## SCHEME OF STUDIES & EXAMINATION
## B.TECH. 2nd year Aeronautical Engineering -3rd Semester

| Course No. | Course Title | Teaching Schedule | | | | Examination schedule | | | Total Marks | Duration of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P/P | Total | Theory | Sessional | Practical | | |
| MATH-201 E | Mathematics-III | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-201E | Thermodynamics | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-203E | Strength of Materials –I | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-205E | Analog and Digital Communication | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-207E | Kinematics of Machines | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-209E | Computer Programming and Network | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-211 E | Kinematics of Machines Lab | - | - | 3 | 3 | - | 50 | 50 | 100 | 3 |
| ME-213E | Thermodynamics Lab | - | - | 3 | 3 | - | 50 | 25 | 75 | 3 |
| ME-215E | Strength of Materials –I Lab | - | - | 3 | 3 | - | 50 | 25 | 75 | 3 |
| ARE-217E | Computer Programming and Network Lab | - | - | 3 | 3 | - | 25 | 25 | 50 | 3 |
| | TOTAL | 18 | 6 | 11 | 36 | 600 | 475 | 125 | 1200 | - |



## SCHEME OF STUDIES & EXAMINATION
## B.TECH. 2nd year Aeronautical Engineering -4th Semester

| Course No. | Course Title | Teaching Schedule | | | | Examination schedule | | | Total Marks | Duration of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P/D | Total | Theory | Sessional | Practical | | |
| HUM-201E | Basics of Economics and Management | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-202E | Aircraft Structures-1 | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-204E | Aerodynamics-1 | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-206E | Strength of Materials -II | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-208E | Fluid Mechanics | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-210E | Dynamics of Machines | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-212E | Aerodynamics – Lab | - | - | 2 | 2 | - | 25 | 25 | 50 | 3 |
| ARE-214E | Aircraft Structures Lab | - | - | 2 | 2 | - | 25 | 25 | 50 | 3 |
| ME-214E | Fluid Mechanics Lab | - | - | 3 | 3 | - | 25 | 25 | 50 | 3 |
| ME-216E | Dynamics of Machines Lab | - | - | 3 | 3 | - | 25 | 25 | 50 | 3 |
| | TOTAL | 18 | 6 | 10 | 34 | 600 | 400 | 100 | 1100 | - |



**SCHEME OF STUDIES & EXAMINATION**

**B.TECH. 3rd year Aeronautical Engineering -5th Semester**

| Course No. | Course Title | Teaching Schedule | | | | Examination schedule | | | Total Marks | Duration of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P/D | Total | Theory | Sessional | Practical Viva | | |
| ARE-301E | Aerodynamics II | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME 305 E | Heat Transfer | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-307E | Aircraft Materials and Manufacturing Processes | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-309E | Introduction To Wind Energy | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ECE-311E | Microprocessor and Interfacing | 4 | 1 | - | 5 | 100 | 50 | - | 150 | 3 |
| ARE-311E | Aircraft Propulsion | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-313 E | Training Report | - | - | - | - | - | 50 | - | 50 | 3 |
| ARE-315 E | Propulsion Lab | - | - | 3 | 3 | - | 25 | 25 | 50 | 3 |
| ME-317E | Heat Transfer Lab | - | - | 2 | 2 | - | 25 | 25 | 50 | 3 |
| | TOTAL | 19 | 6 | 5 | 30 | 600 | 400 | 50 | 1050 | - |



**SCHEME OF STUDIES & EXAMINATION**

**B.TECH. 3rd year Aeronautical Engineering -6th Semester**

| | | Teaching Schedule | Examination schedule | Total | Duration |
|---|---|---|---|---|---|

| Course No. | Course Title | L | T | P/D | Total | Theory | Sessional | Practical/ Viva | Marks | of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| ME-302E | Refrigeration and Air-Conditioning | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-302E | Wind Tunnel Techniques | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-304E | Aircraft Electrical and Manufacturing Processes | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-306E | Aircraft Systems | 4 | 2 | - | 6 | 100 | 50 | - | 150 | 3 |
| ME 304 E | Tribology | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ME-306E | Mechanical vibration | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-310E | Aircraft Systems Lab | - | - | 2 | 2 | - | 25 | 25 | 50 | 3 |
| ME-312E | Refrigeration and Air-Conditioning Lab | - | - | 2 | 2 | - | 25 | 25 | 50 | 3 |
| ME-314E | Tribology & Mechanical Vibration Lab | - | - | 2 | 2 | - | 50 | 25 | 75 | 3 |
| | TOTAL | 19 | 7 | 6 | 32 | 600 | 400 | 75 | 1075 | - |



## SCHEME OF STUDIES & EXAMINATION
## B.TECH. 4th year Aeronautical Engineering -7th Semester

| Course No. | Course Title | Teaching Schedule | | | | Examination schedule | | | Total Marks | Duration of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P/D | Total | Theory | Sessional | Practical/ Viva | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ---------- | Department Elective-1 | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ---------- | Department Elective-II | 3 | 2 | - | 5 | 100 | 50 | - | 150 | 3 |
| ARE-401E | Helicopter Dynamics | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-403E | Airplane Design | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-405E | Automatic Flight Control | 4 | 2 | - | 6 | 100 | 50 | - | 150 | 3 |
| ME 441 E | Computational Fluid Dynamics | 4 | 1 | - | 5 | 100 | 50 | - | 150 | 3 |
| ARE-407E | Aircraft Maintenance Lab | - | -- | 3 | 3 | - | 25 | 25 | 50 | 3 |
| ARE-409E | Aero modeling Lab-I | - | - | 3 | 3 | - | 25 | 25 | 50 | 3 |
| ARE-411E | Minor Project-1 | - | - | 7 | 7 | - | 100 | 100 | 200 | 3 |
| ARE-413E | Practical Training Report | - | - | - | - | - | 125 | - | 125 | 3 |
| | TOTAL | 20 | 8 | 13 | 41 | 600 | 575 | 200 | 1325 | - |

**DEPARTMENT ELECTIVE-I**

ARE-415E INTRODUCTION TO AVIONICS TECHNOLOGY
ARE 417E AEROELASTICITY
ARE 419E AIRPLANE STABILITY AND CONTROL
ME-437E MAINTENANCE ENGINEERING

**DEPARTMENT ELECTIVE-II**

ME-421E FINITE ELEMENT
ARE-421E COMPRESSIBLE AERODYNAMICS
ME-430E ENERGY MANAGEMENT
ME-425E GAS DYNAMICS

**SCHEME OF STUDIES & EXAMINATION**

**B.TECH. 4th year Aeronautical Engineering -8th Semester**

| Course No. | Course Title | Teaching Schedule | | | | Examination schedule | | | Total Marks | Duration of Exam |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P/D | Total | Theory | Sessional | Practical/ Viva | | |
| ---------- | Department Elective -III | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ---------- | Department Elective -IV | 3 | 2 | - | 5 | 100 | 50 | - | 150 | 3 |
| ARE-402E | Space Dynamics | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |
| ARE-404E | Computational Aerodynamics | 3 | 1 | - | 4 | 100 | 50 | - | 150 | 3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ARE-406E | Rockets and Missiles | 4 | 2 | - | 6 | 100 | 50 | - | 150 | 3 |
| ARE-408E | Major Project | - | - | 4 | 4 | - | 100 | 100 | 200 | - |
| ARE-410E | Seminar | 2 | - | - | 2 | - | 25 | - | 25 | - |
| ARE-412E | Comprehensive Viva Voce | - | - | - | - | - | 75 | - | 75 | - |
| | TOTAL | 18 | 7 | 4 | 29 | 500 | 300 | 25 | 1000 | - |

**DEPARTMENT ELECTIVE-III**

ARE-414E ERGONOMICS AND WORK PLACE DESIGN

ARE-416E MODERN MANUFACTURING PROCESSES

ARE-418E BOUNDRY LAYER THEORY

**DEPARTMENT ELECTIVE-IV**

ME-406E OPERATION RESEARCH

ME - 432 E MANAGEMENT INFORMATION SYSTEM

## B. Tech. (Third semester) Aeronautical Engineering
## MATHEMATICS - III

### MATH-201 E

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |
| 3 | 1 | - | Total | : | 150 Marks |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

### UNIT – I

Fourier Series : Euler's Formulae, Conditions for Fourier expansions, Fourier expansion of functions having points of discontinuity, change of interval, Odd & even functions, Half-range series.

