EN010501A ENGINEERING MATHEMATICS IV

(Common to all branches except CS & IT)

Teaching scheme **Credits: 4**

2 hours lecture and 2 hour tutorial per week

Objectives: *Use basic numerical techniques to solve problems and provide scientific techniques to decision making problems.*

MODULE 1 Function of Complex variable (12 hours)

Analytic functions – Derivation of C.R. equations in cartision co-ordinates – harmonic and orthogonal properties – construction of analytic function given real or imaginary parts – complex potential – conformal mapping of z^2 , $\frac{1}{z}$ - Bilinear transformation – cross ratio – invariant property (no proof) – simple problems

MODULE 2 Complex integration (12 hours)

Line integral – Cauchy's integral theorem – Cauchy's integral formula – Taylor's series- Laurent's series – Zeros and singularities – types of singularities – Residues – Residue theorem – evaluation of real integrals in unit circle – contour integral in semi circle when poles lie on imaginary axis.

MODULE 3 Numerical solution of algebraic and transcendental equations (10 hours)

Successive bisection method – Regula –falsi method – Newton –Raphson method - Secant method – solution of system of linear equation by Gauss – Seidel method

MODULE 4 Numerical solution of Ordinary differential equations (10 hours)

Taylor's series method – Euler's method – modified Euler's method – Runge – Kutta method (IV order) - Milnes predictor – corrector method

MODULE 5 Linear programming problem (16 hours)

Definition of L.P.P., solution, optimal solution, degenerate solution – graphical solution –solution using simplex method (non degenerate case only) Big -M method – Duality in L.P.P. – Transportation problem –Balanced T.P. – initial solution using Vogel's approximation method - modi method (non degenerate case only)

References

1. B.V. Ramana – Higher Engg. Mathematics – Mc Graw Hill
2. M.R.Spicgel , S.Lipschutz , John J. Schiller, D.Spellman – Complex variables, schanm's outline series - Mc Graw Hill
3. S.Bathul – text book of Engg.Mathematics – Special functions and complex variables –PHI
4. B.S. Grewal – Numerical methods in Engg. and science - Khanna Publishers
5. Dr.M.K Venkataraman- Numerical methods in science and Engg -National publishing co

6. S.S Sastry - Introductory methods of Numerical Analysis -PHI
7. P.K.Gupta and D.S. Hira – Operations Research – S.Chand
8. Panneer Selvam– Operations Research – PHI
9. H.C.Taneja – Advanced Engg. Mathematics Vol II – I.K.International

ME010 502 Computer Aided Design & Manufacturing

(Common with PE010 604 and AU010 502)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To provide a comprehensive concepts of the design aspects and its importance in computer assisted design and manufacture.*
- *To examine technologies those have been developed to automate manufacturing* operations.

Module 1 (12 hours)

Evolution of CAD/CAM and CIM, computers and workstation, elements of interactive graphics, input/ out put display, storage devices in CAD, – networking of CAD systems - 2D Graphics: line drawing algorithms, DDA line algorithm – circle drawing, bressnham`s circle drawing algorithm– 2D Transformation: translation, rotation, scaling, reflection – clipping -3D Graphics (basic only).

Module 2 (12 hours)

Geometric modeling: Wire frame, surface and solid modeling - Engineering analysis; design review and evaluation, automated drafting.

Numerical control: Need - advantages and disadvantages – classifications – Point to point, straight cut and contouring positioning - incremental and absolute systems – open loop and closed loop systems – DDA integrator and Interpolators – resolution – CNC and DNC.

Programmable Logic Controllers (PLC)**:** need – relays - logic ladder program – timers, simple problems only - Devices in N.C. systems: Driving devices - feed back devices: encoders, moire fringes, digitizer, resolver, inductosyn, and tachometer.

Module 3 (12 hours)

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 world, tool world, miscellaneous functions – programming exercises.

Computer aided part programming: concept and need of CAP – CNC languages – APT language structure: geometry commands, motion commands, postprocessor commands, compilation control commands – programming exercises – programming with interactive graphics.

