**BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING)**

**(Credit Based)**

**SCHEME OF STUDIES/EXAMINATION (Modified)**

**SEMESTER-III w.e.f. 2019-20**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **Teaching Schedule** | | | |  | **Examination Schedule (Marks)** | | | | **Duration of Exam**  **(Hrs.)** |
| **L** | **T** | **P** | **Hours/Week** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** |  |
| 1 | AER-201A | Elements of Aeronautics | 3 | 0 | 0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | BS-204A | Higher Engineering Mathematics | 3 | 0 | 0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | #ES-203A | Basic Electronics Engineering | 3 | 0 | 0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | AER-203A | Fluid Mechanics | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 5 | #MEC-203A | Mechanics of Solids-I | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 6 | #MEC-205A | Thermodynamics | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 7 | AER-205A | Fluid Mechanics Lab | 0 | 0 | 2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 8 | #MEC-209LA | Mechanics of Solids Lab | 0 | 0 | 2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 9 | \*AER-207A | Industrial Training – I | 2 | 0 | 0 | 2 | - | - | 100 | - | 100 |  |
| 10 | \*\*MC-901A | Environmental Sciences | 3 | 0 | 0 | 3 | - | 75 | 25 | - | 100 | 3 |
|  |  | **Total** | **23** | **3** | **4** | **30** | **23** | **450** | **230** | **120** | **800** |  |

***Note:***

*1. \**AER-207A *is a mandatory non-credit course in which students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.*

2. \*\*MC-901A is mandatory credit-less course in which the students will be required to get passing marks in the major test.

3. # The coursesare common with B. Tech. (Mechanical Engineering).

**BACHELOR OF TECHNOLOGY (AERONAUTICAL ENGINEERING)**

**(Credit Based)**

**SCHEME OF STUDIES/EXAMINATION(Modified)**

**SEMESTER-IV *w.e.f.*2019-20**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **Teaching Schedule** | | | |  | **Examination Schedule (Marks)** | | | | | **Duration of Exam**  **(Hrs.)** | | |
| **L** | **T** | **P** | **Hours/Week** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | |  | | |
| 1 | #ES-204A | Materials Engineering | 3 | 0 | 0 | 3 | 3 | 75 | 25 | 0 | | 100 | | 3 |
| 2 | AER-202A | Aircraft Structure-I | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | | 100 | | 3 |
| 3 | AER-204A | Aerodynamics-I | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | | 100 | | 3 |
| 4 | #MEC-206A | Mechanics of Solids-II | 3 | 1 | 0 | 4 | 4 | 75 | 25 | 0 | | 100 | | 3 |
| 5 | AER-206A | Propulsion-I | 3 | 0 | 0 | 3 | 3 | 75 | 25 | 0 | | 100 | | 3 |
| 6 | #ES-206LA | Materials Engineering Lab | 0 | 0 | 2 | 2 | 1 | 0 | 40 | 60 | | 100 | | 3 |
| 7 | AER-208A | Propulsion Lab | 0 | 0 | 2 | 2 | 1 | 0 | 40 | 60 | | 100 | | 3 |
| 8 | \*MC-902A | Constitution of India | 3 | 0 | 0 | 3 | - | 75 | 25 | - | | 100 | | 3 |
|  |  | **Total** | **18** | **3** | **4** | **25** | **20** | **375** | **205** | **120** | | **700** | |  |

***Note:***

1. *\*MC-902A is a mandatory credit-less course in which the students will be required to get passing marks in major test.*

*2. All the students have to undergo 4 to 6 weeks industrial training after 4th semester and it will be evaluated in 5th semester.*

3. #The coursesare common with B.Tech. (Mechanical Engineering).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B. Tech (3rd Semester) Aeronautical Engineering** | | | | | | |
| **AER-201A** | **Elements of Aeronautics** | | | | | | |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **-** | **3** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with the basics of Aeronautical Engineering** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Introduction to basic aircraft structure** | | | | | | |
| **CO2** | **Introduction to the concept of flight** | | | | | | |
| **CO3** | **Understanding the concept of propulsion and thrust generation** | | | | | | |
| **CO4** | **Introduction of basic concept of generation of lift and drag** | | | | | | |

**Unit-I**

**Introduction to Aircraft Structure:** Early airplanes, biplanes and monoplanes, Components of an airplane and their functions, Different types of flight vehicles: classifications. General types of construction, Monocoque, semi-monocoque, typical wing and fuselage structure. Metallic and non-metallic materials, Use of aluminium alloy, titanium, stainless steel and composite materials.

**Unit-II**

**Introduction to Aerodynamics:** Differential forms of Continuity, Momentum and Energy equations, Speed of sound; Mach number. Incompressible v/s compressible flows; Inviscid v/s Viscous flows; Classification of flows based on Mach Number; Wings and airfoils; airfoil nomenclature; lift, drag and moment coefficients; Pressure coefficient; Generation of lift and drag; Classification of airfoil drag; Finite wings and concept of induced drag; Drag polar.