Fourier Transforms : Fourier integrals, Fourier transforms, Fourier cosine and sine transforms. Properties of Fourier transforms, Convolution theorem, Perseval's identity, Relation between Fourier and Laplace transforms, Fourier transforms of the derivatives of a function, Application to boundary value problems.

### UNIT-II

Functions of a Complex Variables : Functions of a complex variable, Exponential function, Trigonometric, Hyperbolic and Logarithmic functions, limit and continuity of a function, Differentiability and analyticity. Cauchy-Riemann equations, Necessary and sufficient conditions for a function to be analytic, Polar form of the Cauchy-Riemann equations, Harmonic functions, Application to flow problems, Conformal transformation, Standard transformations (Translation, Magnification & rotation, inversion & reflection, Bilinear).

### UNIT-III

Probability Distributions : Probability, Baye's theorem, Discrete & Continuous probability distributions, Moment generating function, Probability generating function, Properties and applications of Binomial, Poisson and normal distributions.

### UNIT-IV

Linear Programming : Linear programming problems formulation, Solution of Linear Programming Problem using Graphical method, Simplex Method, Dual-Simplex Method.

**Text Book**

Higher Engg. Mathematics : B.S. Grewal
Advanced Engg. Mathematics : E. Kreyzig

**Reference Book**

1. Complex variables and Applications : R.V. Churchil; Mc. Graw Hill
2. Engg. Mathematics Vol. II: S.S. Sastry; Prentice Hall of India.
3. Operation Research : H.A. Taha

## B. Tech. (Third semester) Aeronautical Engineering
## THERMODYNAMICS

**ME- 201 E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**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, Quasistatic, Reversible and Irreversible Processes, Working Substance. Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility. Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avagadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas. Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states. Mixture of Gases, Bass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of Gases.

**Unit II**

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. 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.

**Unit III**

Entropy: Clausius Inequality and Entropy, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Availability, Irreversibility and Equilibrium: High and Low Grade Energy, Availability 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.

**Unit IV**

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation,
Vaporization, Evaporation and Boiling , Saturated and Superheat 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 –

**Text Books:**

1. Engineering Thermodynamics – Jones and Dugan, PHI, New Delhi.
2. Fundamentals of Engineering Thermodynamics – E. Radhakrishnan, PHI, New Delhi.

**Reference Books :**

1. Theory and Problems of Thermodynamics – Y. V.C. Rao, Wiley Eastern Ltd., New Delhi.
2. Engineering Thermodynamics – C P Arora, Tata McGraw Hill
3. Engineering Thermodynamics – P K Nag, Tata McGraw Hill



## B. Tech. (Third semester) Aeronautical Engineering
## STRENGTH OF MATERIALS –I

**ME-203E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |
| 3 | 1 | - | Total | : | 150 Marks |

Duration of Exam. : 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## Unit 1

Simple stresses & strains : Concept & types of Stresses and strains, Polson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hooks law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical. Compound stresses & strains: Concept of surface and volumetric strains, two dimensional stress system, conjugate shear stress at a point on a plane, principle stresses & strains and principal-planes, Mohr's circle of stresses, Numerical.

### Unit II

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, Problems. Torsion of circular Members : Torsion of thin circular tube, Solid and hollow circular shafts, tapered shaft, stepped shaft & composite circular shafts, combined bending and torsion, equivalent torque, effect of end thrust. Numericals.

### Unit III

Bending & shear Stresses in Beams: Bending stresses in beams with derivation & application to beams of circular, rectangular, I,T and channel sections, composite beams, shear stresses in beams with derivation combined bending torsion & axial loading of beams. Numericals. Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Eulers formulae for the elastic buckling load, Eulers, Rankine, Gordom's formulae Johnson's empirical formula for axial loading columns and their applications eccentric compression of a short strut of rectangular & circular sections, Numerical.

### Unit IV

Slope & Deflection : Relationship between bending moment, slope & deflection, Mohr's theorem, 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.

**Text Books:**

1. Strength of Materials – G.H.Ryder - Macmillan, India
2. Strength of Materials– Andrew Pytel and Fredinand L.Singer, Addison – Wesley

**Reference Books :**

1. Strength of Materials – Popov, PHI, New Delhi.
2. Strength of Materials A Rudimentary Apprach – M.A. Jayaram, Sapna Book

House, Bangalore



**B. Tech. (Third semester) Aeronautical Engineering**
**ANALOG AND DIGITAL COMMUNICATION**

**ARE-205E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 |
| Theory | : | 100 |
| Total | : | 150 |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT – I**

**N**OISE: Classification of Noise, Various sources of Noise, Methods of Noise Calculation in networks and inter connected networks. Addition of noise due to several sources; noise in amplifiers in cascade, noise in reactive circuits, Noise figure, its calculation and measurement. Noise temperature, Mathematical representation of random noise, narrow band noise and its representation. Transmission of noise through linear systems, signal to noise ratio, noise bandwidth.

**UNIT-II**

MODULATION TECHNIQUES: Basic constituents of Communication Systems, need of modulation, Amplitude modulation, spectrum of AM wave, modulation index, DSBSC modulation, SSB Modulation, Collector modulation, Square law modulation methods, Methods of generating SSB Signals, vestigial side band modulation, Detection of AM Signal; Diode detector, Square Law Detector. Time Constant RC in diode detector. Diode detector with filter. FDM, Power relations in AM wave.

**UNIT – III:**

PULSE MODULATION: sampling process, PAM and TDM; aperture effect. PPM noise in PPM, channel Bandwidth, Recovery of PAM and PPM signals Quantization process, quantization noise, PCM, μ Law and A- law compressors. Encoding, Noise in PCM, DM, delta sigma modulator, DPCM, ADM.

**UNIT – IV:**

BASE BAND PULSE TRANSMISSION: Matched filter and its properties average probability of symbol error in binary enclosed PCM receiver, Intersymbol interference, Nyquist criterion for distortionless base band binary transmission, ideal Nyquist channel raised cosine spectrum, correlative level coding Duo binary signalling, tapped delay line equalization, adaptive equalization, LMS algorithm, Eye pattern

**REFERENCE BOOKS:**

Taub & Schilling, Principles of Communication Systems, TMH.
Mithal G K, Radio Engineering, Khanna Pub.
Simon Haykin, Communication Systems, John Wiley.
Dungan F.R., Electronics Communication System, Thomson-Delmar
Electronics Communication System: Kennedy; TMH

**NOTE**:

Eight questions are to be set in all by the examiner taking two questions from each unit. Students will be required to attempt five questions in all selecting at least one question from each unit. Each question will be of equal marks.

**B. Tech. (Third semester) Aeronautical Engineering**

**KINEMATICS OF MACHINES**

**ME-207 E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT I

Kinematics, introduction to analysis and synthesis of mechanisms, Kinematics' pairs, Degree of freedom, Dynamitic chain mechanism, Machine, Four-bar chain, inversions, Single and double slider crank chain, Quick return mechanisms, Introduction to function generation, Path generation and rigid bodied guidance. Velocity determination; Relative velocity methods, Instantaneous center method Acceleration determination, Kennedy's Space cent rode and body cent rode,

## UNIT II

Centripetal and tangential accelerations, Acceleration determination by graphical method using velocity polygons, Cariole's component of acceleration, Klein's and other constructions. Analytical methods to find velocity and acceleration of four –link mechanism, slider crank mechanism, freumdenstein's equation, Coordinate a angular displacements of input and output links (Path generation function generation), Least square technique, Rigid body guidance.

## UNIT III

Pantograph, straight-line motion mechanisms (Peculiar, Hart, Scott Russell, Grasshopper, Watt, Kemp's Tchybishev, Parallel linkages) Indicator mechanisms (Simplex Crosby , Thomson, etc ) Automobile steering gears (Davis and Ackerman),Hooks joint (universal coupling), Double hooks joints. Types of friction, Laws of dry friction, Motion along inclined plane Screw threads, Wedge, Pivots and collars, Plate and cone clutches, Antifriction bearings, friction circle and friction axis, bearings and lubrication. Motion along inclined plane and screws, Pivots and Collars Thrust Bearings lubrication

## UNIT IV

Types of cams and followers, various motions of the follower, Construction of cam profiles, Analysis for velocities and accelerations of tangent and circular arc cams with roller and flat –faced followers. Open and crossed belt drives, velocity ratio, slip , material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts ratio 0f tensions, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drive, chain length, classification of chains

**Suggested reading:**


1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications
2. Theory of Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
3. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
4. Mechanism: J.S. Beggs.
5. Mechanics of Machines: P.Black, Pergamon Press.
6. Theory of Machines: P.L.Ballaney, Khanna Publisher.

