

MTH -301 COMPUTATIONAL TECHNIQUES

UNIT I MATRICES

Eigenvalues and Eigenvectors of a real matrix , Characteristic equation , Properties of Eigenvalues and eigenvectors , Cayley-Hamilton Theorem , Diagonalization of matrices , Reduction of a quadratic form to canonical form by orthogonal transformation

UNIT II INFINITE SERIES

Sequences , Convergence of series , General properties , Series of positive terms , Tests of convergence (Comparison test, Integral test, Comparison of ratios and D'Alembert's ratio test) , Alternating series , Series of positive and negative terms , Absolute and conditional convergence , Power Series , Convergence of exponential, logarithmic and Binomial Series.

UNIT III FUNCTIONS OF SEVERAL VARIABLES

Limits and Continuity , Partial derivatives , Homogeneous functions and Euler's theorem , Total derivative , Differentiation of implicit functions , Change of variables , Partial differentiation of implicit functions , Taylor's series for functions of two variables .

Errors and approximations , Maxima and minima of functions of two variables

UNIT IV IMPROPER INTEGRALS

Improper integrals of the first and second kind and their convergence , Evaluation of integrals involving a parameter by Leibnitz rule – Beta and Gamma functions , Properties , Evaluation of integrals using Beta and Gamma functions , Error functions.

UNIT V MULTIPLE INTEGRALS

Double integrals , Change of order of integration , Area enclosed by plane curves , Triple integrals , Volume of Solids , Change of variables in double and triple integrals , Area of a curved surface.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd.,

AEC-302

ELEMENTS OF AERONAUTICS

UNIT I INTRODUCTION TO FLIGHT

Brief history of Aviation-Hot air balloon and heavier than air flying machines-early airplane configurations-Modern Airplanes-Components of airplane and their functions-Rotary wing aircrafts-Space vehicles.

UNIT II FUNDAMENTALS OF AERONAUTICS

International Standard Atmosphere-Pressure, Temperature and Density altitude, Basic Aerodynamics - Continuity, Momentum and Energy equations, Bernoulli's equation-Mach number-subsonic, transonic, sonic and supersonic flow regimes, Measurement of pressure and airspeed-IAS,EAS and TAS. Airfoil geometry and nomenclature-infinite and finite wing sections-lift, drag and moment coefficients-angle of attack-aspect ratio-Reynolds number-induced drag and parasite drag-airfoil characteristics, Elements of Aircraft performance, stability and control.

UNIT III AIRCRAFT STRUCTURE AND MATERIALS

Structural components of an airplane- monocoque and semi- monocoque structure –materials for structural components – composite materials and their significance in Aviation Technology

UNIT IV AIRCRAFT PROPULSION

Propeller Engine – Gas Turbine Engine – Turbo prop, Turbo jet, Turbo fan Engines- specific fuel consumption-variation of thrust and power with speed and altitude – materials for engine components.

UNIT V SPACE VEHICLES & ASTRONAUTICS

Basics of Rocket Technology-escape velocity-reentry vehicles-heat transfer problems of space vehicles-ablative cooling-Satellite technology– Hypersonic vehicles, Elements of Astronautics.

TEXT BOOKS

1.Anderson, J. D., Introduction to Flight, Tata McGraw-Hill Higher Education, 6th edition 2010.

REFERENCE BOOKS

- 1.Kermode, A. C, Barnard, R. H and Philpott, D. R, Mechanics of Flight, Pearson education, 2012.
- 2.Shevell, R. C., Fundamentals of Flight., Prentice hall (2nd edition), 1989.
- 3.Steven, A. Brandt, Randall J. Stiles, John J. Bertin and Ray Whitford, Introduction to Aeronautics: A Design Perspective, AIAA Education series(2nd edition),2004.
- 4.Torenbeek, E and Wittenberg, H, Flight Physics: Essentials of Aeronautical Disciplines and Technology, with Historical Notes, Springer, 2009.

LIST OF EXPERIMENT

1. Study and identify the component of Flight
2. Study suitable materials for Aircraft structure
3. Perform basic calculation on Mechanics using Newton law for lift, drag and moment.
4. Perform basic calculation on Atmosphere-Pressure, Temperature and Density altitude
5. Study the advance structures used in aircraft

AEC-303

FLUID MECHANICS

UNIT I INTRODUCTION

Fluid –definition-Fluid properties-Newton’s law of viscosity-Classification of fluids-fluid statics-Hydrostatic forces on submerged surfaces- Stability of floating bodies

UNIT II FLUID FLOW ANALYSIS AND FLOW MEASUREMENT

Ideal and real flow-Concept of continuum-Eulerian and Lagrangian approaches-Velocity field-Pathline, Streakline, Streamline- Stream tube- Fluid acceleration-Continuity, momentum differential equations-Navier Stokes equation- Stream function – Vorticity –Irrotationality-Potential function-Potential flow-Laplace equation-Bernoulli’s equation and its applications-Venturimeter-Orifice meter , Flow Rate and Velocity Measurement.