**Unit-III**

**Introduction to Propulsion:** Basic ideas about piston, turboprop and jet engines turbojet and turbofan engines, Use of propeller and jets for thrust production. Comparative merits and demerits.

**Unit-IV**

**Introduction to Flight Dynamics:** Equations of motion, concept of steady level flight, thrust required for level flight, thrust available and maximum velocity; Power required, available power and maximum velocity; Effect of altitude on power; Rate of climb; Gliding flight; Absolute and service ceilings; Time to climb; Range and endurance for propeller and jet engines; Takeoff and landing performance; Turning flight and V-n diagram.

**Text Book:**

1. Introduction to Flight: J.D. Anderson, McGraw Hill, 8th Edition.
2. Aviation Maintenance Technician Handbook- Volume I, FAA-H-8083-31, Himalayan Books.

**Note: The paper setter will set the paper as per the question paper templates provided**

**Suggested Books:**

1. Aircraft Structures for Engineering Students, T.H.G. Megson, 5th Edition, Elsevier.
2. “Flight without Formulae”, Kermode, A.C., McGraw-Hill, 1997.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **BS-204A** | | **HIGHER ENGINEERING MATHEMATICS** | | | | | | |
| **Lecture** | | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | | **-** | **-** | **3** | **75** | **25** | **100** | **3 h** |
| **Purpose** | | **The objective of this course is to familiarize the prospective Engineers with Laplace Transform, partial differential equations which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution. More precisely, the objectives are as under:** | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | **Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.** | | | | | | | |
| **CO 2** | **To introduce the Partial Differential Equations, its formation and solutions for multivariable differential equations originated from real world problems.** | | | | | | | |
| **CO 3** | **To introduce the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems.** | | | | | | | |
| **CO 4** | **To familiar with essential tool of Numerical differentiation and Integration needed in approximate solutions for the ordinary differential equations.** | | | | | | | |

**UNIT-1**

**Laplace Transform**

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

**UNIT-2**

**Partial Differential Equations**

Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit’s method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

**UNIT-3**

**Numerical Methods-1**

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.

**UNIT-4**

**Numerical Methods-2**

Numerical Differentiation using Newton’s forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules, Ordinary differential equations: Taylor’s series, Euler and modified Euler’s methods. Runge-Kutta method of fourth order for solving first and second order equations.

**Textbooks/References:**

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. AICTE Model Curriculum in Mathematics.
2. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
3. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
4. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
8. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
9. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
10. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
11. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.

**Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **B. Tech (3rd Semester) Aeronautical Engineering** | | | | | | | | |
| **ES-203A** | | **Basic Electronics Engineering** | | | | | |  |
| **Lecture** | | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs)** |
| **3** | | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
|  | | | | | | | | |
| **Purpose :** | | To provide an overview of electronic devices and components to Mechanical engineering students. | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | To introduce the basic electronics devices along with their applications. | | | | | | | |
| **CO 2** | To become familiar with basic operational amplifier circuits with applications and oscillators. | | | | | | | |
| **CO 3** | To understand the fundamentals of digital electronics. | | | | | | | |
| **CO 4** | To become familiar with basic electroniccommunication system. | | | | | | | |

**UNIT-I**

**Semiconductor Devices and Applications**: Introduction to P-N junction Diode and V- Icharacteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. BJT structure, its input-output and transfer characteristics, BJT as a Common Emitter amplifier, frequency response and bandwidth.

**UNIT-II**

**Operational amplifier and its applications:** Introduction to operational amplifiers, inverting, non- inverting and differential modes, basic parameters of Op-amp, Op-amp in open loop configuration, study of practical op-amp IC 741, Op-amp applications: adder, subtractor, scale changer, averaging amplifer,comparator, integrator and differentiator.

**Timing Circuits and Oscillators:** IC 555 timer pin diagram: Astableand mono-stable operation, Barkhausen's criteria for oscillations, R-C phase shift and Wein bridge oscillators using BJT and Op- Amp and their frequency of oscillation.

**UNIT-III**

**Digital Electronics Fundamentals** : Difference between analog and digital signals, Booleanalgebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- maps, Logic ICs, half and full adder, multiplexers, de-multiplexers, flip-flops, basic counters.