**B. Tech. (Third semester) Aeronautical Engineering**
**COMPUTER PROGRAMMING & NETWORK**

**ARE-209E**

| L | T | P | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 Marks |
| 3 | 1 | - | Theory | : | 100 Marks |
| | | | Total | : | 150 Marks |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit1**

**Computer Hardware and Software**

Architecture of Computer System, different processors upto PIV systems. Computer Memory and different form of memories, RAM, Cache, secondary memory. Input/output devices and their functions.Client-server architecture of Operating Systems such as in Linux and Window operating Systems.

**Unit 2**

**Basics of C++ Language** :

Introduction to Objects and Object Oriented Programming and basic features of C++Language: various instructions, Encapsulation, inheritance, reusability and polymorphism.Introduction to Structures, abstraction, Classes: Const(Constant) Object And Const MemberFunctions, Object as Member of Classes, Friend Function and Friend Classes. Initializing Class Objects: Constructors, Using default arguments with Constructors, Using Destructors.

**Unit 3**

InheritanceBase Classes and Derived Classes, Protected Members, Casting Base- Class pointers to derived-Class pointers, Using Member Functions, Overriding Base –Class members in a Derived Class;public, protected and private Inheritance; Use of constructors and destructors in derived Classes.Creating sequential access files; Read, write and updating of sequential files.

**Unit 4**

**Simple Programs using C++**

Structure of a C++ program, simple problems of conditional and iterative statements.Basics of exceptional handling. Programs based on inheritance and exception handling.

**Computer Networks & Security**

Introduction to Computer Networks, Example networks ARPANET, Private Networks,Network Topologies: Bus-, Star-, Ring-topologies. Types of Networks : Local Area Networks, Metropolitan Area Networks, Wide Area Networks; Layering architecture of networks, OSI model and functions of each layer; Services and Protocols of each layer.Network security: Various Network security threats: Viruses, Worms, Trojan horses, spam emails. Security techniques: passwords, cryptography, firewalls, anti-viruses.

**Text Books:**

1 Object Oriented Programming with C++ by E Balagurusanry
2 Computer Fundamentals by PK Sinha

Reference Books:

1 Object Oriented Programming i C++ by Robert Lafone
2 Computer Networking by Tanenbaun, PHI.
3. Computer Architecture and Prganisation by Morris Mano.
4. Computer Networking a Top Down Approach featuring the internet- James F Kurose.

**B. Tech. (Third semester) Aeronautical Engineering**
**KINEMATICS OF MACHINES (LAB.)**

**ME-211 E**

**Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory**

| L | T | P |
|---|---|---|
| - | - | 3 |

Class Work : 50 Marks
Exam : 50 Marks
Total : 100Marks
Duration of Exam : 3 Hrs.

List of experiments

1. To determine the modulus of rigidity of the material of a closed coil helical spring and the stiffness of a spring
2. To determine the value of coefficient of friction for a given pair of surfaces using friction apparatus
3. To determine the modulus of rigidity of horizontal shaft
4. To determine experimentally the ratio of the cutting time to idle time (cutting stroke to idle stroke) of the crank and slotted lever (QRM)/ Whitworth and compare the result to theoretical values plot the following
   a. $\theta$ v/s X (displacement of slider).
   b. $\theta$ v/s velocity.
   c. $\theta$ v/s Acceleration and to compare the values of velocities
   (Take angles $\theta$ =45˚, 90˚, 135˚, 225˚, 270˚ &335˚, $\omega$ = 1 rad/s)
5. To determine the value of coefficient of friction between the screw and nut of the jack, while:
   a. Raising the load
   b. Lowering the load
6. To draw experimentally a curve of the follower-displacement v/s cam-angle. Differentiate the above curve to get velocity and acceleration plot and compare the values with those obtained analytically.
7. To determine the coefficient of friction between belt and pulley and plot a graph between $\log_{10} T_1/T_2$ v/s, $\theta$.
8. To determine the displacement, velocities, & accelerations of the driven shaft of a

Hooke's joint for a constant speed of the driver shaft.

9. To determine velocity & acceleration of slider in slider-crank mechanism and plot the following:
    a. θ v/s x (displacement of slider)
    b. θ v/s velocity and
    c. θ v/s acceleration.

Compare the values of velocities & acceleration with those obtained theoretically.(Assume ω=I rad/sec.)**.**

10. Study of the inversions of the single slider crank mechanism.
11. To verify the law of moment using Bell- crank lever.

.

**B. Tech. (Third semester) Aeronautical Engineering**
**THERMODYNAMICS (LAB.)**
**ME-213 E**

| L | T | P | | |
|---|---|---|---|---|
| - | - | 3 | Class Work | : 50 Marks |
| | | | Exam | : 25 Marks |
| | | | Total | : 75 Marks |
| | | | Duration of exam | : 3 Hrs. |

**List of Experiments**

1. Study of 2 stroke petrol and diesel engine models.
2. Study of 4-stroke petrol/diesel engine model.
3. Study of boilers.
4. Study of Babcock-Wilcox boiler (Model).
5. Study of locomotive boiler (Model).
6. Study of Lancashire boiler (Model).
7. To study the Red wood viscometer and measure the viscosity of fluid.
8. To measure the flash point of the given fuel
9. To study the Nestler's boiler.
10. To study various parts of the vertical steam engine.
11 To study the diesel engine and make a trial on it.

**Note: Any 8 experiments from the above list and other 2 from others developed by institute ) are required to be performed by students in the laboratory.**

**B. Tech. (Third semester) Aeronautical Engineering**
**STRENGTH OF MATERIALS LAB**
**ME- 215 E**

| L | T | P |
|---|---|---|
| - | - | 3 |

Class Work : 50 Marks
Exam : 25 Marks
Total : 75 Marks
Duration of exam: 3 Hrs.

**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 test.
7. To perform compression & bending tests on UTM.
8. To perform the sheer test on UTM.
9. To study the torsion testing machine and perform the torsion test.
10. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under Point and Distributed Loads.
11. To determine Mechanical Advantage and Efficiency of Single and Double Purchase Winch Crab.
12. To determine Mechanical Advantage and Efficiency of Worm and Worm Wheel.
13. To determine Mechanical Advantage, Efficiency of Simple and Compound Screw Jack.
14. To find Moment of Inertia of a Fly Wheel.

**Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.**



**B. Tech. (Third semester) Aeronautical Engineering**
**Computer Programming & Network Lab**

**B. Tech. (Fourth semester)Aeronautical Engineering**
**BASICS OF INDUSTRIAL SOCIOLOGY, ECONOMICS & MANAGEMENT**

**ARE-217E**

| L | T | P |
|---|---|---|
| - | - | 3 |

Class Work : 25 Marks
Exam : 25 Marks
Total : 50 Marks
Duration of exam: 3 Hrs.

. The students are required to do Practical on the following:

**(i) Computer Hardware:**

1. To identify various parts of the system on the Mother Board.
2. To observe and study various cables, connections and parts used in computer communication.
3. To study various cards used in a system viz. display card, LAN card etc.
4. To study laser printer assembly and elementary fault detection.
5. To assemble a PC.
6. Simple trouble shooting exercises related to various components of computer like monitor, drives, memory and printers etc
7. Loading of Computer Software

.

**(ii) Computer Software:**

1. Practice of MS-Excel for drawing tables, graphs, bar-chart etc. To prepare the list of marks obtained by students in different subjects and show with the help of chart/graph the average, min and max marks in each subject.
2. Practice of using MS-Access for data storage and databases and use this database in the programs. Create a database of books in the library on a mini scale with respect to Computers and manipulate the database using different forms and reports.
3.Using MS Power Point prepare a presentation explaining the facilities/infrastructure available in your college/institute.

**(ii) Computer Programming in C++:**

Simple Programs using C++ language such as

1. Using C++ write program for (i) addition of matrices, (ii) multiplication of matrices,(iii) norm of matrices.
2. Sort an array of numbers/ names using different sorting methods.
3. searching a given number in an array using sequential or binary search or pick different numbers in an array which satisfy given conditions
4. Prepare result of an examination and print the marks-sheets develop program for inventory system.

**Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the laboratory.**

**HUM – 201 E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT-I

Meaning of social change, nature of social change, theories of social change. The direction of social change, the causes of social change, the process of social change. Factors of social change – the technological factors, the cultural factors, effects of technology on major social institutions, social need of status system, social relations in industry.