(At least one programming exercise should be included in the University examination)

Module 4 (12 hours)

Computer Aided Process Planning (CAPP): concepts; traditional and CAPP; automated process planning: process planning, general methodology of group technology, code

structures of variant and generative process planning methods, AI in process planning, process planning software.
Flexible Manufacturing Systems (FMS): Introduction, types, concepts, need and advantages of FMS - cellular and FMS - JIT and GT applied to FMS.

Module 5 (12 hours)

Robot Technology**:** overview, basic components - robot end effectors – sensors in robotics – control of actuators in robotic mechanisms (basic only) – control of robo joint, stepper motor, direct drive actuators – hydraulic and pneumatic systems (basic only) – robot arm kinematics, direct and inverse kinematics solution robot arm dynamics – robot applications: material transfer, machine loading and unloading, pre cutting operations, assembly, inspection and welding.

TEXT BOOKS:

1. Newman and Sproull - Principles of interactive Graphics, McGraw – Hill.
2. Yoram Koren - Numerical control of machine tools, McGraw-Hill.

REFERENCE BOOKS:

1. Craig John - Introduction to Robotics
2. Groover M.P. - CAD/CAM, PHI.
3. Hearn and Baker - Computer graphics (in C version), Prentice Hall.
4. Petruzella Frank.D. - Programmable logic controllers.
5. Jonn Craig - Introduction to Robotics

ME010 503: Advanced Mechanics of Materials

(Common with PE010 503)

Teaching scheme **Credits:** 4

2 hours lecture and 2 hour tutorial per week

Objectives

1. *To impart concepts of stress and strain analysis in a solid.*
2. *To study the methodologies in theory of elasticity at a basic level.*
3. *To acquaint with energy methods to solve structural problems.*

Module I (12 hours)

Basic equations of Elasticity, Stress at a point with respect to a plane - normal and tangential components of stress - stress tensor - Cauchy's equations - stress transformation - principal stresses and planes - strain at a point - strain tensor - analogy between stress and strain tensors - constitutive equations - generalized Hooke's law - relation among elastic constants – equations of equilibrium -strain-displacement relations –

Module II (12 hours)

Compatibility conditions - boundary conditions - Saint Venant's principle for end effects –uniqueness condition. 2-D problems in elasticity. Plane stress and plane strain problems – Airy's stress function – solutions by polynomial method – solutions for bending of a cantilever with an end load and bending of a beam under uniform load.

Module III (12 hours)

Equations in polar coordinates - Lame's problem - stress concentration problem of a small hole in a large plate. Axisymmetric problems - thick cylinders - interference fit - rotating discs. **S**pecial problems in bending: Unsymmetrical bending - shear center - curved beams with circular and rectangular cross-section

Module IV (12 hours)

Energy methods in elasticity: Strain energy of deformation - special cases of a body subjected to concentrated loads, due to axial force, shear force, bending moment and torque – reciprocal relation -Maxwell reciprocal theorem - Castigliano's first and second theorems - virtual work principle -minimum potential energy theorem - complementary energy

Module V (12 hours)

Torsion of non-circular bars: Saint Venant's theory - Prandtle's method - solutions for circular and elliptical cross-sections - membrane analogy - torsion of thin walled open and closed sections- shear flow

Text Books

1. L. S. Sreenath, Advanced Mechanics of Solids, McGraw Hill
2. S. M. A. Kazimi, Solid Mechanics, McGraw Hill
3. S. P. Timoshenko, J. N. Goodier, Theory of elasticity, McGraw Hill

Reference Books

1. J. P. Den Hartog, Advance Strength of Materials, McGraw Hill
2. C. K. Wang, Applied Elasticity, McGraw Hill

ME010 504**:** Kinematics of Machinery

(Common with AU010 504)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

1. *To understand the basic components and layout of linkages in the assembly of a system/machine.*
2. *To understand the principles involved in assembly the displacement, velocity and acceleration at any point in a link of a mechanism.*
3. *To understand the motion resulting from a specified set of linkages.*
4. *To understand and to design few linkage mechanisms and cam mechanisms for specified output motions.*
5. *To understand the basic concepts of toothed gearing and kinematics of gear trains.*