**UNIT-IV**

**Electronic Communication Systems**: The elements ofcommunication system,

Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

## Text Books:

* 1. Integrated Electronics, Millman&Halkias (Mc-Graw Hill)
  2. Electronics Devices & Circuit Theory, RL Boylestead& L Nashelsky (PHI)

## Reference Books:

1. Modern Digital Electronics, R P Jain, Tata McGraw Hill.
2. Electronic Communication Systems, G. Kennedy, McGraw Hill, 4th Edition

## Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B. Tech (3rd Semester) Aeronautical Engineering** | | | | | | |
| **AER-203A** | **Fluid Mechanics** | | | | | | |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **1** | **-** | **4** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with the basics of Fluid flow** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Understanding of fluid statics and potential flow** | | | | | | |
| **CO2** | **Introduction to the concept of fluid kinematics and dynamics** | | | | | | |
| **CO3** | **Understanding the concept of viscous flow** | | | | | | |
| **CO4** | **Introduction to boundary layers** | | | | | | |

**Unit – I**

**Fluid Properties and Fluid Statics:** Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal’s law, hydrostatic equation, pressure variation in compressible fluids,hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium.

**Potential Flow:** Uniform and vortex flow, flow past a Rankin half body, source, sink, source-sink pair and doublet, flow past a cylinder with and without circulation. Free and forced vortex flows.

**Unit-II**

**Fluid Kinematics:** Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net.

**Fluid Dynamics:** Concept of system and control volume, Euler’s equation, Bernoulli’s equation, venturimeter, orifices, orificemeter. Impulse momentum relationship and its applications.

**Unit-III**

**Viscous Flow:** Flow regimes and Reynold’s number, Relationship between shear stress and pressure gradient, Hagen Poisueille Equation, kinetic and momentum correction factors.

**Flow Through Pipes:** Major and minor losses in pipes, Hagen-Poiseuilli law, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes.

**Unit-IV**

**Boundary Layer Flow:** Boundary layer concept, displacement, momentum and energy thickness, von- karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Streamlined and bluff bodies lift and drag on a cylinder and an airfoil.

**Turbulent Flow:** Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes.

**Text Book:**

1. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Lakshmi Publications.
2. Fluid Mechanics and Hydraulic Machines, R.K. Rajput, S Chand Publications.

**Suggested Books:**

1. Fluid Mechanics, Frank M. White, McGraw Hill.
2. Fluid Mechanics , John F. Douglas, John Wiley.

**Note: The paper setter will set the paper as per the question paper templates provided**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B. Tech. (3rd Semester) Aeronautical Engineering** | | | | | | |
| **MEC-203A** | | **MECHANICS OF SOLIDS-Imn** | | | | | | |
| **Lecture** | | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to make the students aware of Stress, Strain and deformation of solids with the applications to beams, shafts and column and struts. The course will help the students to build the fundamental concepts in order to solve engineering problems. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering, determine centroid and moment of inertia of a different geometrical shapes and able to understand its importance. Explain the basic concepts of stress and strain and solve the problems | | | | | | | |
| **CO 2** | Determine and calculate the values of principal stresses. Express the concept of shear force and bending moment of beams. Construct shear force and bending moment diagram for beams. | | | | | | | |
| **CO 3** | Express the concept of torsion of circular shaft and able to solve the problems on torsion of circular shaft. Illustrate and solve the problems on bending and shear stresses on beams | | | | | | | |
| **CO 4** | Solve the problems on column and strut & slope & deflection & derive the derivations. | | | | | | | |

**Unit-I**

**Introduction:** Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces, forces in equilibrium, principle and laws of equilibrium, Free body diagrams, Lami's Theorem, equations of equilibrium, Concept of center of gravity and centroid, centroid of various shapes: Triangle, circle, semicircle and trapezium, theorem of parallel and perpendicular axes, moment of inertia of simple geometrical figures, polar moment of inertia. Numerical Problems

**Simple Stresses & Strains**: Concept & types of Stresses and strains, Poisson’s ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hook’s law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.

**Unit-II**

**Principle Stresses**: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr’s circle of stresses, Numerical Problems.

**Shear Force & Bending Moments**: Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexture under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii)combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) Application of moments, relation between the rate of loading, the shear force and the bending moments, Numerical Problems.

## Unit-III

**Torsion of Circular Members**: Derivation of equation of torsion, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, Numerical problems.

**Flexural and Shear Stresses** – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T, Angle, channel sections, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections. combined bending and torsion, equivalent torque, Numerical problems.

**Unit-IV**

**Columns & Struts:** Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations, Numerical problems.

**Slope & Deflection** : Relationship between bending moment, slope & deflection, moment area method, method of integration, Macaulay’s method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads, Numerical problems.

## Note: The paper setter will set the paper as per the question paper templates provided.

**Text Books:**

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

**Reference Books:**

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert l. Mott, Pearson, New Delhi
3. Strength of Material – Shaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B. Tech. (3rd semester) Aeronautical Engineering** | | | | | | |
| **MEC-205A** | **THERMODYNAMICS** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to make the students aware of Energy, Entropy, and Equilibrium, various laws of thermodynamics, concepts and principles and help the students to build the fbasic concepts to apply in various applications like IC engines and Air conditioning systems. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | Analyze the work and heat interactions associated with a prescribed process path and to perform an analysis of a flow system. | | | | | | |
| **CO 2** | Define the fundamentals of the first and second laws of thermodynamics and explain their application to a wide range of systems. | | | | | | |
| **CO 3** | Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations. | | | | | | |
| **CO 4** | Solve the problems related to Steam and plot the processes on H-S and T-S diagram. Understand thermodynamics relations. | | | | | | |

**Unit-I**

**Basic Concepts:** Thermodynamics: Macroscopic and Microscopic Approach, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property – Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Zeroth Law of Thermodynamic and its utility.