## UNIT-II

Meaning of Industrial Economic, Production
Function, its types, Least Cost Combination, Law of Variable Proportion, Laws of Return – Increasing, Constant & Diminishing.
Fixed & variable costs in short run & long run, opportunity costs, relation between AC & MC, U-shaped short run AC Curve.
Price & Output Determination under Monopoly in short run & long run. Price Discrimination, Price Determination under Discriminating Monopoly. Comparison between Monopoly & Perfect Competition.

## UNIT – III

Meaning of Management, Characteristics of Management, Management Vs. Administration, Management – Art, Science & Profession, Fayol's Principles of Management.
Personnel Management – Meaning & Functions, Manpower – Process of Manpower Planning, Recruitment & Selection – Selection Procedure.
Training – Objectives & Types of Training, Various Methods of Training. Labour Legislation in India – Main provisions of Industrial disputes Act 1947;

## UNIT – IV

Marketing Management – Definition & Meaning, Scope of Marketing Management, Marketing Research – Meaning, Objectives.
Purchasing Management – Meaning & Objectives, Purchase Procedure, Inventory Control Techniques.
Financial Management – Introduction, Objectives of Financial decisions, Sources of Finance.

**TEXT BOOKS :**


1. "Modern Economic Theory" Dewett, K.K., S. Chand & Co.
2. "Economic Analysis" K.P. Sundharam & E.N. Sundharam (Sultan Chand & Sons).
3. "Micro Economic Theory" M.L. Jhingan (Konark Publishers Pvt. Ltd.).
4. "Principles of Economics" M.L. Seth (Lakshmi Narain Aggarwal Educational Publishers – Agra).
5. "An Introduction to Sociology", D.R. Sachdeva & Vidya Bhusan.
6. "Society – An Introductory Analysis", R.M. Maclver Charles H. Page.

7. "Principles and Practices of Management : R.S. Gupta; B.D. Sharma; N.S. Bhalla; Kalyani.

**REFERENCE BOOKS**

1. "Organization and Management : R.D. Aggarwal, Tata McGraw Hill.
2. Business Organization and Management : M.C. Shukla



**B. Tech. (Fourth semester)Aeronautical Engineering**
**AIRCRAFT STRUCTURES-I**

**ARE-202E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |

| | | | | | |
|---|---|---|---|---|---|
| 3 | 1 | - | Total | : | 150 Marks |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT 1**

**Aircraft Structures**

Introduction, Various Types of Structures used in Aircraft Construction.

**Analysis of 2D Problems**

Analysis of 2-D problems in rectangular and polar co-ordinates employing "Theory of Elasticity:Plane Stress and Plane Strain Condition".

**UNIT 2**

**Statically Indeterminate Structures**

Truss analysis with single and double redundancy, frames and rings.Torsion and bending of multicell box beams.

**UNIT 3**

**Torsion**

Torsion of non-circular solid bars, warping, axially constrained stresses. Torsional deflection of noncircular shell, analysis of thick walled tubes.

**Joints in Structures**

Riveted and Bolted Joints. Analysis and Design.

**UNIT 4**

**Structural components**

Function of various components eg aileron, flaps, rudder, landing gear etc. Design Criteria, Safe-Life, Fail Safe and Damage Tolerance Approach. Fatigue damage.

Text Books

1. S.Timoshanko and J.N., "Theory of Elasticity".
2. Lalit Gupta and O.P. Sharma, "Aircraft Structures", Himalayan Books

**References:**

1. David J.Perry, "Aircraft Structures", McGraw Hill Book Co. 1949.
2. T.H.G.Megson, "Aircraft Structures for Engineering Students", Edward Arnold and Co., 2nd Ed,1990.
3. Joe Christy, "Aircraft construction, Repair and Inspection"

**B. Tech. (Fourth semester)Aeronautical Engineering**
**AERODYNAMICS –I**

**ARE-204E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT 1

**Air and airflow**

Standard atmosphere, airspeed, air resistance or drag, streamlines and form drag, skin friction and boundary layer, wind tunnels.

**Subsonic Flow**

Aerofoil, airflow and pressure over aerofoil, Lift and Drag, Chord line and angle of attack, aerofoil characteristics, aspect ratio, Induced drag, Cp,Cl,,Cd,Cm.

## UNIT 2

Thin Aerofoil theory; Finite wings, induced drag, swept wings. Qualitative effects on low aspect ratio wings. Mach No, critical Mach no.

**Aircraft Performance**

Steady Level flights, altitude effects, absolute ceiling, steady climbing flight, take-off and landing, relation between air speed and angle of attack, effect of weight. Flying for maximum range & endurance – propeller propulsion, jet propulsion.

## UNIT 3

**Aircraft Stability and Control**

Longitudinal stability & longitudinal dihedral, lateral stability – dihedral angle, side slip. High wing and low center of gravity, sweepback, fin area and lateral stability. Directional stability. Control of an aircraft- Longitudinal control, Roll control and directional control: control surfaces, control tabs and mass balance.

## UNIT 4

**High Lift and Drag Devices**

Slots and flaps, Vortex Generators,, Boundary layer fences.

**Text Books**

1 A.C. Kermode, " Mechanics of Flight", Pearson Education Ltd.
2 S.K.Ojha, "Flight Performance of Aircraft", AIAA Series, 1995
3 J.D.Anderson, "Introduction to Flight", McGraw Hill, 1989

**Reference Books**

1. Houghton E.L. and Brock A.E., "Aerodynamics for Engineering Students", Edwards Arnolds,UK
2. Anderson John D Jr, "Fundamentals of Aerodynamics", McGraw Hill

**B. Tech. (Fourth semester) Aeronautical Engineering**
**STRENGTH OF MATERIALS-II**
**ME- 206 E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

Sessional : 50Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam: 3Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**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 & Maxwell's theorems, Numerical. Theories of Elastic Failure: 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**

Unsymmetrical Bending: Properties of beam cross section, product of inertia, ellipse of inertia,

slope of the neutral axis, stresses & deflections, shear center and the flexural axis Numericals. Thin Walled Vessels : Hoop & Longitudinal stresses & strains in cylindrical & spherical vessels & their derivations under internal pressure, wire would cylinders, Numericals.

**UNIT III**

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, wire wound cylinders, hub shrunk on solid shaft, Numericals. 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.

**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 link, deflection of simple chain links, Problems. Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs, Numericals.

**Text Books:**

1. Strength of Materials – G.H.Ryder, Third Edition in SI Units 1969 Macmillan, India. 2. Mechanics of Materials – (Metric Edition) : Ferdinand P. Beer and E. Russel Johnston, Jr. Second Edition, McGraw Hill.

**Reference Books :**.

1. Book of Solid Mechanics – Kazmi, Tata Mc Graw Hill
2. Strength of Materials – D.S. Bedi - S. Chand & Co. Ltd.
3. Advanced Mechanics of Solids and Structures – N. Krishan Raju and D.R.Gururaje- Narosa Publishing House.
4. Strength of Materials – Andrew Pytel and Fredinand L. Singer Fourth Edition, Int. Student Ed. Addison – Wesley Longman.

**B. Tech. (Fourth semester)Aeronautical Engineering**
**FLUID MECHANICS**

**ME- 208 E**

| L | T | P | | |
|---|---|---|---|---|
| 3 | 1 | - | Sessional | : 50 Marks |
| | | | Theory | : 100 Marks |
| | | | Total | : 150 Marks |
| | | | Duration of Exam | : 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**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, hydrostatic forces on plane and curved surfaces, stability of floating and submerged bodies, relative equilibrium. Problems. 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. Problems.

**Unit II**

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orificemeter, mouthpieces, kinetic and momentum correction factors,

Impulse momentum relationship and its applications. Problems.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. Problems.

**UNIT III**

Viscous Flow: Flow regimes and Reynold's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, movement of piston in a dashpot, power absorbed in bearings. Problems. 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. Problems.

**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, Problems. 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. Problems.

**Text Books:**


1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Mechanics of Fluids – I H Shames, Mc Graw Hill


**References Books:**


1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi

**B. Tech. (Fourth semester) Aeronautical Engineering**
**DYNAMICS OF MACHINES**

**ME –210 E**

| L | T | P | | |
|---|---|---|---|---|
| 3 | 1 | - | Sessional | : 50 Marks |
| | | | Theory | : 100 Marks |
| | | | Total | : 150 Marks |
| | | | Duration of Exam | : 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

Static force analysis, Static equilibrium, free by diagram, Analysis of static forces in mechanism. D'Alembert's principal, Equivalent offset inertia force, Dynamics of reciprocation parts, Piston effort, Crank effort, Equivalent dynamical systems, and Inertia force in reciprocating engines by graphical and analytical method. Turning moment and crank effort diagrams for single cylinder and multi-cylinder engines, coefficient of fluctuation of energy, coefficient of fluctuation of speed, flywheel and its function.