Module I (14hours)

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law –Kinematic inversions of four-bar chain, slider crank chains and double slider crank chains – Limit positions –Mechanical advantage – Transmission Angle -Coupler curves – Description of some common Mechanisms – Quick return mechanisms, Straight line generators, Dwell Mechanisms, Ratchets and Escapements, Universal Joint, steering mechanisms

Module II (12hours)

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method – Velocity and acceleration polygons – Velocity analysis using instantaneous centers – Kennedy's theorem, kinematic analysis by complex algebra methods – Vector approach – Computer applications in the kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration.

Module III (10hours)

Kinematic synthesis (Planar Mechanisms) - Tasks of kinematic synthesis – Type, Number and dimensional synthesis – Precision points - Graphical synthesis for four link mechanism Function generator – 2 position and 3 position synthesis – Overlay Method - Analytical synthesis techniques

Module IV (12 hours)

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. Introduction to Polynomial cams.

Module V (12 hours)

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting – Non-standard

gear teeth – Helical, Bevel, Worm, Rack and Pinion gears [Basics only] Gear trains – Speed ratio, train value – Parallel axis gear trains– Epicyclic Gear Trains – Differentials

Reference Books

1. R L Norton, Kinematics and Dynamics of Machinery, 1st ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
2. J. E. Shigley, J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill
3 S .S Rattan Theory of Machines, 3rd ed., *Tata McGraw Hill Education Private Limited*, Delhi, 2009
4 A. Ghosh, A. K. Malik, *Theory of Mechanisms and Machines*, Affiliated East West Press
5 A. G. Erdman, G. N. Sandor, *Mechanism Design: Analysis and synthesis Vol I & II*, Prentice Hall of India

ME010 505 I. C. Engines & Combustion

(Common with AU010 505)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of IC Engine and Combustion*

Module I (15 hours)

Working of two stroke and four stroke engines and valve timing diagrams of – Petrol and diesel engine. (Review only). Fuel air cycles. Ignition systems- Battery and magneto systems- ignition timing and spark advance. Fuels – Qualities, rating of fuels - Octane and Cetane numbers. Alternative fuels.

Types of engines - Wankel engine,- Stirling engine - Stratified charge engine - VCR engine - free piston engine.

Module II (15 hours)

Air fuel mixture requirements – Solex Carburettor. Stoichiometric and excess air calculations. Fuel injection systems in SI and CI engines - Fuel injection pumps.- nozzle- direct and indirect injections. MPFI systems and GDI engines. CRDI technology.

Lubrication systems- types – properties of lubricants. Flash point, fire point and viscosity index.

Module III (10 hours)

Thermodynamics of combustion. Combustion reaction of common fuels. Exhaust gas composition. Flue gas analysis. Air fuel ratio from exhaust gas composition. Variation of specific heats- heat losses- Dissociation.

Engine cooling systems- Air and liquid system- Super charging and turbo charging

Module IV (10 hours)

Combustion in SI engines- P-θ diagram- Stages of combustions- Ignition lag. Flame propagation – Abnormal combustion – detonation effects. Combustion in CI engines, P-θ diagram - Ignition delay, diesel knock- controlling methods.

Air motion- Squish, tumble, swirl motions. Different types combustion chamber for SI and CI engines.

Module V (10 hours)

Pollutants in SI and CI engines. NOx, CO, unburned hydrocarbons ,smoke and particulate. Measurement of exhaust emission. (HC, CO, NOx and smoke intensity) Exhaust gas treatment.- Catalytic converter – Thermal reaction -Particulate trap.

Testing of IC engines - Indicated power – Brake Power - Volumetric efficiency - Heat balance test - Morse test.

Text Books

V Ganesan, *Internal Combustion Engine* Tata Mc Graw Hill Publishing Company Ltd. New Delhi 2006. -

Reference Books

John B Heywood, Internal Combustion Engine Fundamentals, Mc Graw Hill Publishing Company Sigapur,1998.