**First Law of Thermodynamics:** Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, 1st Law Applied to Non-Flow Process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process.

**Unit-II**

**Second Law of Thermodynamics:** Limitations of First Law, Thermal Reservoir Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and Their Equivalence, Perpetual Motion Machine of Second Kind. Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot’s Theorem and its Corollaries, Thermodynamic Temperature Scale, Numericals **Entropy:**Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature-Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of thermodynamics.

**Unit -III**

**Availability, Irreversibility and Equilibrium:** High and Low Grade Energy, Available Energy and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Availability of a Non-Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb’s Functions, Effectiveness and Irreversibility.

**Pure Substance:** Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling , Saturated and Superheated Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam.

**Unit-IV**

**Thermodynamic Relations:** TDS Relations, Enthalpy and Internal Energy as a Function of Independent Variables, Specific Heat Capacity Relations, Clapeyron Equation, Maxwell Relations.

**Gas Power Cycles:** Air standard efficiency, Otto cycle, Diesel cycle, Dual cycle, Atkinson cycle, Stirling and Ericsson cycles, Brayton or Joule cycle, Lenoir cycle

**Text Books:**

1. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
2. Engineering Thermodynamics – P K Nag, Tata McGraw Hill
3. Thermodynamics – An Engineering Approach; Y. A. Cengel, M. A. Boles; Tata McGraw Hill

**Reference Books:**

1. Thermal Science and Engineering – D S Kumar, S K Kataria and Sons
2. Engineering Thermodynamics -Work and Heat transfer – G F C Rogers and Maghew Y R Longman

## Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B. Tech (3rd Semester) Aeronautical Engineering** | | | | | | |
| **AER-205A** | | **Fluid Mechanics Lab** | | | | | | |
| **L** | | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | | **-** | **2** | **1** | **60** | **40** | **100** | **3h** |
| **Purpose** | | **To give the practical knowledge of handling the fluid related instruments.** | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO** | **To make the students familiar with the experiments related with Fluid Mechanics.** | | | | | | | |

**Note: Student will be required to perform at least 8 experiments out of the following list.**

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturimeter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli’s Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.

**Suggested Books:**

1. Instrumentation, measurements and experiments in fluids, E Rathakrishanan, Taylor and Francis Group.
2. Experiments in Fluid Mechanics, Sarabjit Singh, PHI.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B.Tech. (3rd semester) Aeronautical Engineering** | | | | | | | |
| **MEC-209LA** | | **MECHANICS OF SOLIDS LAB** | | | | | | | |
| **Lecture** | | **Tutorial** | **Practical** | **Credits** | **Major**  **Test** | **Minor**  **Test** | **Practical** | **Total** | **Time**  **(Hrs.)** |
| **0** | | **0** | **2** | **1** | **0** | **40** | **60** | **100** | **3** |
|  | | | | | | | | |  |
| **Purpose** | To make the students aware of different properties of material using different experiments. | | | | | | | | |
| **Course Outcomes** | | | | | | | | | |
| **CO1** | Ability to design and conduct experiments, acquire data, analyze and interpret data | | | | | | | | |
| **CO 2** | Ability to determine the behavior of ferrous metals subjected to normal and shear stresses by means of experiments. | | | | | | | | |
| **CO 3** | Ability to determine the behavior of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments. | | | | | | | | |
| **CO 4** | Physical insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes. | | | | | | | | |
| **CO5** | Write individual and group reports: present objectives, describe test procedures and results, synthesize and discuss the test results. | | | | | | | | |

**List of Experiments:**

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).
6. To study the Universal testing machine and perform the tensile, compression & bending tests.
7. To perform the shear test on UTM.
8. To study the torsion testing machine and perform the torsion test.
9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point and distributed Loads.
10. To prepare the composite specimen using hot compression molding machine and test for different mechanical properties.