**UNIT II**

Types of gears, terminology, condition for correct gearing, cyclical and involutes profiles of gear teeth, pressure angle, path of contact, arc of contact, Interference, undercutting, minimum number of teeth, number of pairs of teeth in contact, helical, spiral, worm and worm gear, bevel gear. Gear trains; simple, compound, reverted, and epicyclical, Solution of gear trains, sun and planet gear, bevel epicyclical gear, compound epicyclical gear, pre-selective gear box, differential of automobile, torque in gear taints.

**UNIT III**

Types of brakes, friction brakes, external shoe brakes, band brakes, band and block brakes, internal expanding shoe brake, dynamometers; absorption, and tensional. Types of governors; watt, Porter, Proell, spring loaded centrifugal, Inertia,, Sensitiveness, Stability, Isochronism's,

Hunting, Effort and power of governor, controlling force, Static and dynamic balancing of rotating parts, balancing of I. C. Engines, balancing of multi-cylinder engine; V-engines and radial engines, balancing of machines.

**UNIT IV**

Gyroscope, Gyroscopic couple and its effect on craft, naval ships during steering, pinching and rolling, Stability of an automobile (2-wheeers), Introduction, open and closed lop control, terms related to automatic control, error detector, actuator, amplification, transducers, lag in responses, damping, block diagrams, system with viscous damped output, transfer functions, relationship between open –loop and closed loop transfer function.

**Suggested reading:**


1. Theory of machines: S. S. Rattan, Tata McGraw Hill Publications.
2. Theory of Mechanism and Machines: Jagdish Lal, Metropolitan Book Co.
3. Mechanism synthesis and analysis: A.H. Soni, McGraw Hill Publications.
4. Mechanism: J.S. Beggs.
5. Mechanics of Machines: P.Black, Pergamon Press.
6. Theory of Machines: P.L.Ballaney, Khanna Publisher.

**B. Tech. (Fourth semester) Aeronautical Engineering**
**AERODYNAMICS LAB**
**ARE-212E**

| L | T | P |
|---|---|---|
| | | 2 |

Sessional : 25Marks
Theory : 25 Marks
Total : 50 Marks
Duration of Exam: 3Hrs.

**List of Experiments:**

1. Use of Anemometer for measuring velocity.
2. Measurement of velocity profile in favourable and adverse pressure gradient.
3. Pressure distribution over a 2D cylinder and to find lift and drag.
4. Pressure distribution over an airfoil and to find lift and drag.
5. Experiments on potential flow Analogy (Hele-Shaw flow).
6. To study shocks using a water table.
7. To find the displacement thickness for the given aerofoil at low Reynolds number.
8. To plot Cp vs angle of attack for a pitching aerofoil.

Reference Books:

1. Low speed wind tunnel testing, Allen Pope, John Willey &sons
2. Low speed wind tunnel testing, W.E. Rae & Allen Pope, John Willey &sons

**Note: Total eight experiments must be performed. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Fourth semester) Aeronautical Engineering**
**AIRCRAFT STRUCTURES LAB**
**ARE-214E**

| L | T | P |
|---|---|---|
| | | 2 |

Sessional : 25Marks
Theory : 25 Marks
Total : 50 Marks
Duration of Exam: 3Hrs.

**List of experiments**

1 study the construction of fuselage and identify the primary load carrying members
2 Study the construction of wings, ailerons, flaps, slits , slats and spoilers.
3 Study the construction of empennage, stabilizers, rudders adjusting tabs etc with detail
4 of honeycomb structure.
5 Study the construction of landing gears and wheel turning mechanism
6 Study of aileron control linkages including artificial feel mechanism, booster and mannual controls and their adjustments
7 Study the measurement techniques with strain gauges
8 Study checks on airframe for life extension
9 Dye penetrant testing for surface crack detection
10 Measurement of deflection of truss using DTI
11 Measurement of deflection of simply supported beam
12 Determination of compressive strength of thin plates

**Note: At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus**

**B. Tech. (Fourth semester) Aeronautical Engineering**
**FLUID MECHANICS LAB**

**ME- 214 E**

| L | T | P |
|---|---|---|
| - | - | 3 |

Sessional : 25 Marks
Practical/Viva : 25 Marks
Total : 50 Marks
Duration of Exam. : 3 Hrs.

**List of Experiments:**

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orificemeter.
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 Bernoullis 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.
11. To show the velocity and pressure variation with radius in a forced vertex flow.

**Note: At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus**



**B. Tech. (Fourth Semester) Aeronautical Engineering**
**DYNAMICS OF MACHINE (LAB**

**ME 216E**

| L | T | P | | |
|---|---|---|---|---|
| - | - | 3 | Sessional | : 25 Marks |
| | | | Practical/Viva | : 25 Marks |
| | | | Total | : 50 Marks |
| | | | Duration of Exam | : 3 Hrs |

**LIST OF EXPERIMENT**

1. To determine experimentally, the moment of inertia of a flywheel and axle compare with theoretical values.
2. To find out critical speed experimentally and to compare the whirling speed of a shaft with theoretical values.
3. To find experimentally the Gyroscopic couple on motorized gyroscope and compare with applied couple.
4. To perform the experiment of balancing of rotating parts and finds the unbalanced couple and forces.
5. To determine experimentally the unbalance forces and couples of reciprocating parts.
6. To calculate the torque on a planet carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
7. To study the different types of centrifugal and inertia governors and demonstrate any one.
8. To study the automatic transmission unit.
9. To study the differential types of brakes.
10. To find out experimentally the corolis component of acceleration and compare with theoretical values.

**Note: At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or designed & set by the concerned institute as per the scope of the syllabus.**



**B. Tech. (Fifth semester) Aeronautical Engineering**

**AERODYNAMICS II**

**ARE-301E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-I**

**CONFORMAL TRANSFORMATION**

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

**Unit-II**

**INCOMPRESSIBLE FLOW OVER AIRFOILS**

Glauert's thin airfoil theory, symmetrical airfoil, cambered airfoil, flapped airfoil, determination of mean camber line shapes for uniform & linear distribution of circulation. Description of flow about multi-element airfoils.

**Unit-III**

**INCOMPRESSIBLE FLOW OVER FINITE WINGS**

Downwash & induced drag, Biot-Savart's law and Helmholtz's theorem, Prandtl's classical lifting line theory, fundamental equations. Elliptic and general lift distribution over finite unswept wings, effect of aspect ratio, Drag polar ,Correlation of Cl distribution over other aspect ratios, Lifting Surface theory, Formation Flying, Ground effect.

**Unit-IV**

**COMPUTATIONAL AERODYNAMICS OF AIRFOILS AND WINGS**

Computation of flow field due to distribution of source doublet and line and horse shoe vortices, vortex lattic method,wing as a planar surface covered with HSVs.

**Unit-V DELTA WING AERODYNAMICS**

Polhamus theory, leading edge suction analogy, calculations of lift coefficient, flow field, aspect ratio effect, leading edge extension, HAA aerodynamics

**Unit-VI COMPRESSIBLE SUBSONIC FLOWS OVER AIRFOILS**

The derivation of velocity potential equation. Linearization , Prandtl-Glauert compressibility correction. Karman –Tsien correction, Critical Mach number, Whitcomb's area rule, Super critical airfoil.

**BOOKS:**

1. Fundamentals of Aerodynamics : John D.Anderson,2nd Ed. McGrawHill,1991
2. Aerodynamics for Engineers : Bertin and Smith,Prentice Hall,1989

**REFERENCE:**

1 Aerodynamics for engineering students ; Houghten EL & Brock AE

**B. Tech. (Fifth semester) Aeronautical Engineering**
**HEAT – TRANSFER**

**ME 305 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

Definition of heat; Modes of Heat Transfer; Basic Laws of heat transfer, Electrical Analogy of heat conduction; Conduction through composite Walls; Overall heat transfer coefficient. The general conduction equation in Cartesian, cylindrical and spherical coordinates Steady one dimensional heat conduction without internal heat generation; The plane slab; The cylindrical shell; The spherical shell; Critical thickness of insulation; Variable thermal conductivity, Steady one dimensional heat conduction with uniform internal heat generation the plane slab; Cylindrical and spherical systems; Fins of uniform cross section; Governing equation; Temperature distribution and heat dissipation rate; Efficiency and effectiveness of fins.

