Begeman
5. Processes and Materials of Manufacture - Roy A.Lindberg

COMPUTER PROGRAMMING

M503  2+2+0

Module 1  
Introduction to C language – character set – operators – constants and variables – data types – use of built in I/O functions - use of control statements if, if – else, for, while, do-while and switch – use of logical AND, OR and NOT – pre-processor directive - writing summation of various mathematical series like e^x, sin(x), cos(x) etc.

Module 2  

Module 3  
Functions – declaration – global and local variables - call by value method – writing different string handling functions – storage classes – passing an array to a function – passing a structure to a function – recursion - macros – programs

Module 4  

Module 5  
Different types of files – reading writing and appending of text and binary files – other various file handling functions - transfer of data in blocks - command line arguments – use of bit-wise AND, OR and NOT.

References

1. Programming with C – Schaum’s series
2. Programming in C – Balaguruswamy
Module 1
Static force analysis: - force couples-conditions for equilibrium-free body diagram-analysis of four bar chain-force analysis of slider-crank mechanism-Coulomb friction.
Dynamic force analysis: - D’Alemberts principle-inertia forces-dynamic force analysis of four bar chain, and slider crank mechanism.

Module 2

Module 3

Module 4
Gear trains: -simple, compound-epicyclic trains with coaxial shafts.

Module 5
Cams and Followers: - types-follower motion-SHM-uniform velocity and acceleration-cycloidal - displacement, velocity and acceleration curves-cam profile-reciprocating and oscillating followers-tangent cams-convex and concave cams with footed followers.

References
1. Mechanism and Machine Theory - Ambedkar
2. Theory of Mechanism and Machines - A.Ghosh & A.K.Mallick
3. Theory of Machines - V.P.Singh
5. Theory of Mechanism and Machines - Joseph Shigley
MECHATRONICS AND CONTROL SYSTEMS

M 505                2+2+0

Module 1

Module 2
Input/Output systems: - ports, interface requirements-adaptors-programmable logic controllers-data-handling- digital communications-system, networks, protocols, interfaces, fault finding-design and mechatronics-design solutions.

Electromechanical systems: CD, DVD ROMs, OCR, Printers-Medical devices: Artificial internal organs-Diagnostic and Therapeutic EMDs.

Module 3
Introduction to Control systems Engineering:- concept of automatic control-open loop and closed loop systems-servomechanisms-block diagrams-transfer functions. Representation of control components and systems-Translational and rotational mechanical components-series and parallel combinations-comparators, integrating devices, hydraulic servomotors, temperature control systems, and speed control systems.

Module 4

Module 5
References

1. Mechatronics - W.Bolton, Pearson
2. Understanding Electromechanical Engineering - Lawrence J.Kamm
3. Mechatronics - Dan S. Necsuleseu, Pearson
5. Automatic Control Theory - Ravan
6. Modern Control Engineering - Katsuhiko Ogata
7. Control Systems - A.Nagoor Kani
8. Modern Control Engineering - Dorf, Pearson

THERMAL ENGINEERING - I

M 506 2+2+0

Module 1
Steam Engineering: Properties of steam - wet, dry and superheated steam - dryness fraction - enthalpy and internal energy - entropy of steam - temperature entropy diagram - process - Mollier chart - Rankine cycle for wet, dry and superheated steam. Steam Generators - classification - modern steam generators - boiler mountings and accessories.

Module 2
Steam nozzles - Mass flow rate - throat pressure for maximum discharge - throat area - effect of friction - super saturated flow.
Steam turbines: velocity triangles, work done, governing, and efficiencies.

Module 3

Module 4
Introduction to solar energy - solar collectors - Liquid flat plate collectors - principle - thermal losses and efficiency - characteristics - overall loss coefficient - thermal analysis - useful heat gained by fluid - mean plate temperature - performance - focussing type solar collectors - solar concentrators and receivers - sun tracking system - characteristics - optical losses - thermal performance - solar pond - solar water heating - solar thermal power generation (Description Only)

Module 5
Thermal power plants: layout and operation of steam and diesel power plants - coal burners - stockers - cooling ponds & towers - chimneys - draught - dust collectors -
precipitators - feed water heaters - evaporators - steam condensers - coal handling - ash handling.

References

1. Power plant technology - E. L. Wahid
2. Thermodynamic and heat power engineering - Mathur and Mehta
4. Gas Turbine Theory - Cohen & Rogers
5. Solar Energy Utilization - G. D. Rai

COMPUTER LABORATORY

M 507

0+0+3

a) Familiarization of operating systems. Use of file directories, editors, compilers and file managers etc.
b) Familiarization of Word processing packages – editing, formatting and printing
c) Familiarization with spread sheet packages for graphical representation of data
d) Introduction to computer aided drafting – drawing simple objects
e) Programming experiments in C to cover control structures functions, arrays, structures, pointers and files

Examples: -

i. Counting characters, lines and words
ii. Checking leap year
iii. Finding sum of digits and reversing a number
iv. Generating Prime numbers, Fibonacci numbers and Angstrom numbers
v. Sine and Cosine series
vi. Sorting of numbers, strings and records
vii. Matrix addition and multiplication
viii. Implementation of dynamic memory allocation
ix. Implementation of linked lists
x. File handling
xi. Problems using Command line arguments

MACHINE TOOL LABORATORY

M 508

0+0+3

Study of Centre Lathe: Origin of the name lath and lathe- specification of lathe- head stock, tail stock, carriage, cross slide, compound rest, guide ways, feed gar box, apron
box, micro structural requirement of bed material. Accessories: Chuck, two and three jaws, and faceplate, follow rest, tool post grinder, and centres.

**Study of Machining technology:** Study of metal cutting – tool terminology as per ASA, ISO, DIN standards – merchant’s circle, Lee & Shaffer theory, thick & thin zone models - tool materials, coated HSS, ceramic, CBN, diamond etc, inserts, chip breakers -- Tool wear mechanisms, VB determination - Use of Taylor’s equation at shop floor - Machineability index - Role of specific heat in cutting fluids. – Cutter types and selection – Abrasive machining (Ra values) – Diamond turning of parts (Ra values) - Production of axi – symmetric parts – Production of prismatic components – Hole machining – Gear machining.

**Study of Basic measurement and devices:** accuracy, precision, sensitivity, and standards of measurements, metrology lab; standard and calibration, linear measurements, limit gauges (types and design), Taylor’s principle, comparators (optical, mechanical, electrical, pneumatic), slip gauges, optical projector with digital measuring. – Geometrical measurements: angular measurements, vernier and optical protractors, sine bar. - Measurement of light wave interference, flatness and parallelism and round measurement, checking the dimensional accuracy of slip gauges with interference microscope. - **Surface characterization:** measurement of surface finishes RMS and CLA values, waviness, cut off, skid, instruments for measurement of roughness of a sand cast surface, slip gauge surface, ground bore of an engine cylinder, importance of surface finish on crack initiation. – **Screw thread terminology**, best wire size, two and three wire methods pitch measurement – Gear metrology (spur gear): run out checking, composite errors, base pitch measurement, profile measurement, checking backlash, alignment errors. – **Advanced measuring devices:** CMM, machine vision, toolmakers microscope, limitations, SEM, & TEM, laser measuring instruments, laser micrometer and alignment test using laser interferometry.