.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B.Tech. (3rd semester) Aeronautical Engineering** | | | | | | | |
| **AER-207A** | | **INDUSTRIAL TRAINING-I** | | | | | | | |
| **Lecture** | | **Tutorial** | **Practical** | **Credits** | **Major**  **Test** | **Minor**  **Test** | **Practical** | **Total** | **Time**  **(Hrs.)** |
| **2** | | **0** | **0** | **--** | **--** | **100** | **--** | **100** |  |
|  | | | | | | | | |  |
| **Purpose** | To provide comprehensive learning platform to students where they can enhance their employ ability skills and exposure to the industrial environment. | | | | | | | | |
| **Course Outcomes** | | | | | | | | | |
| **CO1** | Capability to acquire and apply fundamental principles of engineering. | | | | | | | | |
| **CO 2** | Become updated with all the latest changes in technological world. | | | | | | | | |
| **CO 3** | Capability and enthusiasm for self-improvement through continuous professional development and life-long learning | | | | | | | | |
| **CO 4** | Awareness of the social, cultural, global and environmental responsibility as an engineer. | | | | | | | | |

**Note:** MEC-211 is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **MC-901A** | **Environmental Sciences** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **0** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | To learn the multidisciplinary nature, scope and importance of Environmental sciences. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | The students will be able to learn the importance of natural resources. | | | | | | |
| **CO2** | To learn the theoretical and practical aspects of eco system. | | | | | | |
| **CO3** | Will be able to learn the basic concepts of conservation of biodiversity. | | | | | | |
| **CO4** | The students will be able to understand the basic concept of sustainable development. | | | | | | |

**UNIT 1**

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

1. Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
2. Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
3. Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
4. Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
5. Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
6. Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

**UNIT II**

**Ecosystem-Concept of an ecosystem**. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

**UNIT III**

**Biodiversity and its conservation:** Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

**Environmental Pollution Definition:** Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

**UNIT IV**

**Social Issues and the Environment**. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

**Suggested Books**

* + - * Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
      * Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
      * Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
      * Environmental Science- Botkin and Keller. 2012. Wiley , India

**Note: The Examiner will be given the question paper template to set the question paper.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B.Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **ES-204A** | **MATERIALS ENGINEERING** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Purpose:** | To understand internal structure- properties relationship of different t ypes of materials and learn about Metallographic analysis and Characterization. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | To understand the Crystal structures and deformation mechanism in various materials. | | | | | | |
| **CO 2** | To study various types of phase diagrams, TTT curve and Iron carbon diagram. To learn about different heat treatment processes. | | | | | | |
| **CO 3** | To learn about the failure mechanisms like Creep and Fatigue and designation of materials. | | | | | | |
| **CO 4** | To study Basics of Metallography and Basic Principle involved in the working of various types of Material characterization techniques. | | | | | | |

**UNIT I**

**Crystallography:**ReviewofCrystalStructure,SpaceLattice,CoordinationNumber,NumberofAtomsperUnitCell,AtomicPackingFactor;Numerical Problems Related toCrystallography.

**Imperfection in Metal Crystals:** Crystal Imperfections and their Classifications, Point Defects,LineDefects,Edge&ScrewDislocations,SurfaceDefects,VolumeDefects.

**Introduction to Engineering materials and Standard Materials Designation:** Introduction to Engineering materials,Steel Terminology, Standard Designation System for Steels, Indian Standard specifications for steels as per BIS: Based on Ultimate Tensile Strength and based on Composition, AISI-SAE standard designation for Steels and Aluminium Alloys

**UNIT II**

**PhaseDiagrams:**Alloy Systems, Solid solutions, Hume Rothery’s Rules, Intermediate phases, Phase Diagrams, Gibbs Phase Rule, Cooling curves,TheLever Rule,binary phasediagrams, Applications of Phase Diagrams, PhaseTransformation, Micro constituentsof Fe-Csystem,Allotropic FormsofIron,Iron-ironcarbide phase diagram, ModifiedIron CarbonPhaseDiagrams, Isothermal Transformation, TTT Curve,

**Heat Treatment:** Heattreatmentof steels,Annealing,Normalising,Hardening,Tempering, Case Hardening, Ageing, Austemperingand Martempering, Surface Hardening, Mass Effect, EquipmentsforHeatTreatment,MajorDefectsinMetalsorAlloysduetofaultyHeattreatment.

**UNIT III**

**Deformation of Metal:** Elastic and Plastic Deformation, Mechanism of Plastic Deformation, Slip; Critical Resolved Shear Stress, Twinning, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomena, Bauschinger Effect, Work Hardening.

**Failure of Materials:** Fatigue, Fatigue fracture, fatigue failure, Mechanism of Fatigue Failure, Fatigue Life calculations, Fatigue Tests, Theories of Fatigue.

**Creep**: Creep Curve, Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Fracture, Creep Test, Stress Rupture test.

**UNITIV**

**Introduction to Metallography:** Metallography, Phase analysis, Dendritic growth, Cracks and other defects Corrosion analysis, Intergranular attack (IGA), Coating thickness and integrity, Inclusion size, shape and distribution, Weld and heat-affected zones (HAZ), Distribution and orientation of composite fillers, Graphite nodularity, Intergranular fracturing.

**Materials Characterization Techniques:** Characterization techniques such as X-Ray Diffraction (XRD), Scanning Electron Microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, Atomic absorption spectroscopy.