**UNIT II**

Free and forced convection; Newton's law of cooling, Convective heat transfer Coefficient; Nusselt number; Dimensional analysis of free and forced convection; Analytical solution to forced convection problems; The concept of boundary layer; Hydrodynamic and thermal boundary layer; Momentum and Energy equations for boundary layer; Exact solution for laminar flow over an isothermal plate using similarity transformation; The integral approach; Integral momentum and energy equations; Solution of forced convection over a flat plate using the integral method. Analysis of free convection; governing equations for velocity and temperature fields. Relation between fluid friction and heat transfer, Reynolds analogy Dimensionless numbers; Reynolds, Prandtl Nusselt , Grashoff and Stanton Numbers and their significance, Heat transfer with change of phase; Nusselt theory of laminar film Condensation.

**UNIT III**

Theories of thermal radiation; Absorption, Reflection and transmission, Monochromatic and total emissive power; Black body concept; Planck's distribution law; Stefan Boltzman law; Wien's displacement law; Lambert's cosine law; Kirchoff's law; Shape factor; Heat transfer between black surfaces.

**UNIT IV**

Introduction; Classification of heat exchangers; Logarithmic mean temperature Difference; Area calculation for parallel and counterflow heat exchangers; Effectiveness of heat exchangers; N T U method of heat exchanger design; Applications of heat exchangers.

**Reference and Text books:**

A Text book of Heat Transfer by S.P Sukhatme, university press
Heat transfer by Holman, TMG
Heat and Mass transfer by D.S Kumar

**B. Tech. (Fifth Semester) Aeronautical Engineering**
**AIRCRAFT MATERIALS AND MANUFACTURING PROCESSES**

**ARE 307 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT1**

**Introduction**

Properties of flight vehicle materials, Importance of strength/weight ratio of materials for Aerospace Vehicles: Structures, Importance of temperature variations, factors affecting choice of material for different parts of airplane.

**Metallurgy**

Alloying Theory, Binary diagrams, iron-carbon diagram, Aluminum-copper diagram, structure- property correlation, General Characteristics of Metallic Materials- Stress- strain curve, fatigue, creep, corrosion and prevention, Surface hardening of metals, weld ability, formability & machineability.

**UNIT 2**

**Aircraft Steels**

Classification of alloy steels, Effect of alloying elements, Carbon steels v/s Alloys steels, corrosion resistant steels, Heat treatment, Corrosion prevention methods, Selection and application of steel alloys to aircraft manufacture

**Light Metal Alloys**

Aluminum alloys, Heat treatment, High strength and high corrosion resistant alloys, Magnesium alloys and their properties, Heat treatment. Application to Aerospace Vehicle of these alloys.

**UNIT 3**

**High Strength and Heat Resistant Alloys**

Classification of heat resistant materials and iron, Nickel and cobalt base alloys, Refractory materials:Ceramics, Titanium and its alloys, properties of Inconel, Monal and K-Monal, Nimonic and super alloys: Application to Aerospace vehicles.Transparent Materials, plastic, Rubber,Synthetic Rubber wood, Fabrics.

**UNIT 4**

**COMPOSITE MATERIALS:**

**T**ypes, curing processes.

**Aircraft Manufacturing Processes**

Profiling, Hydro forming, mar forming bending rolls, Spar milling, Spark erosion and Powdered metal parts, integral machining, Contour etching, High energy rate forming, Manufacturing of honeycomb structures, General methods of construction of aircraft and aero engine parts.

**Text Books:**

1. G.F.Titterton, "Aircraft Materials and Processes", Himalayan Books, New Delhi

**References**

1. Chapman WAJ, "Workshop Technology", Vol. I, II, III.
3. G.B.Ashmead, "Aircraft Production Methods". :
4. Lalit Gupta, "Advanced Composite Matertials", Himalayan Books, New Delhi,1998

**Note:** Eight questions are to be set two questions from unit-1, 2 & 4 and one from unit-3 & 5. Students have two attempt five questions.

**B. Tech. (Fifth Semester) Aeronautical Engineering**

**INTRODUCTION TO WIND ENERGY**

**ARE 309 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-I**

**INTRODUCTION**

History of wind power technology, wind resources, economic viability, experience in Europe and America , The Indian experience, factors in favor of wind energy, environmental effects.

**CLASSIFICATION OF WIND MACHINES**

Types of wind energy collectors: horizontal axis rotors; Head on, Fixed pitch and variable pitch blade rotors, cross wind. Vertical axis rotors; Savonius type and its variants, Darrieus type .lift based devices and drag devices.

**Unit-II**

**SOME CASE STUDIES**

Description of various types of wind energy conversion systems (WECS) in use through their design features from 1kW range onwards. Considerations of complexities getting in to the design and operation with increase in size and power output.

**APPLICATION:**

Stand alone system; water pumping, direct heating and electric generation applications. Wind energy farms; Grid connected mode ,hybrid mode.

**Unit-III**

***SITING***

Wind histories, wind characteristics, power in wind stream, recording wind streams, wind rose, choice of site.

**PERFORMANCE OF WIND MACHINES**

Power extraction from the wind stream, Ideal power coefficient, Typical performance curves for various types, maximum power coefficients, speed-torque curves, power density of a wind stream, ducted system, vortex generator.

**Unit-IV**

**SYSTEM DESIGN**

Objectives, power requirements, wind availability, type and size of WECS required, cost of energy delivered, WECS viability, system characteristics, system requirements, system evaluation, design optimization, wind system design synthesis.

**BOOK:**

Wind Machines : Frank R Eldridge,Van Nostrand Reinhold 1980.

**REFERENCE:**

Wind power principles, Calvert, NG, Charles Griffin & Co.

**Note: In the semester examination, the examiner will set Eight questions, atleast one question from each unit. The students will be required to attempt only 5 questions**

**B. Tech. (Fifth Semester) Aeronautical Engineering**
**MICROPROCESSORS & INTERFACING**

**ECE 311 E**

| L | T | P/D | Total | |
|---|---|---|---|---|
| 4 | 1 | - | 5 | Theory: 100 Marks<br>Sessional: 50 marks<br>Duration of Exam: 03 hours |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-I:**

INTRODUCTION : Evolution of microprocessors, technological trends in microprocessor development. The Intel family tree. CISC Versus RISC. Applications of Microprocessors.
8086 CPU ARCHITECTURE : 8086 Block diagram; description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU. 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module.

**UNIT-II:**

8086 INSTRUCTION SET : Instruction formats, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions; Assembler directives.
8086 PROGRAMMING TECHNIQUES : Writing assembly Language programs for logical processing, arithmetic processing, timing delays; loops, data conversions. Writing procedures; Data tables, modular programming. Macros.

**UNIT-III:**

MAIN MEMORY SYSTEM DESIGN : Memory devices, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode. Address decoding techniques. Interfacing SRAMS; ROMS/PROMS. Interfacing and refreshing DRAMS. DRAM Controller –

TMS4500.

**UNIT-IV:**

BASIC I/O INTERFACE : Parallel and Serial I/O Port design and address decoding. Memory mapped I/O Vs Isolated I/O Intel's 8255 and 8251- description and interfacing with 8086. ADCs and DACs, - types, operation and interfacing with 8086. Interfacing Keyboards, alphanumeric displays, multiplexed displays, and high power devices with 8086. INTERRRUPTS AND DMA : Interrupt driven I/O. 8086 Interrupt mechanism; interrupt types and interrupt vector table. Intel's 8259. DMA operation. Intel's 8237. Microcomputer video displays.

**Suggested Books:**

1. D.V.Hall , Microprocessors and Interfacing , McGraw Hill 2nd ed.
2. J Uffenbeck , The 8086/8088 family , (PHI).
3. Liu,Gibson , Microcomputer Systems – The 8086/8088 family, (2nd Ed-PHI).

**B. Tech. (Fifth Semester) Aeronautical Engineering**

**AIRCRAFT PROPULSION**

**ARE 311 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-I**

Basics, simple flows: nozzle flow, nozzle design, nozzle operating characteristics for isentropic flow, nozzle flow and shock waves. Nozzle characteristics for some operational engines. Rayleigh flow and Fanno flow. Effect of frictional duct length in subsonic flow and supersonic flow, numerical problems in 1D flow.

**INLETS, NOZZLES AND COMBUSTION CHAMBERS**

Subsonic inlets: pressure recovery, inlet sizing drag flow distortion. Supersonic inlets: Total and sonic state points, A/A* normal shock based internal compression inlets,. Combustion systems, burners, ignition, flame stability. After burners: System design, flame stability, pressure losses etc.