**Experiments**

Student’s assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and university examination shall be done by Faculty members.

References

2. HMT- Production Technology, TMH.
SIXTH SEMESTER
MECHANICS OF MATERIALS

Module 1

Module 2

Module 3

Module 4

Module 5

References
1. Theory of Elasticity - Timoshenko & Goodyear
3. Advanced mechanics of Solids - L.S.Srinath
5. Introduction to Mechanics of Solids - Ezer P.Popov
Module 1

*General measurements concepts:* Principles for achieving accuracy; Methods for estimating accuracy and precision, precision Vs accuracy, systematic and constant errors; progressive, random, erratic, drunken errors; statical concepts in metrology, statistical analysis of measurement data, control chart techniques – comparators – *General principle of measurements:* line & end measurements, standards; linear measurements, basic units, and quantities for displacement, mass, time, temperature & optics; systems of limits and fits; selecting & assigning of fits, tolerances for linear dimensions.

Module 2


Module 3

*Measurement of surface finish:* surface structure, integrity, texture, roughness, waviness, lay, cut off, RMS & CLA values, roughness values produced by machining processes, instruments for different surface finish measurements, concept of apparent to real area of contact of mating surfaces, applications in clutch plate surface, brake liner, inner race of a bearing, cylinder liner, machine tool guide way, surface to be painted etc & importance of surface finish on crack initiation. *Optical measuring instruments:* interferometry, optical flats, optimeters, and optical projectors, tool maker’s microscope, limitations, SEM & TEM.

Module 4


Module 5

*Generalized measurement system:* measurement terminology, input, output configurations, static characteristics, errors in measurement, drift, noise, accuracy, precision static sensitivity and resolution, loading effects on instruments- *Detector transducer elements:* principles of calibration, applications in measurement of strain, types of strain gauges, application in measurement of load & torque, measurement of force and torque, hydraulic, pneumatic & train gauge type load cells, hydraulic & electric
Reference

1. ASME - Hand book of industrial Metrology
2. Beckwith - *Mechanical measurements, 5/e, Pearson*
4. Hume - Metrology, McDonald
5. Sharpe - Metrology, ELBS
6. Taher - Metrology, ELBS
Pollutant formation and control in S. I. and C. I. Engine, Nox, CO, Unburned hydrocarbon and particulate - Exhaust gas treatment - catalytic converter - Thermal reaction - Particulate Trap.

References

1. Internal Combustion Engine Fundamentals - John B. Heywood
2. Internal Combustion Engine and Air Pollution - Obert E. F.
3. Internal Combustion Engine - Lichty L. C.
4. Internal Combustion Engine - V. Genesan
5. A course in internal combustion Engine - Mathur and Sharma.

HEAT AND MASS TRANSFER

M 604 2+2+0

Module 1

Module 2

Module 3
Module 4
Radiation - Nature of thermal radiation - Definitions and concept - Monochromatic and total emissive power - Absorptivity - Reflectivity transmissivity, Black Grey and Real surfaces. Concept of Black body Planks distribution law - Kirchoff's law Wein's displacement law-Geometric factors of simple configuration. Heat exchange by radiation between black surfaces - Large parallel black plate - equal parallel and opposite black squares, discs, black rectangles perpendicular to each other having a common edge-heat exchange by radiation between large parallel planes of different emissivity (no derivations - simple problems with the use of chart and equations)

Module 5

References
1. Elements of Heat Transfer - Jacob Hawkins
2. Principles of Heat Transfer - Krieth
3. Heat and Mass Transfer - Fckert & Drake
4. Heat transfer - Holmann
6. Engineering Thermodynamics and Heat Transfer - Gupta and Rajendra Prasad

PRINCIPLES OF MANAGEMENT AND ENGINEERING ECONOMICS

M605 3+1+0

Part A – Principles of Management

Module 1
Functions of management: planning, organizing, staffing, directing, motivating, communicating, controlling and coordinating – Organizational structure-line, staff and functional relationship-span of control and delegation.
Module 2

Module 3
Formation of companies: proprietary and partnership-joint stock, private limited, public limited companies-private sector, public sector, joint sector and co-operative sector.

Wages and incentives: Time and piece rate system, bonus, incentives-monetary and non-monetary Total quality management-re-engineering-management by objectives

Part B – Engineering Economics

Module 4

Module 5

References
1. Benga & Sharma – Industrial Organisation and Management
2. Fred Lufthans – Organisational Behaviour
3. Keith Davis – Human Behaviour at Work
4. Philip Kotler – Marketing Management
5. K.K.Dewett – Modern Economic Theory
COMPUTER AIDED DESIGN AND MANUFACTURING

M 606 3+1+0

Module 1
Evolution of CAD/CAM and CIM segments of generic CIM, computers and workstation,
elements of interactive graphics, input/ output display, storage devices in CAD - an
overview of CIM software - 2D Graphics: line drawing algorithms, DDA line algorithm
– circle drawing, bressnham’s circle drawing algorithm – 2D translation, rotation, scaling
– clipping -3D Graphics (basic only).

Design process – CAD process: wireframe, surface, solid modeling; Engineering
analysis; design review & evaluation, automated drafting – CAD hard ware, software,
data presentation, CAD software packages

Module 2
Numerical control: Need - advantages & disadvantages – classifications – Point to point,
straight cut & contouring positioning - incremental & absolute systems – open loop &
closed loop systems – DDA integrator & Interpolators – resolution – CNC & DNC.
Programmable logic controllers (PLC): need – relays- logic ladder program – timers -
Simple exercises only.
Devices in N.C. systems: Driving devices - feed back devices: encoders, moire fringes,
digitizer, resolver, inductosyn, tachometer.

Module 3
NC part programming: part programming fundamentals - manual programming – NC co-
ordinate systems and axes – tape format – sequence number, preparatory functions,
dimension words, speed word, feed word, tool world, miscellaneous functions –
programming exercises.
Computer aided part programming: concept & need of CAP – CNC languages – APT
language structure: geometry commands, motion commands, postprocessor commands,
compilation control commands – programming exercises – programming with
interactive graphics.

Module 4
Automated process planning: Process planning, general methodology of group technology, code structures of variant & generative process planning methods, AI in process planning, process planning software.

Module 5
Robotics: Industrial robots and their applications for transformational and handling activities, configuration & motion, actuators, sensors and end effectors, feature like work envelop, precision of movement, weight carrying capacity, robot programming languages.
Vision systems: introduction to intelligent robots.