## Text Books:

* + 1. Material Science by S.L.Kakani, New Age Publishers.
    2. The Scienceand Engineering of Materials, Donald R. Askeland , Chapman&Hall.
    3. Fundamentals of Material Science and EngineeringbyW. D. Callister, Wiley.
    4. Fundamental of Light Microscopyand Electronic Imaging by Douglas B.Murphy, Kindle Edition 2001
    5. Materials Science and Engineering, V. Raghvan
    6. Phase Transformation in Metals and Alloys,D. A.Porter &K.E. Easterling

## Reference Books:

* + 1. Material SciencebyNarula, TMH
    2. Metallographic Handbook by Donald C. Zipperian, Pace Technologies, USA.
    3. Robert Cahn Concise Encyclopedia of Materials Characterization, Second Edition:2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.
    4. Smart Materials and Structures by Gandhi and Thompson, Chapman and Hall.

## Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B.Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **AER-202A** | | **Aircraft Structure I** | | | | | | |
| **L** | | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | | **1** | **-** | **4** | **75** | **25** | **100** | **3h** |
| **Purpose** | | **To familiarize the students with the mathematical analysis of aircraft structures** | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | **Understanding of basic construction details of an aircraft and the materials used** | | | | | | | |
| **CO2** | **Introduction to the concept of airworthiness and airframe loads and fatigue based design.** | | | | | | | |
| **CO3** | **Understanding the theory of elasticity** | | | | | | | |
| **CO4** | **Introduction to virtual and energy methods** | | | | | | | |

**Unit – I**

**Sructural Components of aircraft:** Basic aircraft anatomy, loads on structural components, functions and fabrication of structural components, connections.

**Aircraft Materials:** Aluminium alloys, steel, titanium, plastics, glass, composite materials. Properties of materials.

**Unit-II**

**Airworthiness:** Factors of safety-light envelope and load factor determination.

**Airframe loads:** Aircraft inertia loads, symmetric manoeuvre loads, normal acceleration associated with various types of manoeuvres, gust loads.

**Unit-III**

**Basic Elasticity:** Stress, equations of equilibrium, plane stress, boundary conditions, stresses on inclined planes, principal stresses. Mohr’s circle, strain, compatibility conditions, plane strain, strains on inclined planes, principal strains, Mohr’s circle of strain, stress-strain relationships.

**Unit-IV**

**Virtual Work:** work, principle of virtual work and applications of the principle of virtual work.

**Energy Methods:** Strain energy and complimentary energy, principle of stationary value of total complimentary energy, deflection problems, statically indeterminate systems, unit load method, flexibility method, superposition principle, reciprocal theorem, temperature effects.

**Text Book:**

1. Aircraft Structures for Engineering Students, T.H.G. Megson, McGraw Hill.

2. Aircraft Structures, David J. Perry, McGraw Hill.

**Suggested Books:**

1. Analysis of Aircraft Structures- An Introduction, B.K. Donaldson, McGraw Hill.
2. Aircraft Structures, Lalit Gupta and O.P. Sharma, Himalayan Books.

**Note: The paper setter will set the paper as per the question paper templates provided**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B.Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **AER-204A** | **Aerodynamics I** | | | | | | |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **1** | **-** | **4** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with the fundamentals of Aerodynamics** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Understanding conformal transformations and its applications** | | | | | | |
| **CO2** | **Introduction to the concept inviscid, incompressible and irrotational flows** | | | | | | |
| **CO3** | **Understanding the thin airfoil theory** | | | | | | |
| **CO4** | **Introduction to flow over finite wings** | | | | | | |

**Unit – I**

**Conformal Transformations:** Complex potential function, Blasius theorem, principles of conformal transformation, Kutta -Juokowaski transformation of a circle into flat plate, airfoils & ellipses.

**Review of basic fluid mechanics:** Differential and Integral forms of continuity, momemtum and energy equations. Pathlines and streamlines, angular velocity, vorticity and strain, circulation, stream function, velocity potential and their relationship.

**Unit-II**

**Inviscid Incompressible flow:** Bernoulli’s Equation, flow in a duct, pitot tube, pressure coefficient, condition on velocity for incompressible flow, Laplace equation, uniform flow, source floe, flow past a half body and rankine oval, doublet, non-lifting flow over a circular cylinder, vortex flow, lifting flow over a circular cylinder, Kutta- Joukowski theorem.

**Unit-III**

**Incompressible flow over airfoils:** Airfoil nomenclature and characteristics, vortex sheet, Kutta condition, Kelvin’s Circulation theorem and the starting vortex, Classical thin airfoil theory- symmetric and cambered airfoils, modern low speed airfoils, flow over an airfoil- the real case, role of airfoil thickness on airplane design.

**Unit-IV**

**Incompressible flow over finite wings:** Downwash and induced drag, vortex filament, Biot-Savart Law, Helmholtz theorems, Prandtl’s classical lifting line theory, numerical non-linear lifting line method, flow over a delta wing.