UNIT III DIMENSIONAL ANALYSIS

Buckingham Pi Theorem-Non dimensional numbers and their significance-Flow similarity and model studies.

UNIT IV FLOW THROUGH PIPES

Laminar and turbulent flow- Boundary layer flow – Boundary layer thickness - Reynolds number and its significance-Laminar fully developed pipe flow-Hagen-Poiseuille flow-Coefficient of friction-Head loss – Darcy-Wiesbach equation-Hydraulic gradient- Total energy lines-Moody’s diagram-Turbulent flow through pipes.

UNIT V FLUID MACHINERY

Classification of fluid machines-Reciprocating and centrifugal pumps-impulse and reaction turbines-Working principle of Pelton, Francis and Kaplan turbines-Velocity triangles-fans and blowers.

TEXT BOOKS

1. Frank M White, Fluid Mechanics, The McGraw Hill companies. 7th edition), 2011.
2. Rathakrishnan, E, Fundamentals of Fluid Mechanics, Prentice-Hall (3rd edition), 2012.
3. Yunus A. Cengel and John M Cimbala, Fluid mechanics: Fundamentals and Applications, Tata McGraw Hill (2nd edition), 2010.

REFERENCE BOOKS

1. Irving H Shames, Mechanics of Fluids, The McGraw Hill companies (4th edition), 2003.
2. Yuan, S.W, Foundations of Fluid Mechanics, Prentice-Hall, 1967.

LIST OF EXPERIMENTS

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Orifice meter and Venturi meter.
4. Determination of C_c , C_v , C_d of Orifices.
5. Calibration of Nozzle meter and Mouth Piece.

AEC-304

THERMODYNAMICS

UNIT I BASIC THERMODYNAMICS

Systems, Zeroth law, First law - Steady flow energy equation - Heat and work transfer in flow and non-flow processes - Second law, Kelvin-Planck statement - Clausius statement – Reversibility and irreversibility - Concept of Entropy, Clausius inequality, Principle of increase of entropy – Absolute entropy – Availability - Entropy change in non-flow processes

UNIT II AIR POWER CYCLES

Carnot, Otto, Diesel, Dual, Stirling and Ericsson cycle - Air standard efficiency – Mean effective pressure – Actual and theoretical PV diagram of two stroke and four stroke IC engines.

UNIT III VAPOUR POWER CYCLE

Introduction – Rankine cycle – Means of increase of efficiency of the Rankin cycle – Ideal reheat and regenerative Rankine cycle – Second law analysis of vapour power cycles – Cogeneration.

UNIT IV REFRIGERATION AND AIR-CONDITIONING

Principles of refrigeration and Psychrometric - Vapour compression - Vapour absorption types - Co-efficient of performance, Properties of refrigerants – Basic Principle and types of Air conditioning.

UNIT V THERMODYNAMICS OF AIRCRAFT PROPULSION CYCLES

Isentropic flow through passages – Brayton cycle – Brayton cycle with intercooling, reheat and regeneration – Ideal jet propulsion cycles. Basics of heat transfer.

TEXT BOOKS

1. Rathakrishnan E., Fundamentals of Engineering Thermodynamics, Prentice-Hall India, 2012.
2. Nag.P.K., Engineering Thermodynamics, Tata McGraw-Hill, New Delhi, 2007.
3. Yunus A Cengel and Michael A Boles., Thermodynamics- an Engineering approach, McGraw Hill Education (7th edition), 2012.

REFERENCE BOOKS

1. Holman.J.P, Thermodynamics, McGraw-Hill (3rd edition), 2007.
2. Gordon J. Van Wylen and Richard E. Sonntag and Claus Borgnakke, Fundamentals of Classical Thermodynamics – Vol 1, Wiley Eastern, 1994.
3. Arora C.P., Thermodynamics, Tata McGraw-Hill, New Delhi, 2003.
4. Merle C Potter and Craig W Somerton., Thermodynamics for Engineers, Schaum's

LIST OF EXPERIMENTS

1. To find mechanical equivalent of heat using Joules apparatus.
2. To study working of impulse and reaction steam turbine by models.
3. To study working of Gas turbines by models and to identify various processes of Brayton Cycle.
4. To calculate COP of vapor compression refrigeration system and to plot on T-S, P-H diagrams.
5. To plot specific fuel consumption versus rpm diagrams for diesel and petrol engine.