References
1. Craig John - Introduction to Robotics
2. Groover M.P. - CAD/CAM, PHI.
7. Jonn Craig - Introduction to Robotics

HEAT ENGINES LABORATORY
M 607
Study of systems and components of IC Engines and automobiles - study of dynamometers used in engine testing - study of IC Engine repairs and maintenance. Study of boilers, boiler mountings and accessories - study of steam engine parts and systems.

Testing of IC engines • Performance analysis of IC engine using computerized test rig-Load test on petrol and diesel engines- determination of indicated and brake thermal efficiencies - mechanical efficiency - relative efficiency - volumetric efficiency - air-fuel ratio and compression ratio - valve timing diagram - retardation test - Morse test - heat balance - effect of varying the rate of cooling water and varying the speed on the performance characteristics of engines. Testing of steam boiler - boiler trial - steam calorimeters and steam nozzles - performance test on steam engines - performance test on steam turbines.

Testing of fuels and lubricants - determination of flash and fire points of petroleum products - determination of kinematics and absolute viscosity of lubricating oils - determination of calorific
Study of Vibration: two and multi degree freedom systems, signature analysis and preventive maintenance, noise control. Study of Automated process planning: process planning, general methodology of group technology, code structures variant generative process planning methods, AI in process planning.


Experiments

Key way slotting, side & face milling of a rod to make square head – 5mm material removal by Shaping – Drill 10.5 mm. CBR 16 mm, 10 mm deep – Surface grinding, cylindrical grinding and tool grinding - Vibration study of machine tools with an analyser. Preparation of process plans using CAPP software –Planning of experiments for process improvement using software – simulation of factory layout - facilities layout analysis – line balancing – materials requirement planning – inventory analysis – quality assurance using control charts – preparation of process sheet for manufacturing of spindle like & housing type component – preparation of process plan & cost estimation for the manufacture of typical product like submersible pump, three phase motor etc. Preparation of CNC programs for drilling, grooving, parting, linear interpolation, circular interpolation, etc. – Simulate and produce a component has valley shaped undercuts along its length, etc. PLC operated solenoid valves. Design of a jig and a fixture for

Student’s assessment, continuous evaluation, awarding of sessional marks, record bonafides, oral examination etc and university examination shall be done by Faculty members.

References

2. HMT - Production Technology, TMH.
3. Petruzella Frank. D - Programmable logic controllers.
SEVENTH SEMESTER
Module 1
Introduction to gas dynamics: control volume and system approaches acoustic waves and sonic velocity - Mach number - classification of fluid flow based on mach number - mach cone-compressibility factor - General features of one dimensional flow of a compressible fluid - continuity and momentum equations for a control volume.

Module 2

Module 3
Simple frictional flow: adiabatic flow with friction in a constant area duct-governing equations - fanno line limiting conditions - effect of wall friction on flow properties in an Isothermal flow with friction in a constant area duct-governing equations - limiting conditions. Steady one dimensional flow with heat transfer in constant area ducts-governing equations - Rayleigh line entropy change caused by heat transfer - conditions of maximum enthalpy and entropy

Module 4

Module 5
Propulsion: Air craft propulsion: - types of jet engines - energy flow through jet engines, thrust, thrust power and propulsive efficiency turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems. Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines. Rocket propulsion - rocket engines, Basic theory of equations - thrust equation - effective jet velocity - specific impulse - rocket engine
performance - solid and liquid propellant rockets - comparison of various propulsion systems.

References

1. Compressible fluid flow - A. H. Shapiro
2. Fundamentals of compressible flow with aircraft and rocket propulsion - S. M. Yahya
3. Elements of gas dynamics - Liepman & Roshko
4. Aircraft & Missile propulsion - Zucrow
5. Gas dynamics - M.J. Zucrow & Joe D.Holfman

INDUSTRIAL ENGINEERING

Module 1
Introduction: Evolution of Industrial Engineering- Fields of application of Industrial Engineering -Functions of Industrial Engineer-Organisational structure of Industrial Engineering Department.
Value Engineering: Historical perspective-reasons for poor values-types of values-the different phases of value analysis-applications of value analysis.

Module 2
Plant design: Plant location-factors influencing plant location. Plant layout-types of plant layout-introduction to layouts based on group technology, just in time and cellular manufacturing systems.
Material handling: Principles of material handling-selection of material handling devices-types of material handling equipments.

Module 3
Job evaluation and merit rating: Objectives of job evaluation-Methods of job evaluation. Objectives and uses of merit rating-Merit rating plans.

Module 4
**Ergonomics**: Objectives and applications.

**Module 5**

**Inventory control**: Determination of Economic order quantity and reorder level.

**Quality control**: Destructive and nondestructive testing methods. Statistical quality control-process control charts-acceptance sampling.

**Cost accounting and control**: Elements of cost- Selling price of a product-Types of cost-Allocation of overheads.

**References**

1. Production system - Riggs
2. Production control - Hiejet
3. Human factors in Engg design - Mc Cormic E.J.
5. Industrial Organisation & Management - Banga & Sarma
6. Industrial Engg - A.P.Verma
7. Value Engg - Mudge
8. Manufacturing organization & Management - Amrine
9. Time & Motion Study - Lowry
10. Quality Control - Hansen

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**REFRIGERATION AND AIR CONDITIONING**

**M 703**

**Module 1**

Principles of refrigeration: Thermodynamics of refrigeration - Carnot cycle, reversed carnot cycle, heat pump, and refrigerating machine- coefficient of performance - unit of refrigeration - refrigeration methods- conventional refrigeration systems. Air refrigeration system- Bell Coleman cycle - C.O.P. capacity work and refrigerant flow requirements in Bell - Coleman cycle.

**Module 2**

Vapour compression system: simple cycle -comparison with Carnot cycle - theoretical, actual and reactive - COP effect of operating parameters on COP - wet, dry and superheated compression - under cooling - actual cycle representation on TS and PH diagrams simple problems. Advanced vapour compression systems - multistage vapour compression systems - flash chamber multiple compression and evaporation systems cascading - simple problems.

**Module 3**
Vapour absorption systems: simple, cycles - actual cycle - ammonia water and lithium bromide water systems - COP - electrolux system. Refrigerant and their properties: Nomenclature - suitability of refrigerants for various applications - unconventional refrigeration methods- Vortex tube, steam-jet, magnetic (cryogenics) refrigeration and thermoelectric refrigeration - applied refrigeration house hold refrigerators - unit air conditioners and water coolers - ice plant cold storage.

Module 4

Module 5

References
1. Refrigeration and air conditioning - Ballaney P. L.
2. Refrigeration and air conditioning - Stocker W. F.
3. Refrigeration and air conditioning - Jordan and Protester
4. Principles of Refrigeration - Roy J. Dossat

DYNAMICS OF MACHINERY
M 704 2+1+0

Module 1
Balancing: - Balancing of rotating masses, static balancing and dynamic balancing, Balancing of several masses rotating in same plane, Balancing of several masses rotating in several planes, Balancing machines.