**Text Book:**

1. Fundamentals of Aerodynamics, J. D. Anderson, McGraw Hill.

2. Aerodynamics for Engineers, Bertin and Smith, Prentice Hall.

**Note: The paper setter will set the paper as per the question paper templates provided**

**Suggested Books:**

1. Aerodynamics, L. J. Clancey, Pitman.
2. Aerodynamics for engineering students, Houghton EL & Brock AE.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B. Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **MEC-206A** | | **MECHANICS OF SOLIDS-II** | | | | | | |
| **Lecture** | | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time (Hrs.)** |
| **3** | | **1** | **0** | **4** | **75** | **25** | **100** | **3** |
| **Purpose** | The objective of this course is to show the development of strain energy and stresses in springs, pressure vessel, rings, links, curved bars under different loads. The course will help the students to build the fundamental concepts in order to solve engineering problems | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO1** | Identify the basics concepts of strain energy and various theories of failures and solve the problems | | | | | | | |
| **CO 2** | Differentiate different types of stresses induced in thin pressure vessel and solve the problems. Use of Lame’s equation to calculate the stresses induced in thick pressure vessel. | | | | | | | |
| **CO 3** | Able to compute stresses in ring, disk and cylinder due to rotation. Classify the different types of spring and analyze the stresses produced due to loading | | | | | | | |
| **CO 4** | Determine the stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings. Analyze the stresses due to unsymmetrical bending and determine the position of shear centre of different section. | | | | | | | |

**Unit I**

**Strain Energy & Impact Loading**: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano’s theorem, Numerical.

**Theories of Elastic Failures:** Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

**Unit II**

**Thin Walled Vessels:** Hoop & Longitudinal stresses & strains in cylindrical &spherical vessels & their derivations under internal pressure, wire would cylinders, Numericals.

**Thick Cylinders & Spheres**: Derivation of Lame’s equations, radial & hoop stresses and strains in thick, and compound cylinders and spherical shells subjected to internal fluid pressure only, hub shrunk on solid shaft, Numericals.

**Unit III**

**Rotating Rims & Discs:** Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders. Numericals.

**Springs:** Stresses in closed coiled helical springs, Stresses in open coiled helical springs subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

**Unit IV**

**Bending of Curved Bars** : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings, deflection of rings by Castigliano’s theorem, stresses in simple chain links, deflection of simple chain links, Problems.

**Unsymmetrical Bending:** Introduction to unsymmetrical bending, stresses due to unsymmetrical bending, deflection of beam due to unsymmetrical bending, shear center for angle, channel, and I- sections, Numericals.

**Text Books:**

1. Strength of Materials – R.K. Rajput, Dhanpat Rai & Sons.
2. Strength of Materials – Sadhu Singh, Khanna Publications.
3. Strength of Materials – R.K. Bansal, Laxmi Publications.

## Reference Books:

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials – Robert l. Mott, Pearson, New Delhi
3. Strength of Material – Shaums Outline Series – McGraw Hill
4. Strength of Material – Rider – ELBS

## Note: The paper setter will set the paper as per the question paper templates provided.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B.Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **AER-206A** | **Propulsion I** | | | | | | |
| **L** | **T** | **P** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **-** | **3** | **75** | **25** | **100** | **3h** |
| **Purpose** | **To familiarize the students with the fundamentals of Propulsion** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Comparison between ideal cycles and practical cycles** | | | | | | |
| **CO2** | **Mathematical analysis of jet propulsion cycles** | | | | | | |
| **CO3** | **Understanding the centrifugal compressor** | | | | | | |
| **CO4** | **Introduction to axial flow compressors** | | | | | | |

**Unit – I**

**Ideal cycles and their analysis:** Assumptions, simple gas turbine cycle, cycles with heat exchange, reheat and inter-cooling and their combinations, comparison of various cycles, Ericsson Cycle.

**Practical cycles and their analysis:** Assumptions, stagnation properties, compressor and turbine efficiency, pressure losses, heat exchanger effectiveness, effect of varying mass flow and variable specific heat, mechanical losses and losses due to incomplete combustion, cycle efficiency, poly-tropic efficiency, actual cycle performance.

**Unit-II**

**Jet propulsion cycles and their analysis:** Propeller engines, gas turbine engines, Ramjet, Pulse Jet, Turboprop and Turbojet engines, analysis of turbofan engines, Thrust and thrust equation, specific thrust of the turbojet engine, efficiencies, parameters affecting flight performance, thrust augmentation.

**Unit-III**

**Centrifugal Compressor:** Essential parts, principle of operation, ideal energy transfer, blade shapes and velocity triangles, flow analysis through the compressor, diffuser, volute casing, performance parameters, losses in centrifugal compressors, compressor characteristics, surging and choking.