**Unit-II**

**AIRCRAFT GAS TURBINE ENGINES**

Air-standard Brayton cycle, actual gas turbine engine cycle, compressor and turbine efficiencies, compressor work and turbine work, centrifugal and axial type of compressor, their comparative action, relative merits in operations, combustion chambers: various arrangements, simplex and duplex burners. line design. Flow path dimensions, no. of blades per stage. Radial variation, design process, performance.

**Unit-III**

**AXIAL FLOW COMPRESSOR**

Euler's Turbo machinery equations. Axial flow compressor analysis, cascade action, flow field. Euler's equation, velocity diagrams, flow annulus area stage parameters. Degree of reaction, cascade airfoil nomenclature and loss coefficient, diffusion factor, stage loading and flow coefficient, stage pressure ratio, Blade Mach No., repeating stage, repeating row, mean

**AXIAL FLOW TURBINE**

Introduction to turbine analysis, mean radius stage calculations, stage parameters, stage loading and flow coefficients degree of reaction, stage temperature ratio and pressure ratio, blade spacing, radial

variation, velocity ratio. Axial flow turbine, stage flow path, Dimensional stage analysis. Multistage design; steps of design: single stage and two stages. Turbine performance. Blade cooling.

**Unit-IV**

**PROPELLERS**

Ideal momentum theory and blade element theory and their relative merits, numerical problems on the performance of propellers using propeller charts, selection of propellers, fixed, variable and constant speed pro pellers, prop-fan, material for propellers, shrouded propellers helicopter ,rotor in hovering performance.

**BOOKS:**

1. Gas Turbine Theory – Saravanamuttoo, H I H , RC
2. Aircraft Gas Turbine Engine Technology – Treager, IRWIN E

**REFERENCE:**

**1.** Jet Aircraft power systems: Casamassa JV & Bent

**Note: In the semester examination, the examiner will set Eight questions, atleast one question from each unit. The students will be required to attempt only 5 questions**

**B. Tech. (Fifth Semester) Aeronautical Engineering**
**Practical training report**
**ARE 313 E**

| P/D | Total | |
|---|---|---|
| - | - | **Sessional : 50 marks** |
| | | **Duration of Exams. : 03 hours** |

Student will submit summer training (about 8 weeks' industrial training) report for his/her assessment.

**B. Tech. (Fifth Semester) Aeronautical Engineering**
**PROPULSION LAB**
**ARE- 315E**

L T P
0 0 3

Sessional : 25 Marks
Practical : 25 Marks
Total : 50 Marks
Duration of Exam : 3 Hrs

**List of Experiments :**

1. Study the constructional details of axial flow compressor
2. Study the constructional details of centrifugal compressor
3. Study of accessory gear box and its construction
4. Study the constructional details of main fuel pump
5. Study the constructional details of combustion chamber
6. Study the constructional details of after burning system
7. Study the constructional details of piston engines
8. Study the functioning of complete jet engine
9. Study the constructional details of propellers

**Note: Total NINE experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**



**B. Tech. (Fifth semester) Aeronautical Engineering**
**Heat Transfer (Practical)**
**ME 317 E**

| L | T | P/D | Total | |
|---|---|---|---|---|
| - | - | 2 | 2 | Theory: 25 Marks<br>Sessional: 25 marks<br>Duration of Exam: 03 hours |

**List of Experiments**

1. Determination of thermal conductivity of a metal rod
2. Determination of thermal conductivity of an insulating powder
3. Determination of thermal conductivity of a liquid using Guard plate method
4. Determination of thermal resistance of a composite wall
5. Temperature distribution of a pin fin in free-convection
6. Temperature distribution of a pin fin in forced-convection
7. Forced convection heat transfer from a cylindrical surface
8. Determination of Electiveness of a Heat exchanger
9. Determination of Stefan-Boltzman constant
10. Performance of Solar still
11. Determination of critical heat flux
12. Performance of solar water heater
13. Measurement of solar radiation using solar integrator.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**



**B. Tech. (Sixth semester) Aeronautical Engineering**
**Refrigeration and Air-Conditioning**

**ME 302 E**

| L | T | P/D | Total | |
|---|---|---|---|---|
| 3 | 1 | - | 4 | Theory: 100 Marks<br>Sessional: 50 marks |

Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT I

Basics of heat pump & refrigerator; Carnot's refrigeration and heat pump; Units of refrigeration; COP of refrigerator and heat pump; Carnot's COP; ICE refrigeration; evaporative refrigeration; refrigeration by expansion of air; refrigeration by throttling of gas; Vapor refrigeration system; steam jet refrigeration; thermoelectric cooling; adiabatic demagnetization.

Basic principles of operation of air refrigeration system, Bell-Coleman air refrigerator; advantages of using air-refrigeration in aircrafts; disadvantages of air refrigeration in comparison to other cold producing methods; simple air refrigeration in air craft; simple evaporative type air refrigeration in aircraft; necessity of cooling the aircraft.

## UNIT II

Simple Vapor Compression Refrigeration System; different compression processes( wet compression, dry or dry and saturated compression, superheated compression); Limitations of vapour compression refrigeration system if used on reverse Carnot cycle; representation of theoretical and actual cycle on T-S and P-H charts; effects of operating conditions on the performance of the system; advantages of vapour compression system over air refrigeration system.

Methods of improving COP; flash chamber; flash inter cooler; optimum interstate pressure for two stage refrigeration system; single expansion and multi expansion processes; basic introduction of single load and multi load systems; Cascade systems.

Basic absorption system; COP and Maximum COP of the absorption system; actual $NH_3$ absorption system; functions of various components; Li-Br absorption system; selection of refrigerant and absorbent pair in vapour absorption system; Electro refrigerator; Comparison of Compression and Absorption refrigeration systems; nomenclature of refrigerants; desirable properties of refrigerants; cold storage and ice-plants.

## UNIT III

Difference in refrigeration and air conditioning; Psychometric properties of moist air (wet bulb, dry bulb, dew point temperature, relative and specific humidity of moist air, temperature of adiabatic saturation); empirical relation to calculate $P_V$ in moist air.

Psychometric chart, construction and use, mixing of two air streams; sensible heating and cooling; latent heating and cooling; humidification and dehumidification; cooling with dehumidification; cooling with adiabatic humidification; heating and humidification; by-pass factor of coil; sensible heat factor; ADP of cooing coil; Air washer.

## UNIT IV

Classification; factors affecting air conditioning systems; comfort air-conditioning system; winter air conditioning system; summer air- conditioning system; year round air conditioning. unitary air-conditioning system; central air conditioning system; room sensible heat factor; Grand sensible heat factor; effective room sensible heat factor.

Inside design conditions; comfort conditions; components of cooling loads; internal heat gains from (occupancy, lighting, appliances, product and processes); system heat gain (supply air duct, A.C. fan, return air duct); external heat gain (heat gain through building, solar heat gains through outside walls and roofs); solar air temperature; solar heat gain through glass areas; heat gain due to ventilation and infiltration.
Transport air conditioning; evaporative condensers, cooling towers; heat pumps.

**References and Text books**


1. Refrigeration and air-conditioning by C.P arora
2. Basic Refrigeration and air-conditioning by Annanthana and Rayanan, TMG
3. Refrigeration and air-conditioning BY Arora and Domkundwar, Dhanpat rai




**B. Tech. (Sixth semester) Aeronautical Engineering**

**WIND TUNNEL TECHNIQUES**

**ARE 302 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-I**

**WIND TUNNEL AS A TOOL**

Test section, diffuser, fan section, fan design, return passage, cooling ,The breather- vibration, test section flow quality, diffuser design , wind tunnel construction , energy ratio, final form.

**INSTRUMENTATION AND CALIBRATION OF TEST SECTION**

Measurement of pressure, velocity, turbulence , flow angularity, hot wire anemometry, laser velocimeter, data acquisition, flow visualization techniques, wind tunnel calibration.

**Unit-II**

**MODEL FORCES, MOMENT AND PRESSURE MEASUREMENT**

Wind tunnel balances- Internal & External balances, design of wind tunnel balances, Wake survey method.

**Unit-III**

**WIND TUNNEL CORRECTION**

Method of Images , boundary corrections, buoyancy corrections, wake blockage, solid blockage- (2D & 3D corrections).

**Unit-IV**

**NON AERONAUTICAL USES OF THE WIND TUNNEL**

Applications in wind engineering, Surface vehicle testing, testing of buildings for wind forces, pollution, other applications at low Reynolds numbers.