Module 2

Vibrations: - Definitions, simple harmonic motion.  
Single degree freedom systems: - 
Undamped free vibrations: - Equations of motion Natural frequency, Energy method, Equilibrium methods, Rayleigh’s methods, Equivalent stiffness of spring combinations.  
Damped free vibrations: - Viscous damping, Free vibrations with viscous damping, over-damped system, critically damped system, under-damped system, Logarithmic decrement, viscous dampers, coulomb damping.  

Module 3

Two degree freedom systems: - Principal modes of vibration, Rectilinear and angular modes, systems with damping, vibration absorbers, centrifugal pendulum damper, dry friction damper, untuned viscous damper.  
Torsional Vibrations: - Torsionally equivalent shaft, torsional vibration of two-rotor, three-rotor, and geared systems.

Module 4

Critical speeds of shafts: - Critical speed of a light shaft having a single disc without damping. Critical speeds of a light cantilever shaft with a large heavy disc at its end.  
Transient vibration: - Laplace transformation, response to an impulsive input, response to a step input, response to a pulse input, phase plane method, shock spectrum.  
Non-linear vibrations: - Phase plane, undamped free vibration with non-linear spring forces, hard spring, soft spring, Perturbation method, Forced vibration with nonlinear forces, Duffings equation, self excited vibrations.

Module 5

Noise control: - Sound propagation, decibels, acceptance noise levels, Air columns, Doppler effect, acoustic measurements, microphones and loud speakers, Recording and reproduction of sound, fourier’s theorem and musical scale, Acoustics of buildings, Acoustic impedance filters and human ear.
References

1. Theory of Machines - Thomas Bevan
2. Theory of Machines - P.L. Ballaney
4. Theory of Vibrations with applications, III Edn - W.T. Thomson
5. Mechanical Vibrations - S. Graham Kelly, Schaum’s outlines
9. Noise & Vibration Control - Leo N. Beraneck

MACHINE DESIGN AND DRAWING - I

Module 1


Module 2

Springs – Classification and uses of springs – design of helical springs – effect of end turns – energy absorbed – deflection – design for fluctuating loads – vibration in springs – buckling of spring materials

Shafts – Torsion and bending of shafts – hollow shafts – design of shafts for strength an deflection – effect of keyways – transverse vibration and critical speed of shafts

Design of IC engine parts – connecting rod – piston – flywheel –

References

1. Mechanical Engg. Design – Joseph Shigley
7. Elements of Machine Design – Pandya & Shah

Note

For the University Examination 100% choice may be given. i.e. two questions from each module with full choice.

OPTIMIZATION TECHNIQUES (ELECTIVE - I)

CMELRTA 706-1 3+1+0

Module 1: Classical optimization techniques

Module 2: One-dimensional unconstrained minimization

Module 3: Unconstrained minimization

Module 4: Integer – Linear programming problem
Gomory’s cutting plane method – Gomory’s method for all integer programming problems, mixed integer programming problems.

Module 5: Network Techniques

References

1. Optimization theory and application - S.S. Rao, New Age International P. Ltd.
5. Operations Research - R. Panneerselvam, PHI

PLANT ENGINEERING AND MAINTENANCE (ELECTIVE-I)

Module 1

Module 2
Lubricants: -solid, fluid and semifluid-synthetic lubricant-general properties and uses-tests and classification-aniline point-cloud, pour and flash point-carbon residue-flash and fire points-sulphur content-lubricant additives-lubricant systems-lubrication equipments and components.

Module 3

Module 4

Module 5
Non destructive testing and diagnostic instruments: - inventory control of spare parts-simple problems.

Safety management: - accident prevention program-designing of safe operation-fire protection –legal provisions for safety in industry.

References
1. Standard Handbook of Plant Engineering - Robert C. Rosder
2. Reliability & Maintainability Management - Balbir S. Shillon
3. Industrial Maintainence Management - Sushilkumar, Srivasthava
4. Handbook of Tribology - Bharat Bhooshan, B.K. Guptah
5. Inspection, Quality control and Reliability - S.C. Sharma

WELDING TECHNOLOGY (ELECTIVE - I)

M 706-3  
3+1+0

Module 1

Introduction: - Welding as a fabrication process - advantages and limitations – principal types of welding process and their characteristics.

Module 2


Module 3


Module 4

Module 5
Basic metallurgy of welding: Three prominent zones: weld metal zone – heat affected zone & the unaffected zone.
Welding Stresses: causes of development of residual stresses – methods of relieving or controlling of residual stresses in weldments.

Defects: commonly found defects in welded joints.
Inspection & testing of weldments: - Needs of inspection & testing of weldments – the various testing methods – destructive tests such as tensile, bend, impact, neck break & hardness tests – Non destructive tests such as Magnetic particle, Ultrasonic, Dye-penetrant, radiographic & eddy current methods.

References
1. Welding Engineering -Rossi
2. Welding & welding Technology -Little.
3. Metallurgy of welding -Bruckner
4. The Electric Welder -Tse Golsky
5. Welding Engineer’s Hand Book Vol 1,2 & 3 (ASME)
6. Welding for Engineers -Udin & Funk
8. Welding Engineering -R.L Agarwal
9. Welding engineering & Technology -R. S. Parmer

FOUNDRY TECHNOLOGY (ELECTIVE - I)
M 706-4 3+1+0

Module 1
Patterns: Different types of patterns – colour codes of patterns.
Moulding sands: Natural and synthetic sand- ingredients of moulding sands- special sand additives sand mixing- general properties of moulding sand – testing of moulding sand - effect of ingredients and Additives on properties of moulding sand- reusability of moulding sands- sand conditioning.
Module 2
Gates and gating system – functions and types of gates – design of gating system – gating ratios for ferrous and nonferrous castings – risering- functions and requirements of riser – types of risers - theoretical considerations – Chvorinov s rule – riser shape and directional solidification – use of chills, insulators and exothermic compounds

Module 3
Ferrous foundry metallurgy: Gray cast iron – composition – effect of composition in properties – types of graphite in gray cast iron – foundry characteristics of grey cast iron – effect of inoculation and inoculants – low alloy and high alloy cast iron – malleable iron – white heart and black heart malleable iron – malleablisation – S.G. iron – compositon and properties

Module 4
Non-ferrous foundry metallurgy: Foundry characteristics of copper and aluminium base alloys – degassing and melt treatment.
Melting and pouring: Types of furnaces used for C.I., steel and non-ferrous metals – details and charge calculation in cupola charging

Module 5
Cleaning and inspection: Knock out and fettling – destructive and non-destructive testing- salvaging.
Mechanisation in foundry: Elementary ideas of mechanisation in sand conditioning and supply, moulding, core making, knock out and fettling.