AEC-305

STRENGTH OF MATERIALS

UNIT I MOMENT OF INERTIA

Moment of Inertia, Mass Moment of Inertia, Area Moment of Inertia, Parallel Axis theorem, Polar Moment of Inertia, Principal axes, Principal moment of inertia.

UNIT II STRESS AND STRAIN

Definition, Stress- strain, uni-axial, bi-axial and tri-axial stresses, tensile & compressive stresses, shear stress-Elastic limit, Hooke's Law. Elastic Constants: Poisson's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, Volumetric Strain, Volumetric strain for tri-axial loading, Deformation of Tapering members, Deformation due to self-weight, bars of varying sections, composite sections, Thermal Stress.

UNIT III BEAMS

Shear Force and Bending Moment in Beams: Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading, relationship between rates of loading, shear force & bending moment. Deflection of Cantilever, simply supported and over hanging beams using. Double integration and Macaulay's Method for different type of loadings.

UNIT IV STRESSES IN BEAMS

Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section moduli for different sections, beams for uniform strength, Flitched beams. Direct & Bending Stresses: Core of Section, Chimneys subjected to wind pressure Shear Stress in Beams: Distribution of shear stress, across plane sections used commonly for structural purposes, shear connectors.

UNIT V COLUMN & TORSION

Buckling load, Types of end conditions for column, Euler's column theory and its limitations, Rankine- Gordon Formula, Torsion of circular shafts-solid and hollow, stresses in shafts when Transmitting power, shafts in series and parallel. Strain Energy: Resilience, proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.

TEXTS BOOKS

1. Strength of Materials, Subramanian, Oxford University Press, Edition 2005
2. Mechanics of Materials, B.C Punmia Ashok Jain, Arun Jain, Lakshmi Publications, New Delhi.

REFERENCE BOOKS

1. Elements of Strength of Materials, Timoshenko and Young Affiliated East-West Press.
2. Mechanics of Materials, James M. Gere (5th Edition), Thomson Learning.

LIST OF EXPERIMENTS

1. Standard tensile test on MS and CI test specimen.
2. Direct/ cross Shear test on MS and CI specimen.
3. Transverse bending test on wooden beams to obtain modulus of rupture.
4. Fatigue test.
5. Brinell Hardness tests.

AEC-306 MECHANICS OF MACHINES

UNIT I MECHANISMS

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion – Degrees of freedom slider crank – Single and double – Crank rocker mechanisms – Inversions – applications, Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION

Types of friction – friction in screw and nut – pivot and collar – thrust bearings – collar bearing – plate and disc clutches – belt (flat & vee) and rope drives – creep in belts – Jockey pulley – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – Effect of centrifugal and initial tension – condition for maximum power transmission.

UNIT III GEARING AND CAMS

Gear profile and geometry – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple and compound gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – cam design for different follower motions.

UNIT IV BALANCING

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – balancing single and multi-cylinder Engines – Governors and Gyroscopic effects.

UNIT V VIBRATION

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – Torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

TEXT BOOKS

1. Bansal Dr. R.K. “Theory of Machines” Laxmi Publications (P) Ltd., New Delhi, 2001.
2. Rattan S.S.”Theory of machines” Tata McGraw Hill publishing Co., New Delhi, 2002.

REFERENCES:

1. Rao J. S. and Dukkipati R.V. “Mechanism and Machine Theory” Second Edition, Wiley Eastern Limited, 1992.
2. Malhotra D.R. and Gupta H.C “The Theory of machines” Satya Prakasam, Tech. India Publications, 1989.
3. Gosh A and Mallick A.K. “Theory of Machines and Mechanisms” affiliated eastwest press, 1989.
4. Shingley J.E. and Vicker J.J. Theory of Machines and Mechanisms” McGraw Hill, 1986.
5. Burton Paul “Kinematics and Dynamics of Machinery”, Prentice Hall, 1979.

LIST OF EXPERIMENTS

1. To observe the lift-off speed of a Porter Governor.
2. To observe the effect of varying sleeve weight or spring force on the operation of a Porter Governor.
3. To observe the lift-off speed of a Proell Governor.
4. To observe the effect of varying sleeve weight or spring force on the operation of a Proell Governor.
5. To observe the lift-off speed of a Hartnell Governor.
6. To observe the effect of varying sleeve weight or spring force on the operation of a Hartnell Governor.
7. To investigate the behavior of Flat Clutch plates and to compare the results using two different methods (uniform pressure and uniform wear) of calculations.
8. To investigate the behavior of a Worm wheel gear set.
9. To measure the coefficient of static and kinetic friction between wooden blocks.
10. To study the tension in the tight and in slack side of a square thread and a vee thread.