Obert E F,Internal Combustion Engine and air Pollution Mc Graw Hill book company New York.

Mathur and Sharma,A course in Internal Combustion Engine - Dhanpat Rai Publications new Delhi, 2004.

Sharma S.P, Fuels and Combustion, Tata Mc Graw Hill Publishing Company Ltd. New Delhi.1990.

Spalding D.B. Some Fundamentals of Combustion Better Worths Scientific Publications London, 1955.

ME010 506 Thermodynamics

(Common with PE 010 506 and AU010 506)

Teaching scheme **Credits:** 4

3 hours lecture and 1 hour tutorial per week

Objectives

- *To impart the basic concepts of Thermodynamics*

Pre-requisites: *Knowledge required to study this subject (especially any subject previously studied)*

Module I (10 hours)

Fundamentals concepts – scope and limitations of thermodynamics. Thermodynamic systems – different types of systems – macroscopic and microscopic analysis – continuum – Properties – state – processes. Thermodynamics equilibrium – Equation of state of an ideal gas – PVT system – Real gas relations – Compressibility factor – Law of corresponding states.

Module II (15 hours)

Laws of thermodynamics- Zeroth law of thermodynamics – Thermal equilibrium – Concept of temperature – Temperature scales – Thermometry – Perfect gas temperature scales. – Thermometry – Perfect gas temperature scales. Work and heat – First law of thermodynamics – Concept of energy _ First law for closed and open systems – Specific heats – internal energy and enthalpy – Steady flow energy equations _ Jule Thompson effect.

Module III (15 hours)

Second law of thermodynamics- Various statements and their equivalence_ Reversible process and reversible cycles- Carnot cycles- Corollaries of the second law – thermodynamics temperature scales – Clausis inequality- Concept of entropy – Calculation of change in entropy in various thermodynamic processes – Reversibility and irreversibility – Available and unavailable energy – Third law of thermodynamics.

Module IV (10 hours)

Thermodynamic relations – Combined first and second law equations – Hemholtz and gibbs functions – Maxwell relations- Equations for specific heats, internal energy, enthalpy and entropy – Clausius Clapeyron equations _ applications of thermo dynamic relations.

Module V (10 hours)

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- Thermodynamic properties of mixtures

Text Books

1 P K Nag, *Engineering Thermodynamics*, Tata Mc Graw Hill Publishing Company Ltd. New Delhi 2008.

Reference Books

1. J. F. Lee and FW Sears, *Engineering Thermodynamics,* Addison-Wesleg Publishing Company, London, 1962.
2. Spalding and Cole, *Engineering Thermodynamics,* The English Language Book Society and Edward Arnold Ltd.,1976.
3. M. A.chuthan, *Engineering Thermodynamics*,Prentice Hall of India Private Ltd, New Delhi 2002.
4. J.H Keenan, *Thermodynamics,* John Wiley and Sons , New York, 1963.
5. Edward F Obert, *Concept of Thermodynamics,* McGraw Hill book company New York, 1988.
6. J.P. Holman, *Thermodynamics,* McGraw Hill book company New York, 1988.
7. Mark W. Zemansky, *Heat and Thermodynamic*, McGraw Hill, New Delhi, 2001.
8 Roy T, *Basic Engineering Thermodynamics,* Tata Mc Graw Hill Publishing Company Ltd. New Delhi 1989.

ME010 507**: CAD/CAM Lab**

(Common with PE010 708)

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To train the students in solid modelling, surface modelling and drafting*
- *To gain experience in assembly modelling, mechanism design and systems routing*
- *To practise computer controlled manufacturing methods*
- *To expose students to rapid prototyping*

Solid Modeling (15 hours)

Creation of 3D models-Wireframe, Surface and Solid modeling techniques using CAD packages- Parametric modeling-Drafting-Generation of orthographic 2D views from models,Sectioning,Detailing –Exposure to Industrial components-Application of Geometrical Dimensioning &Tolerancing.