References
1. Principles of Metal Casting - Hine and Rosenthal
2. Foundry Technology - P.R.Beeley
3. Manufacturing Science - Amitabha Ghosh and Ashok Kumar Mallick
4. Manufacturing Engineering and Technology - Kalapakjian and Schmid

ADVANCED OPERATIONS RESEARCH (ELECTIVE - I)

M 706-5 3-1-0

Goals: The course is designed to develop an understanding of operation research with particular attention to linear programming, dynamic programming, and integer programming.

Module 1
- Linear Programming
  1. Problem Formulation
  2. Graphical Solution
  3. Simplex Method
4. Revised Simplex Method
5. Duality Theory
6. Sensitivity Analysis

Module 2
- **Transportation Model**
  1. North-west corner method
  2. Least cost method
  3. VAM
  4. Test of optimality

Module 3
- **Integer Programming**
  1. Introduction, basic concepts and simple problems
  2. Gomory’s all integral cutting plane method
- **Goal Programming**
  1. Application of goal programming
  2. Introduction basic concepts and simple problems

Module 4
- **Dynamic Programming**
  1. Shortest path models
  2. Characteristic of Dynamic Programming
  3. Discrete Dynamic Programming models

Module 5
- **Simulation**
  1. Basic Concepts
     Binomial distribution
     Poisson distribution
     Normal distribution
  2. Monti-cralo simulation
  3. Generation of random numbers
  4. Simulation software

Course Outcomes
1. Students will have a working knowledge of operation research techniques such as linear programming, Integer Programming, Goal Programming and Dynamic Programming.
2. Students will have the ability to analyze and perform sensitivity analysis on different optimum solutions generated.
3. Students will have the ability to tackle real life optimization problems.
MARKETING AND SALES MANAGEMENT (ELECTIVE - I)

M 706-6 3+1+0

Module 1


Marketing Management: Functions-Sales forecasting-Pricing-Distribution- Advertising- Sales promotion- Marketing research.

Module 2

Strategic Planning: Strategic business unit (SBU)- Business strategic planning-SWOT analysis. Marketing decision support system.

Module 3

Product life cycle: Marketing strategies in the different stages of product life cycle.

New product development: Idea generation- Concept development and testing- conjoint analysis.

Introduction to Relationship marketing, International marketing and online marketing.

Module 4

Consumer behaviour: Major factors affecting consumer buying behaviour- Consumer decision making process.

Organisational buying behaviour: Buying situations- the buying center- Purchasing process.

Module 5

Sales management: Evolution of Sales management- Objectives of Sales management- Personal selling situations- Theories of selling- Basic selling styles-Recruitment, selection and training of sales personnel-Sales territory-Sales quotas.

References

1. Marketing Management - Philip Khotler
2. Sales Management - Richard, Edward & Norman
3. Industrial Engg & Management - O.P. Khanna
4. Industrial Organisation & Management - Banga & Sarma
5. Organisational Behaviour - Fred Luthans
6. Consumer Behaviour - Schifman & Kanuk
7. Basic marketing - Gundiff
8. Marketing Management for small units - Jain
9. Sales Engg - Lester
10. Salesmanship concept - Thomson

COMPUTATIONAL FLUID DYNAMICS (ELECTIVE - I)
M 706 -7 3+1+0

Module 1
Basic concepts: -conservation principles-mass, momentum energy-conservation of scalar quantities-dimensionless form of equations-simple mathematical models for incompressible, inviscid, potential and creeping flows-approximations of hyperbolic, parabolic, elliptic, and mixed flows-introduction to numerical methods, advantages and limitations-components of numerical solution methods and properties.

Module 2
Finite difference methods: - concept-approximation of first derivative, second derivative and mixed derivative-boundary conditions, errors, spectral methods, examples-finite volume method, approximation of surface and volume integrals, boundary conditions-examples.

Module 3

Module 4
Solutions of Navier Stokes equations: -choice of variable arrangement on grid-calculation of pressure-other methods-solution methods for Navier Stokes equations.

Module 5
Turbulent flows: - direct numerical solution-large eddy simulation, RANS models, Reynolds stress models- compressible flows (introduction only)-pressure correction models-simple examples.

References

2. Computational Fluid Dynamics (The basics with applications) -John D.Anderson (Mc Graw Hill Pub.)

MECHANICAL ENGINEERING LABORTAORY

M 707 0+0+4

Tests on reciprocating air compressor
Tests on blowers and rotary compressors
Vibration of springs – free and forced vibrations.

Whirling of shafts.
Balancing of reciprocating and revolving masses – balancing machines.
Tests on universal governor apparatus.
Tests on gyroscope.
Friction in hydrodynamic bearings – bearing testing machines.
Metallurgical analysis of specimens using metallurgical microscope.
Testing of foundry sands for strength, moisture content, permeability etc.
Determination of minimum fluidizing velocity in a conventional fluidized bed.

HEAT TRANSFER LABORTAORY

M 708 0+0+4

Tests on refrigeration equipment.
Tests on air conditioning units.

Determination of thermal conductivity of conducting and insulating materials.
Determination of emissivity of surfaces
Heat flow through lagged pipes.
Heat flow through composite walls.
Determination of overall heat transfer co-efficient of a heat exchanger.
Free and forced convection.
EIGHTH SEMESTER

PRODUCTION ENGINEERING

M 801 2+1+ 0

Module 1

angle, cutting angle, nose radius etc. on cutting force and surface finish – Empirical determination of force component.

Module 2

Module 3


Module 4

Module 5
Advanced production methods: Rapid prototyping: background & definitions – Process methods: Stereolithography, selective laser sintering, fused deposition modeling, laminated object manufacturing, laser engineered net shaping, 3D welding – Information processing – Indirect fabrication of metals & ceramics. – Non traditional machining: EDM, ECM, USM – principle, types, process parameters, control, MRR, surface finish, application etc. – Electro chemical grinding, lapping, honing; process principle & Ra only, applications – EBM, LBM, IBM, AJM, Abrasive water jet machining, LIGA process.
References

5. HMT, Production Technology, Tata McGraw Hill
6. Kalpakjian, Manufacturing Engineering & Technology, Addison – Wesley, 4\textsuperscript{th} edn.
7. Lal G.K., Introduction to Machining Science, New Age publishers
8. Metcut research, Machinability Data Center Vol.1 & 2, Metcut research associates, Cincinnati

AUTOMOBILE ENGINEERING

M 802 3+1+0

Module 1

\textbf{Engines}: Types of engines in automobiles-classifications-engine components-working of various systems-CNGengines-R&D works-present and future vehicles-frame, body and engine construction-structure and mechanism forming components- carburetors, diesel fuel pumps, injector, single point and multi point fuel injection-combustion chambers-lubricating oil pumps-cooling systems-Vehicle performance-resistance to the motion of vehicle-air, rolling, and radiant resistance-power requirement-acceleration and gradeability-selection of gear ratios.

