Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal

Branch- Common to All Discipline

New Scheme Based On AICTE Flexible Curricula

BT301	**Mathematics-III**	**3L-1T-0P**	**4 Credits**

OBJECTIVES: The objective of this course is to fulfill the needs of engineers to understand applications of Numerical Analysis, Transform Calculus and Statistical techniques in order to acquire mathematical knowledge and to solving wide range of practical problems appearing in different sections of science and engineering. More precisely, the objectives are:

- To introduce effective mathematical tools for the Numerical Solutions algebraic and transcendental equations.
- To enable young technocrats to acquire mathematical knowledge to understand Laplace transformation, Inverse Laplace transformation and Fourier Transform which are used in various branches of engineering.
- To acquaint the student with mathematical tools available in Statistics needed in various field of science and engineering.

Module 1: Numerical Methods – 1: (8 hours): Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

Module 2: Numerical Methods – 2: (6 hours): Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules. Solution of Simultaneous Linear Algebraic Equations by Gauss's Elimination, Gauss's Jordan, Crout's methods, Jacobi's, Gauss-Seidal, and Relaxation method.,

Module 3: Numerical Methods – 3: (10 hours): Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. RungeKutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poission equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Module 4: Transform Calculus: (8 hours): Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Module 5: Concept of Probability: (8 hours): Probability Mass function, Probability Density Function, Discrete Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential Distribution.

Textbooks/References:

1. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
8. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
9. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968. Statistics

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics, III-Semester

RM 302 Thermo fluid Engineering

Course Objectives:

The objective of this course is to develop ability and gain insight into the process of problem-solving, with emphasis on thermodynamics and Fluid Mechanics .

Learning Outcomes

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

- Know about the basic concepts, statement and applications of Zeroth Law, First Law and Second Law of Thermodynamics
- To understand the concept of entropy, change in entropy, Available & Unavailable energy, concept of Availability
- Learn about pure substances, steam, properties of steam, determination of dryness fraction ,enthalpy, entropy and internal energy of different types of steam using steam table and Mollier diagram
- To have knowledge of basic properties of fluid, Hydrostatics, Buoyancy, Metacentre and stability conditions of floating bodies
- Derive and solve problems related to Euler's equation, Bernoulli's equation ,Application of Bernouli's Equation in Venturi meter, Orifice meter, Pitot Tube (working principle), Momentum equation

Syllabus:

Unit 1: Basic Concepts & Laws of Thermodynamics : Basic concepts: Property, Equilibrium, State, Process, Cycle, Zeroth law of thermodynamics, Heat and work transfer. First law of thermodynamics, first law applied to various systems steady flow process, limitations of first law of thermodynamics.

Unit 2 Second law of Thermodynamics: Heat engine, heat reservoir, Refrigerator, heat pump, Carnot's cycle, statements of second law Reversible and irreversible processes, consequence of second law, Clausious Inequality , Entropy, T-S diagrams, Available & Unavailable energy Availability

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

Unit 4: Fluid Properties: Introduction, fluid and the continuum, fluid properties, surface tension, Newton's laws of viscosity and it's coefficients, Types of fluids, Pascal's Law, Hydrostatic Law, hydrostatics and buoyancy, meta centre and metacentric height, stability of floating bodies and submerged bodies.

Unit 5 : Fluid Kinematics and Dynamics: Kinematics: Types of fluid flow, stream line, path line and streak line, types of flow and types of motion, local and connective acceleration, continuity equation of one, two and three dimensions, Velocity potential function, Stream Function, Laplace equation, circulation, flow nets.

Fluid Dynamics: Euler's equation, Bernoulli's equation ,Application of Bernouli's Equation: Venturimeter, Orifice meter, Pitot Tube, Momentum equation ,Impulse Momentum Equation and moment of momentum equation, their applications,

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

References:

1. Nag P.K.; Engineering Thermodynamics; Mc Graw Hills Fifth Edition
2. Cengel Y; Thermodynamics; MC Graw Hills ,Eight Edition
3. Dwivedi K.K. , Pandey Mukesh. Engineering Thermodynamics, Dhanpat Rai & Co.
4. Chattopadhya P , Engineering Thermodynamics Second Edition,OXFORD University Press
5. Yadav R. Applied Thermodynamics , Central Publishing house Allahabad
6. Khurmi R.S. ,Thermal Engineering, S Chand
7. Rajput R.K. ,Thermal Engineering, Laxmi Publication
8. Domkundwar Thermal Engineering, Dhanpat Rai & Co.
9. Bansal R.K. Fluid Mechanics Laxmi Publication
10. Modl and Seth, Fluid Mechanics
11. Shames, Fluid Mechanics, Tata McGraw Hills

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics, III-Semester

RM 303 Kinematics of Machines

UNIT 1: Simple Mechanism: Introduction, kinematics and kinetics, , concept of kinematic links, basic terminology and definitions, types of motion, kinematic joint, kinematic pair, mechanisms and machines, degree of freedom, Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law, kinematic chains, inversions of four bar chain mechanism, single slider crank mechanism, double sliders crank mechanism

UNIT 2 : Kinematic Analysis of Simple Mechanism: Velocity analysis of simple mechanisms, Graphical method, Velocity and acceleration polygons , Velocity analysis using instantaneous centres, Kennedy Theorem, relative velocity method, Acceleration Analysis, Coincident points, Coriolis component of Acceleration.