Assembly Design (15 hours)

Assembling of various machine parts and tolerance analysis, generation of 2D drawings and bill of materials from assembly
Mechanism Design - synthesis and design of mechanisms - animations - exercises on various mechanisms like four bar chain, slider crank mechanism and its inversions
System Design-Schematic and non schematic driven routing of pipes and tubes,

Computer aided manufacturing (15 hours)

Part programming fundamentals - manual part programming and computer aided part programming - hands on training in computer controlled turning and milling operations - tool path generation and simulation - exercises on CNC lathe and machining center/milling machines
Generation of STL files and rapid prototyping of CAD models

Exercises

1) Modeling of machine parts, brackets using 2D drawings
2) Modeling of surfaces using given master geometry
3) Parametric modeling of standard parts such as nuts, bolts, rivets, washers etc
4) Assembling of machine parts
5) Generation of manufacturing drawings from 3D models/assembly
6) Synthesis of four bar mechanism and its simulation using software packages
7) Synthesis of slider crank mechanism and its simulation using software packages
8) Schematic and non schematic routing of pipes/tubes
9) Manual/Computer aided part programming for turning and milling operations
10) Rapid prototyping of simple CAD models

Reference Books

1. CAD and Solid Modeling Software Packages CATIAV5, UNIGRAPHICS and PRO-E Manuals of Latest Version
2. Ibrahim Zeid, R Sivasubrahmanian CAD/CAM: Theory & Practice *Tata McGraw Hill Education Private Limited*, Delhi,
3. Yoram Koren, Computer Control of Manufacturing Systems *Tata McGraw Hill Education Private Limited*, Delhi,
4. Peter Smid, (2003), CNC programming Handbook a comprehensive guide to practical CNC programming, Industrial Press

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

Note: Exercise in Rapid prototyping may be demonstrated for the entire batch

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, modeling steps, results
30% - Viva voce

ME010 508 Electrical & Electronics Lab

(Common with PE010 508 and AU010 508)

Teaching scheme **Credits:** 2

3 hours practical per week

Objectives

- *To conduct various tests on Electrical Machines and to study their performance.*
- *To conduct various tests on practical electronic circuits*

PART A

1. Study of 3-point and 4-point starters for D.C machines

2. OCC of self excited D.C machines – critical resistances of various speeds. Voltage built-up with a given field circuit resistance. Critical speed for a given field circuit resistance

3. OCC of separately excited D.C machines

4. Load test on shunt generator – deduce external, internal and armature reaction characteristics.

5. Load test on compound generator

6. Swinburne's test on D.C machines

7. Brake test on D.C shunt motors and determination of characteristics.

8. Brake test on D.C series motors and determination of characteristics.

9. Brake test on D.C compound motors and determination of characteristics.

10. O.C and S.C tests on single phase transformers – calculation of performance using equivalent circuit – efficiency, regulation at unity, lagging and leading power factors.

11. Load test on single phase transformers.

12. Alternator regulation by emf and mmf methods

13. Study of starters for three phase induction motors

14. Load tests on three phase squirrel cage induction motors

15. Load tests on three phase slip ring induction motors

16. Load tests on single phase induction motors

PART B

1. Design and testing of clipping and clamping circuits

2. Design and testing of of RC integrator and differentiator circuits.

3. Design and testing of rectifier circuits – Half wave – Full wave (centre – tapped and bridge) circuits. Filter circuits.

4. Design and testing of RC coupled amplifier– frequency response.
Sweep circuits

5. Design and Testing of RC phase-shift Oscillator

References

1. Dr. P S Bimbra, *Electrical Machinery*, Khanna Publishers
2. R K Rajput, *A text book of Electrical Machines*, Laxmi publishers
3. A.P. Malvino, *Electronic Principles*– TMH
4. Floyd, *Electronic Devices*, Pearson Education, LPE

Internal Continuous Assessment *(Maximum Marks-50)*

50%-Laboratory practical and record
30%- Test/s
20%- Regularity in the class

End Semester Examination *(Maximum Marks-100)*

70% - Procedure, conducting experiment, results, tabulation, and inference
30% - Viva voce