Module 2


Module 3

\textbf{Steering and Suspension}: Different steering mechanisms-steering gear boxes-power steering –types-suspension systems-front axle, rigid axle and independent suspensions-anti-roll bar-coil spring and leaf spring-torsion bar-Macpherson strut-sliding pillar-wish bone-trailing arm suspensions-front axle types-front wheel geometry-castor, camber,
king pin inclination, toe-in toe-out. Shock absorbers-hydraulic and gas charged shock absorbers-air suspensions.

**Module 4**

**Chassis and Body**: Types of chassis and body constructions-crumble zones, air bags and impact beams-automotive air conditioning-braking mechanism and convectional brakes-booster, hydraulic and power brakes, components and attachments-mechanical, hydraulic and pneumatic brakes-anti-lock braking systems-Wheels and Tyres: tube-less tyres-ply ratings- radial tyres-hybrid vehicles-vintage cars-racing cars-automated roads-coach works-materials- safety provisions- motor vehicle act.

**Module 5**

**Electrical systems** Battery, charging and ignition systems-electronic ignition-dynamos and alternators-voltage regulators-light and horn relays-circuit diagrams-starting motor-bendix and follow through drives-power windows-electronic engine control unit for fuel injection- automotive lighting, accessories and dashboard instruments-Preventive and breakdown maintenance-engine testing, servicing-overhaul- engine tuning- wheel balancing-trouble shooting-garage tools and equipments-noise, vibration, and performance tests.

**References**

1. Automobile Engineering (Vol. 1 & 2) - K.M.Guptha
3. Automobile Engineering - Harbans Singh Reyd

**PRODUCTION PLANNING AND CONTROL**

**M 803**

**Module 1**

**Introduction to PPC**: need for PPC, effect, advantages, functions and problems of PPC.

**Forecasting**: methods of sales forecasting-forecasting for new products-forecasting for established products-time series analysis for sale forecasting – long term forecasting – methods of estimating Sales trend- problems- correlation analysis.

**Module 2**
Production planning: objectives-characteristics-process planning. Capacity planning-
factors affecting-Master production scheduling-material requirement planning – BOM
and product structure.

**Production control**: objectives- production control systems- principle and procedure of
production Control.

**Routing**: objectives- procedure – route sheets.

**Module 3**

**Sequencing assumptions**: solution of sequencing problems-processing n jobs through
two machines
Processing n jobs through three machines – processing n jobs through m machines –
processing two
Jobs through m machines-problems

**Module 4**

**Materials management**: Components of integrated material management Purchasing
management- stores management. Supply chain management – ERP-Role of I.T.

**Module 5**

**Loading and scheduling**: aim- reasons for scheduling- master scheduling or aggregate
scheduling
Estimating shop loads- short term scheduling – mathematical loading and scheduling-
problems-
Scheduling through PERT / CPM problems.
Despatching- duties- procedure- rules.
Follow up and reporting- types-report preparation and presentation.

**References**

1. Modern Production Management - E.S.Buffa
2. Principles of Production Management - J.Apple
3. Production management principles - Mcycss
4. Production Planning and Control - K.C.jani& L.N.Aggarwal
5. Manufacturing Planning &Control - Wolfman, Berry, Whybark systems
6. Production and operations management - R.Paneerselvam
7. Modeling the supply chain - Jeremy F Shapiro

**MACHINE DESIGN AND DRAWING - II**

M 804 2+0+2

**Module 1**
**Gears:** Types of gears – spur gear, helical gear, bevel gear, worm and worm wheel strength of gear teeth – gear forces and their effects – formative number of teeth – lead – lead angle – basic geometry and nomenclature of meshed spur gear set – dynamic load – endurance load – wear loads – AGMA standards – Lewis equation for strength design and Lewis form factor – design for wear – design of gears such as spur gear, helical gear, bevel gear, worm and worm wheel.

**Module 2**


**Pumps:** Design of centrifugal pump (Simple problems)

**References**

1. Mechanical Engineering Design – Joseph Shigley
4. Principles of Lubrication – Cameron A.
5. Mechanical Seals – Mayer E.
6. Design of Machine Elements – Bhandari V. B.

**Note**

Question Paper pattern same as Machine Design - I

**ADVANCED MATHEMATICS (ELECTIVE - II)**

CMELRTM 805-1 3+1+0

**Module 1 Green’s Function**


**Module 2 Integral Equations**

Definition of Volterra and Fredholm Integral equations – conversion of a linear differential equation into an integral equation – conversion of boundary value problem into an integral equation using Green’s function – solution of Fredholm integral equation with separable Kernels – Integral equations of convolution type – Neumann series solution.
Module 3  Gamma, Beta functions

Module 4  Power Series solution of differential equation
The power series method – Legendre’s Equation – Legendre’s polynomial – Rodrigues formula – generating function – Bessel’s equation – Bessel’s function of the first kind – Orthogonality of Legendre’s Polynomials and Bessel’s functions.

Module 5  Numerical solution of partial differential equations.
Classification of second order equations- Finite difference approximations to partial derivatives – solution of Laplace and Poisson’s equations by finite difference method – solution of one dimensional heat equation by Crank – Nicolson method – solution one dimensional wave equation.

References

7. Principles and Techniques of Applied Mathematics - Bernard Friedman, John Wiley and sons

EXPERT SYSTEMS IN MANUFACTURING (ELECTIVE - II)

M 805-2 3+1+0

Module 1
Artificial Intelligence - expert / knowledge based systems - definition - expert system architecture: software components, knowledge base, inference engine, inference sub systems.

Module 2
Hard ware requirements - knowledge acquisition, knowledge base, knowledge representation - semantic networks, objects, nods; links, attributes, values - semantic network structures: nodes, object, links, attributes, values.

Module 3
Knowledge representation: rule based system - heuristic rules - frame based knowledge representation - inference engine components - inferences strategies; modus ponens,
backward & forward chaining, monotonic & non monotonic reasoning, search strategies -
expert system building tools: languages, shells.

Module 4
Commercial software for manufacturing applications in CAD, CAPP, MRP - 11,
adaptive control of devices, robotics, process control, fault diagnosis, failure analysis etc;
linking expert systems to other software such as DBMS, MIS, MDB, process control and
office automation.

Module 5
Case studies and programming of typical applications in process planning, tool selection,
Grinding wheel selection, part classification, inventory control, facilities planning etc.