**Unit-IV**

**Axial flow compressors:** Historical background, geometry and working principle, stage velocity triangles, work done factor, h-s diagram, stage efficiency, performance coefficients, degree of reaction, flow through blade rows, flow losses, stage losses, pressure rise calculation in blade ring, performance characteristics, comparison with centrifugal compressors.

**Text Book:**

1. Gas Turbines, V Ganesan, McGraw Hill.

2. Gas Turbine Theory, H. Cohen, GFC Rogers and HIH Saravanamuttoo, Pearson.

**Note: The paper setter will set the paper as per the question paper templates provided**

**Suggested Books:**

1. Gas Turbine, Jet and Rocket Propulsion, Mathur, M.L. and Sharma, R.P., Standard Publishers & Distributors.
2. Aero thermodynamics of Aircraft Engine Components, G.C. Oates, AIAA Education Series.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B. Tech. (4th Semester) Aeronautical Engineering** | | | | | | | |
| **ES-206LA** | **MATERIALS ENGINEERING LAB** | | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time (Hrs.)** |
| **0** | **0** | **2** | **1** | **-** | **40** | **60** | **100** | **3** |
| **Purpose** | To make the students aware of material structure and properties of material using different experiments. | | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Ability to design and conduct experiments, acquire data, analyze and interpret data | | | | | | | |
| **CO 2** | Ability to determine the grain size and microstructure in different Ferrous alloys by means of experiments. | | | | | | | |
| **CO 3** | Ability to learn about microstructures of different Non-Ferrous alloys by means of experiments. | | | | | | | |
| **CO 4** | To learn about heat treatment processes through experiments. | | | | | | | |
| **CO 5** | Ability to Analyze microstructure of Heat-treated specimens and perform Fatigue and creep test on different materials. | | | | | | | |

**List of Experiments:**

* 1. To Study various Crystal Structures through Ball Models.
  2. To study the components and functions of Metallurgical Microscope.
  3. To learn about the process of Specimen Preparation for metallographic examination.
  4. To perform Standard test Methods for Estimation of Grain Size.
  5. To perform Microstructural Analysis of Carbon Steels and low alloy steels.
  6. To perform Microstructural Analysis of Cast Iron.
  7. To perform Microstructural Analysis of Non-Ferrous Alloys: Brass & Bronze.
  8. To perform Microstructural Analysis of Non-Ferrous Alloys: Aluminium Alloys.
  9. To Perform annealing of a steel specimen and to analyze its microstructure.
  10. To Perform Hardening of a steel specimen and to analyze its microstructure.
  11. To performFatiguetest on fatiguetestingmachine.
  12. To perform Creep test oncreep testingmachine.

**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **B.Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **AER-208A** | | **Propulsion Lab** | | | | | | |
| **L** | | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | | **-** | **2** | **1** | **60** | **40** | **100** | **3h** |
| **Purpose** | | **To give the practical knowledge of Propulsion.** | | | | | | |
| **Course Outcomes** | | | | | | | | |
| **CO** | **To make the students familiar with the experiments related with Propulsion.** | | | | | | | |

**Note: Student will be required to perform at least 8 experiments out of the following list.**

1. To study the constructional details of axial flow compressor.

2. To study the constructional details of centrifugal compressor.

3. To study of accessory gear box and its construction.

4. To study the constructional details of main fuel pump.

5. To study the constructional details of combustion chamber.

6. To study the constructional details of after burning system.

7. To study the constructional details of piston engines.

8. To study the functioning of complete jet engine.

9. To study the constructional details of propellers.

**Suggested Books:**

1. Gas Turbines, V Ganesan, McGraw Hill.

2. Gas Turbine Theory, H. Cohen, GFC Rogers and HIH Saravanamuttoo, Pearson.

**Note: -** For better understanding of the experiments, department is also required to utilize the resources available on various websites, digital media & industrial visits etc.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **B. Tech. (4th Semester) Aeronautical Engineering** | | | | | | |
| **MC-902A** | **Constitution of India** | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Credits** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **-** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | To know the basic features of Constitution of India | | | | | | |
|  | **Course Outcomes** | | | | | | |
| **CO1** | The students will be able to know about salient features of the Constitution of India. | | | | | | |
| **CO2** | To know about fundamental duties and federal structure of Constitution of India. | | | | | | |
| **CO3** | To know about emergency provisions in Constitution of India. | | | | | | |
| **CO4** | To know about fundamental rights under constitution of India. | | | | | | |

**UNIT I**

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India.

Scheme of the fundamental rights

**UNIT II**

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Parliamentary Form of Government in India – The constitution powers and status of the President of India

**UNIT III**

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.

Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

**UNIT IV**

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

Scope of the Right to Life and Personal Liberty under Article 21.

**Text Books**

1. Constitution of India. Prof. Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

**Reference Books:**

1. The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.