Unit 3 Kinematics of CAM Mechanisms : *Introduction, classifications of Cams and followers, nomenclature, analysis of cam and follower motion: Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions, construction of cam profile.*

Unit 4 : Power Transmission Systems: : Kinematics of belt- pulley, flat and v –belt drive, rope drive , Relation between tension ratio for flat belt drive and rope drive, power transmission through belt and rope drives, centrifugal tension, initial tension in belt. condition of maximum power transmission for belt drive.

Clutches and Brakes: Purpose of Clutch, classifications, Single and multi plate clutch, cone clutch, brakes, classifications, single and double block, band, internal and external.

Unit 5: Gears and Gear Trains: Basic terminology, Classification of toothed gearing, Law of gearing, tooth profiles, types of gears, spur, bevel, worm, helical, hypoid ,interference in involute gears,

Gear trains, Types: Simple and Compound gear train, Reverted gear train, Epicyclic , Sun and Planet type.

Text Books:

1. Theory of Machines by S.S Ratan, THH
2. Theory of Machines by V.P Singh; Dhanpat Rai and sons, New Delhi.
3. Theory of Machines by Jagdish Lal; Metropolitan Publishers, New Delhi.
4. Theory of Machine by R.S.Khurmi, S. Chand
5. Theory of Machine by R.K.Bansal, ,Laxmi Publication.

Reference Books:

1. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.
2. http://swayam.gov.in .
3. Theory of Machine by Thomas Beven
4. Theory of Machine by Balani

Suggested List of Experiments:

1. To study various types of Links, Pairs, Chain and Mechanism

2. To study inversion of Four Bar Mechanism, Single Slider Crank Chain Mechanism and Double Slider Crank Chain Mechanism.

3. To study velocity diagram for Slider Crank Mechanism.

4. To study various kinds of belts drives.

5. To study and find coefficient of friction between belt and pulley.

6. To study various types of Cam and Follower arrangement.

7. To plot follower displacement Vs cam rotation graph for various cam follower arrangement.

8. To study Different types of Gears.

9. To study Different types of Gear Trains.

10. To create various types of linkage mechanism in CAD and simulate the motion output and study the relevant effect.

11. To generate spur gear involute tooth profile using simulated gear shaping process.

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New Scheme Based On AICTE Flexible Curricula

Robotics and Mechatronics, III-Semester

RM 304 Strength of Material

Objectives :

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

Learning Outcomes : At the completion of this course, students will be able to

1. Know the concepts of simple stress and strain, principle stress and strain ,Mohr circle.

2. Analyze the beam of different cross sections for shear force, bending moment, slope and deflection.

3. Understand the concepts necessary to design the structural elemets.

4. analyze column and strut, thin shells.

5. understand the concept of different theories of failures.

UNIT-I Simple Stress and Strain

Concept of Elastic body, stress and Strain, stress strain diagram, Hooke's law, Various types of stress and strains, Elastic constants, Stresses in compound bars, composite and tapering bars, Temperature stresses. strain energy under axial loads and stresses due to impact of falling weights.

Complex Stress and Strains- Two dimensional and three dimensional stress system. Normal and tangential stresses, Principal Planes, Principal Stresses and Strains, Mohr's circle of stresses.

UNIT-II Bending and Shearing Stresses

Bending: Theory of simple bending, Concept of pure bending and bending stress, Equation of bending, Neutral axis, Section-Modulus, Determination of bending stresses in simply supported, Cantilever and Overhanging beams subjected to point load and uniformly distributed loading, Bending stress distribution across a section of beam, strain energy in bending.

Shearing Stress: Shearing Stress in a beam and shear stress distribution across a section in Beams.

UNIT III Slopes and Deflection

Differential equation of the elastic curve ,Determination of Slope and Deflection of beams by Double Integration Method, Macaulay's Method, Area Moment Method, and Strain Energy Method.

UNIT IV Torsion of Shafts and Theories of Failure

Concept of pure torsion, Torsion equation, Determination of shear stress and angle of twist of shafts of circular section, Torsion of solid and hollow circular shafts, comparison of hollow and solid shafts, Analyses of problems based on combined Bending and Torsion, Theories of Failure

UNIT V Columns & Struts, Thin Shells

Columns & struts : Theory of columns, Slenderness ratio, Direct and bending stresses in short columns, Stability of structures, Euler's formula for columns with different end conditions, Rankine's formula, Eccentric loads and the Secant formula ,Imperfections in columns

Thin Pressure Vessels: cylinders and spheres. Stress due to internal pressure, Change in diameter and volume.