References
2. Prentice - hall hand book of expert systems

AEROSPACE ENGINEERING (ELECTIVE - II)
M 805-3 3+1+0

Module 1
The atmosphere: Characteristics of Troposphere, Stratosphere, Mesosphere and
Ionosphere - International Standard Atmosphere – Pressure, Temperature and Density
variations in the International Standard Atmosphere – Review of basic fluid dynamics –
continuity, momentum and energy for incompressible and compressible flows – static,
dynamic and stagnation pressures – phenomena in supersonic flows

Module 2
Application of dimensional analysis to 2D viscous flow over bodies – Reynolds number
– Mach number similarity – Aerofoil characteristics – Pressure distribution – Centre of
Pressure and Aerodynamic Center – Horse shoe vortex
Module 3
Momentum and Blade Element Theories – Propeller co-efficients and charts – Aircraft engines – Turbo jet, Turbo fan and Ram Jet engines – Bypass and After Burners

Module 4

Module 5

References
1. Mechanics of Flight - Kermode A. C.
2. Aerodynamics for Engineering Students - Houghton and Brock
3. Airplane Aerodynamic - Dommasch

COMBUSTION (ELECTIVE - II)
M 805-4 3+1+0

Module 1

Module 2
Elements of chemical kinetics: law of mass action-order and molecularity of reaction – rate equation- Arrheniuss law – activation energy – collision theory of reaction rates-

Module 3

Module 4

Module 5

References

1. Fuels and combustion – Sharma S.P
2. Some fundamentals of combustion – Spalding D.B
3. Fundamentals of combustion – Strelow . R.A
4. Elementary reaction Kinetics – Lathan J.L
5. Flames – Gaydan and wolfhard.
PROJECT MANAGEMENT (ELECTIVE - II)

M 805-5          3+1+0

Module 1

Module 2
Project Management- nature and scope- PERT and CPM techniques, Estimates-time, cost, resources (man, material, tool).

Module 3
Forecasting Methods-Time series analysis-method pf least square, moving average, curvilinear, correlation analysis.

Module 4
Risk Analysis-risk in economic analysis-measuring risk in investment; risk profiles, decision trees, formulation of discounted decision trees, simulation.

Module 5
MS Project: (Software Practice) Creation of task, sequencing of task, assignment of resources, finding critical path, ABC activities (discuss), breaking the activities, colouring techniques, resource balancing, allocating overtime, using different calendars (Like 8 or 12 hours shift, Friday/Sunday holiday, Special public holidays etc), cost estimates, assignment of blank fields, creation of different views on screen.
Reports: Daily reports for completed activity, lagging activities, overall progress review, Management high-level reports, individual Departmental reports.

References
2. Harvey Maylor, Project Management, Pearson Education.

PROGRAMMING IN C++ AND VISUAL C++ (ELECTIVE - II)

M805-6          3+1+0

Module 1
Module 2
Classes and Objects – Specifying the Class – The private and public key words –
Defining Member Functions – Defining Objects – Calling Member Functions –
Constructors – Destructors – Overloaded Constructors – Objects as Arguments –
Returning Objects from Functions – Array of Objects.

Module 3

Module 4
Pointers – Memory Management – The new and delete Operators – Pointers to Objects – Self Containing Classes – Virtual Functions – Accessing Normal and Virtual Member Functions with Pointers – Pure Virtual Functions – Friend Functions – The ‘this’ Pointer – Accessing Member Data with ‘this’.

Module 5
Introduction to Windows Programming – Basic Windows Program Structure – Different Windows Messages like WM_PAINT, WM_TIMER etc. – Introduction to MFC – MFC Hierarchy - Use of Simple Foundation Classes like CTime, CString, CFile etc. – Exception Handling.

References
1. Object Oriented Programming in Microsoft C++ - Robert Lafore
2. Windows Programming Primer Plus - Jim Conger

SILICATES - STRUCTURE, PARTICLE ANALYSES AND SPRAY COATING
(ELECTIVE - II)
M 805-7 3+1+0

Module 1
Module 2


Module 3


Module 4

**Particle Analyses** – Coarse and powder materials- Coarse material-Size distribution- Grain size parameters, coefficient of angularity, specific surface area (actual and theoretical) by sieve analysis. Powder material-Size and area determination by various methods- Blane’s methods, air jet sieve, Bacho dust classifier and BET methods.

Module 5


References

8. Non-ferrous foundry metallurgy, A.J. Murphy, Pergamon Press Ltd.
Goals
To learn Management Information System (MIS), implementation requirements and process standardisation.

Module 1

Module 2

Module 3
Communication and distributed Data processing.

Module 4
Managing and controlling the MIS function. Application Development Cycle.

Module 5

Outcomes
Student will learn elements of MIS & steps in implementing MIS. Students will also learn hardware and software selection for MIS.

References
1. Mudric and Rose - Information System and Management.
5. James Obrein - Management Information Systems

CRYOGENICS (ELECTIVE - III)
M 806-2 3+1+0

Module 1
Introduction: Historical development- present areas involving cryogenic engineering. Basic thermodynamics applied to liquefaction and refrigeration process - isothermal, adiabatic and Joule Thomson expansion process - adiabatic demagnetization – efficiency to liquefaction and coefficient of performances irreversibility and losses.

Module 2
Low temperature properties of engineering materials: mechanical properties - thermal properties - electrical and magnetic properties. Properties of cryogenic fluids - materials of constructions for cryogenic applications.

Module 3
Gas liquefaction systems: production of low temperatures - general liquefaction systems - liquefaction systems for neon, hydrogen, nitrogen and helium.

Module 4
Cryogenic refrigeration systems: ideal refrigeration systems- refrigerators using liquids and gases as refrigerants - refrigerators using solids as working media.

Module 5
Cryogenic storage and transfer systems - Cryogenic fluid storage vessels cryogenic fluid transfer systems. Application of cryogenics - cryo pumping - superconductivity and super fluidity - cryogenics in space technology - cryogenics in biology and medicine.

References

1. Cryogenic Systems - Barron R. F
2. Cryogenic Engineering - Scot R. W.
3. Cryogenic Engineering - Bell J.H.

NUCLEAR ENGINEERING (ELECTIVE - III)
M 806-3 3+1+0

Module 1
Review of elementary Nuclear Physics: Atomic structure – Nuclear energy and nuclear forces – Nuclear fission
Nuclear reactions and radiations: Principle of radioactive decay – Interaction of α and β rays with matter – Neutron cross section and reactions – The fission process – Chain reaction – Basic principles of controlled fusion.

Module 2
Nuclear reaction principles – Reactor classifications – Critical Size – Basic diffusion
theory – Slowing down of neutrons – Neutron flux and power – Four factor formula –
Criticality condition – Basic features of reactor control

Module 3
Boiling water reactor: Description of reactor system – Main components – control and
safety measures Materials of Reactor: Construction – Fuel – Moderator coolant –
Structural materials – Cladding – Radiation damage.

Module 4
Nuclear fuels: Metallurgy of Uranium – General principles of solvent extraction –

Module 5
Reaction heat removal: Basic equations of heat transfer as applied to reactor cooling –
Reactor heat transfer systems – Heat removal in fast reactors
Radiation Safety: Reactors shielding - Radiation dozes – Standards of radiation
protections – Nuclear waste disposal.

References
1. Nuclear Engineering - Glasstone & Sesoske
2. Sources book on Atomic Energy - Glasstone S.

INDUSTRIAL HYDRAULICS (ELECTIVE - III)
M 806-4  3+1+0

Module 1
Introduction to hydraulic / pneumatic devices – their application and characteristics –
comparison of electric, hydraulic and pneumatic devices.

Module 2
Pumps and motors: Principle of working – range of displacement and pressures- fixed
and variable discharge pumps-gear, screw, vane, piston pumps – axial piston pump-
swash pump-bent axis pump. Types of hydraulic motors – their characteristics.

Module 3
Hydraulic valves: Stop valve- non return valve-relief valve-sequence valve-counter
balance valve- pressure reducing valve – flow control valve –rection control valves-their
principle of operation- and application-JIC symbols of hydraulic- pneumatic components.
Module 4
Properties of commonly used hydraulic fluids—Typical hydraulic circuits like those used in machine tools—Rivetter—pneumatic Hammer, hydraulic press, and power steering.

Module 5
Fluidics: Introduction of fluidics devices—Principles of working of common fluidics devices like wall attachment devices—proportional amplifiers-turbulent amplifiers—fluidic logic devices—examples of applications of fluidics devices like edge control of steel plate in rolling mills tension control.

References
1. Daniel Bonteille - Fluid Logic and Industrial automation.
2. John Pippenger & Tyler Hicks - Industrial Hydraulics

MACHINE VISION AND APPLICATION (ELECTIVE - III)
M 806-5 3+1+0

Module 1
Introduction to machine vision—basics of picture processing, Binary and grey scale images.
Preprocessing concepts—Digital image, Geometrical correction, Grey scale modification, Sharpening and smoothing images.

Module 2
Edge detection and line finding—Spatial differentiation, extraction of line descriptions.
Types of cameras for Machine vision and their principles.

Module 3
Software for measurement and pattern recognition applications with examples—two and three-dimensional measurements. Fourier transformation for pattern recognition applications.

Module 4
Image operation studies, interfacing a robot with a vision system. Basics of hardware for vision system.

Module 5
Machine vision applications in engineering—dimension measurement, flaw detection, identification, verification, sorting—coordinate measuring machines, non-contact type—case studies.
FINITE ELEMENT ANALYSIS (ELECTIVE - III)

M 806-6 3+1+0

Goals:
This course is designed to acquaint students with the basic principles of the finite element method, to provide experience with its use in engineering analysis and design, and to provide an opportunity to work with finite element programs used in industry. Computer programming may be involved.

Module 1
Introduction: Structural analysis objectives, static, dynamic and kinematic analysis, skeletal and continuum structures, modeling of infinite d.o.f system into infinite d.o.f system, basic steps in finite element problem formulation, general applicability of the method.

Element types and characteristics: Discretization of the domain, basic element shapes, aspect ratio, shape functions, generalised co-ordinates and nodal shape functions, 1D spar and beam elements, 2D rectangular and triangular elements, axisymmetric elements.

Module 2
Assembly of elements and matrices: Concept of element assembly, global and local co-ordinate systems, band width and its effects, banded and skyline assembly, boundary conditions, solution of simultaneous equations, Gaussian elimination and Cholesky decomposition methods, numerical integration, one and 2D applications.

Module 3
High order and isoparametric elements: One dimensional quadratic and cubic elements, use of natural co-ordinate system, area co-ordinate system, continuity and convergence requirements, 2D rectangular and triangular elements.

Module 4
Static analysis: Analysis of trusses and frames, analysis of machine subassemblies, use of commercial software packages, advantages and limitations.

Module 5
Dynamic analysis: Hamilton’s principle, derivation of equations of equilibrium, consistent and lumped mass matrices, derivation of mass matrices for 1D elements, determination of natural frequencies and mode shapes, use of commercial software packages.

Course Outcomes:

Reference

1. Sonaka M, Hlavac V & Boyle. R. - Image processing, analysis & machine vision
1. The students will understand the fundamental principles of finite element theory and applications.
2. The students will be able to build finite element models correctly for various engineering problems and solve the model using existing finite element codes.

Text Book


References


TOTAL QUALITY MANAGEMENT (ELECTIVE - III)

M 806-7 3+1+0

Goal
To give the detailed information on TQM Tools and Techniques for TQM will be known.

Module 1

Module 2
Continuous Process Improvement – Kaizen, Reengineering, PDSA cycle, Juran Trilogy – Supplier Partnerships – Quality Cost

Module 3
Benchmarking – Quality Function Development – Failure mode and Effect Analysis (FMEA)

Module 4
Total Quality Control (TQC) – Quality Circles – Poka – Yoke- Just–in–Time (JIT)-KANBAN - ‘5-5’

Module 5
Implementing procedure of TQM - case studies
Learning Objective

1. Student will clear principles and practices of TQM
2. Student will learn tools and Techniques used in TQM.
3. Students will learn the procedure of implementation of TQM

References

1. Besterfield, Total quality Management, Person Education
2. Besterfield, Quality Control, Prentice - Hall
3. Arora K.C, TQM & 1S0 14000, S K Kataria & Sons
5. Mitra, Quality control & improvement, Person Education

MECHANICAL MEASUREMENTS LABORATORY

M 807

1. Study of use of laser interferometer for calibration of linear measurements
2. Measurement of temperature:
   Calibration of thermometers and pyrometers
   Preparation and calibration of thermocouple and resistance temperature detectors (TTD & RTD)
3. Measurement of pressure:
   Calibration and use of pressure measuring instruments-Pressure Gauge, Micro manometer, Pressure Transducers, Dead weight pressure gauge calibrator
4. Measurement of speed:
   Calibration and use of tachometers & stroboscope
5. Measurement of linear and angular dimensions:
   Micrometer, Vernier caliper, dial gauge feeler gauge, comparator, interferometer, angle gauge, sine bar, plug gauge and wire gauge
6. Measurement of Flow: Rotameter, watermeter, Anemometer; calibration and use
7. Measurement of surface roughness using subtonic tester
8. Measurement of gear and screw thread profiles- gear tooth calipers, screw thread calipers
9. Measurement of strain and force – calibration of strain gauges and load cells
10. Measurement of vibration – use of vibration pick ups, accelerometer and vibration indicator
11. Acoustic measurements-sound level meter – preparation of noise contours
12. Measurement of PH value
13. Measurement of psychometric properties of air

PROJECT & SEMINAR

M808
At the beginning of the seventh semester, students must submit an abstract of their undergraduate project. They must submit a preliminary report at the end of the semester. They will complete the project in the eighth semester.

Sessional marks for seminar will be out of 25. Sessional marks for project will be out of 75, in which 35 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation board consists of a minimum of 3 faculty members including the guide.

VIVA-VOCE

M809

A comprehensive Viva-voce examination will be conducted to assess the student's overall knowledge in the specified field of engineering. At the time of viva-voce, certified reports of seminar and project work are to be presented for evaluation.