EVALUATION

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

References:

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

Suggested List of Experiments:

1. To conduct a tensile test on a mild steel specimen and determine the following: (i) Limit of proportionality (ii) Elastic limit (iii) Yield strength (iv) Ultimate strength (v) Young's modulus of elasticity (vi) Percentage elongation (vii) Percentage reduction in area
2. To determine the deflection and bending stress of cantilever beam
3. To conduct torsion test on mild steel specimen to find modulus of rigidity or to find angle of twist of the materials.
4. To determine the Impact strength (Specific impact factor) through Izod test
5. To find out the Shear strength of a given specimen using UTM.
6. To perform the Charpy impact test on materials.
7. To determine the Flexural Strength of Concrete beam
8. To study the behavior of the given material under Compressive load and to find out following Modulus of elasticity
   - Maximum Compressive strength or ultimate stress
   - Percentage Decrease in length
   - Percentage Increase in area•

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Robotics and Mechatronics, III-Semester

RM 305 Manufacturing Technology

OBJECTIVES:

To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

Learning Outcomes:

Upon completion of this course, the students can able to

1. Know about metal casting processes and their suitability.
2. Understand the working principle of different welding processes and their applicability
3. Learn about the metal forming processes and their applications
4. Know about sheet metal operations and manufacturing processes of plastics products
5. Apply the different manufacturing process and use this in industry for component production

UNIT I: METAL CASTING PROCESSES

Sand Casting : Sand Mould, Type of patterns, Pattern Materials, Pattern allowances, Moulding sand Properties and testing, Cores ,Types and applications, Moulding machines, Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell , investment, Ceramic mould, Pressure die casting , Centrifugal Casting , CO2 process – Stir casting; Defects in Sand casting

UNIT II : JOINING PROCESSES

Operating principle, basic equipment, merits and applications of : Fusion welding processes : Gas welding , Types ,Flame characteristics; Manual metal arc welding, Gas Tungsten arc welding, Gas metal arc welding , Submerged arc welding , Electro slag welding; Operating principle and applications of : Resistance welding ,Plasma arc welding, Thermit welding, Electron beam welding, Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.

UNIT III : METAL FORMING PROCESSES

Hot working and cold working of metals, Forging processes, Open, impression and closed die forging ,forging operations. Rolling of metals; Types of Rolling ,Flat strip rolling ,shape rolling operations , Defects in rolled parts. Principle of rod and wire drawing, Tube drawing, Principles of Extrusion , Types; Hot and Cold extrusion.

UNIT IV :SHEET METAL PROCESSES

Sheet metal characteristics, shearing, bending and drawing operations, Stretch forming operations, Formability of sheet metal, Test methods, special forming processes, Working principle and

applications, Hydro forming, Rubber pad forming , Metal spinning, Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming, Micro forming

UNIT V : MANUFACTURE OF PLASTIC COMPONENTS

Types and characteristics of plastics, Moulding of thermoplastics, working principles and typical applications, injection moulding , Plunger and screw machines – Compression moulding, Transfer Moulding, Typical industrial applications – introduction to blow moulding ,Rotational moulding, Film blowing , Extrusion, Thermoforming, Bonding of Thermoplastics.

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai,
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2ndEdition, TMH
4. Raghuwanshi B.S., Workshop Technology ,Dhanpat Rai & Co.

REFERENCES:

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education,
2. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education,
3. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice – Hall of India.
4. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd..

Suggested list of Experiments:

1. Study of different types of patterns.
2. Study of casting defects and remidies
3. Fabrication of simple structural shapes using gas welding / arc welding (Lap joint and Butt Joint)
4. Study of welding defects ,causes and remedies
5. Joining of plates and pipes using gas metal arc welding/ arc welding/ submerged arc welding.
6. Preparation of green sand moulds by using patterns.
7. Manufacturing of simple sheet metal components using shearing and bending operations.
8. Manufacturing of sheet metal components using metal spinning on a lathe.

EVALUATION

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

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Robotics and Mechatronics, III-Semester

RM 306 Simulation and Modeling Lab

Modelling and Simulation lab should have advanced licensed softwares like Solid works, CATIA, PRO/E ,ANSYS, ,FLUENT, MSC / Nastran etc.

Course Outcome:

Students will get an insight into the use of different simulation and analysis software (viz. CATIA, PRO/E ,ANSYS, MSC / Nastran ***)*** to simulate flow behaviour and perform Structural analysis.

Suggested List of Experiments:

1) Design and drafting of riveted joints

2) Design and drafting of welded joints.

3) Layout of typical wing structure.

4) Stress analysis of a rectangular plate with a hole.

5) Static analysis on cantilever beam

6) Static analysis of forces in a simply supported beam

7) Static analysis- Plane truss

8) 2-D static stress analysis

9) 3-D static stress analysis

10) Three view diagram of a typical aircraft

11) Analysis of a model airplane wing

12) Simulation of flow through a Converging-diverging nozzle.

13) Structural analysis of a tapered wing

14) Stress and modal analysis of a cylinder under pressure

15) Stress distribution in indeterminate structure

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