**BOOKS:**

1. Low speed wind tunnel testing, : W.E.Rae and A.Pope, John Wiley 1985.

**REFERENCE:**

1. Measurement of Airflow Pankhrust and Ower , Pergamon Press

**B. Tech. (Sixth semester) Aeronautical Engineering**

**AIRCRAFT ELECTRICAL AND MANUFACTURING PROCESSES**

**ARE 304 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT 1**

**AC and DC Power Supply**

Batteries Lead Acid and Nickel Cadmium, Battery charging (From "“ External Power" / " On Board") DC/AC Generator Construction, Constant Frequency Generators, Paralleling Load sharing,Synchronization,.Power conversion, Rectifier Units, Rotary converters, Static Inverters.

**Power distribution**

Busbar System, Split Busbar, Combination of parallel operation, Wires and Cables (Types, routing and special Purpose Cables ),Earhing and Grounding,Cable Termination, Electrical Bonding,Standardizing of Distribution.

**UNIT 2**

**Circuit Controlling and Circuit Protection Devices**

Various Types of Switches ( Toggle switch, Push-in solenoid Switch, micro switch, Mercury switch,Thermal switch, Proximity switch) and Relays. Fuses, current limiters, circuit breakers, over voltage protection and under voltage protection systems.

**Unit 3**

**Indicator System**

Oscilloscope, Electronic Display system, Central warning system

**Measuring Instruments**

Ammeters and voltmeters, Moving coil Instruments, shunts, Instrument transformers, measurement of d.c.loads, frequency meters, Power Meters,

**Unit 4**

**Power Utilisation Systems**

Lighting System: anti-collision lighting, landing lights and taxi lights, cockpit lights. Engine Starting Systems: Turbine Engine starting, turbo starter system, starter generator system,Ignition systems,Auxiliary starting devices, Impulse coupling, booster coils, ignition switches. Turbine engine ignition system, Fire detection and extinguishing system.

Text Book:

1. EHJ pallet, "Aircraft Electrical Systems"' Himalayan Books



## B. Tech. (Sixth semester) Aeronautical Engineering

## AIRCRAFT SYSTEMS

**ARE 306 E**

| L | T | P/D | Total |
|---|---|---|---|
| 4 | 2 | - | 6 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-1**

Air conditioning and Cabin pressurization - Air Supply – Sources including engine bleed, APU and ground Cart - Air-conditioning System component layout, functioning of individual components & routine checks on the system - Distribution System - Flow temperature and humidity control

**Unit- 2**.

Fire protection system - Fire and smoke detection and warning system, Fire Extinguishers system, Portable fire extinguisher type of Fire detectors, standard operating procedures for fire on ground.

**Unit-3**

Fuel System – System layout , fuel tanks , supply system, dumping, venting and draining Indications and warning, functioning of various components, checks during routine servicing. Common problems in the system components

**Unit- 4**

Hydraulic power – system layout, hydraulic reservoirs and accumulators, pressure Generation , pressure control, indication and warning system functioning of hydraulic pump. Checks on hydraulic oil, layout of hydraulic lab.

**Unit-5**. Ice protection system – Ice formation classification and detection, anti icing system, deicing system, working of system in general. Effect of ice formation on functioning on various system
.

**Unit-6.** Oxygen system – system layout, supply regulation, sources, storage charging and distribution. Indications and warning Engine oxygen system, procedures for carrying out oxygen leak check, precaution while working on oxygen system.

**BOOKS**

Airframe and Power plant mechanics – Airframe hand book
Civil Aircraft Injection Procedure

**REFERENCES**

Aircraft repair manual – Lary Rethmaier
Light Aircraft Inspection – J E Heywrod

**B. Tech. (Sixth semester) Aeronautical Engineering**
**TRIBOLOGY**

**ME 304 E**

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

Introduction to tribological systems and their characteristic features; analysis and assessment of surface; topography; deterministic and stochastic tribo- models for asperity contacts; techniques of surface examination; technological properties of surfaces.

Quantitative laws of sliding friction, causes of friction, adhesion theory, laws of rolling friction, measurement of friction

**UNIT II**

Introduction, mechanism of wear, types of wear, quantitative laws of wear, measurement of wear, wears resistance materials

**UNIT III**

Introduction, dry friction, boundary lubrication, hydrodynamic, hydrostatic and elasto-hydrodynamic lubrication, functions of lubricants, types and properties, lubricant additives. Principles, application to rolling contact bearings, cams, Gears

## UNIT IV

Geometry and pressure equation of journal bearing, hydrostatic bearings, thrust bearings, porous bearings and hydrodynamic gas bearings. Journal bearings with specialized applications. General requirements and different types of bearing materials.

**Suggested Reading**


1. Tribology an Introduction - By Sushil Kumar Srivastava
2. Introduction to Tribology of Bearings- By B.C. Majumdar ; A.H.Wheeler
3. Principles of Tribology – By J. Halling, Macmillan
4. Mechanics and Chemistry in Lubrication- By Dorinson and Ludema , Elsevier
5. Friction and wear of Materials- By E. Robinowicz, Johan Wiley
6. Principles of Lubrication-By A. Cameron, Longmans


## B. Tech. (Sixth semester) Aeronautical Engineering
## MECHANICAL VIBRATION

### ME 306 E

| L | T | P/D | Total |
|---|---|---|---|
| 3 | 1 | - | 4 |

Theory: 100 Marks
Sessional: 50 marks
Duration of Exam: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT I

Kinematics of simple vibrating motion, Simple harmonic motions, Vectorial representation of harmonic motion. Degree of freedom, Equations of motions, general solution of free vibration, Phase plane method

## UNIT II

Damped free vibration, undamped and damped forced vibrations, Vibrating isolation, Vibrating instruments.

Undamped free vibration ,Principle modes , Influence coefficients, Coordinate coupling, Orthogonality, Vibration absorbers.

## UNIT III

Geometric method, Stability of equilibrium points, Method of harmonic balance.

Influence coefficients, Dunkerleys equation, Matrix iteration, Holzer method, Rayleigh method, and Rayleigh-Ritz method.

## UNIT IV

Transverse vibration of strings, Longitudinal vibrations of bars, Lateral vibration of beams, Torsional vibration of circular shafts, Whirling of shafts.

Introduction, Method of Laplace transformation and response to an impulsive output, response to

step-input, pulse-input, and phase plane method.

**REFERENCE AND TEXT BOOKS: -**


Mechanical vibration - By G.K. Grover; Nemchand Chand and Sons
Mechanical Vibration – By Thomson; Prentice Hall
Mechanical Vibration - By Den Hartog; Mc Graw Hill
Introductory course to mechanical vibrations – By Rao and Gupta; Wiley Eastern


**B. Tech. (Sixth Semester) Aeronautical Engineering**
**AIRCRAFT SYSTEM LAB**

**ARE- 310E**

L T P
0 0 2

Sessional : 25 Marks
Practical : 25 Marks
Total : 50 Marks
Duration of Exam : 3 Hrs

**List of experiments**

1 Carry out the functional check of cooling turbine and study the air-conditioning system including cooling turbine, distribution and temperature control system
2 Study of refuelling procedure and precautions during refuelling
3 Carry out jacking up operation of the aircraft
4 Study of hydraulic system internal leak check procedure and precautions
5 Study of oxygen system layout and storage
6 Carry out de fuelling and study the fuel sequencing and its indications
7 Study of various types of fire in aircraft and use of fire extinguisher
8 Study of ground running procedure and precautions during ground run

**Note: Total eight experiments must be performed. At least six experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Sixth semester) Aeronautical Engineering**
**Refrigeration and Air Conditioning (Practical)**

**ME 312 E**

| L | T | P/D | Total |
|---|---|---|---|
| - | - | 2 | 2 |

Practical: 25Marks
Sessional: 25 marks
Duration of Exam: 03 hours

**List of Experiments**

1. Study & Performance of basic vapour compression Refrigeration Cycle.
2. To find COP of water cooler.
3. To study the walk in cooler.
4. To study and perform experiment on vapour absorption apparatus.
5. Perform the experiment & calculate various. Performance parameters on a blower apparatus.
6. To find the performance parameter of cooling tower.
7. To study various components in room air conditioner.
8. To find RH of atmosphere air by using sling Psychometric and Psychometric.
9. To find performance of a refrigeration test rig system by using different expansion devices.
10. To study different control devices of a refrigeration system.
11. To study various compressor.
12. To find the performance parameters of Ice Plant.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Sixth semester) Aeronautical Engineering**
**TRIBOLOGY & MECHANICAL VIBRATION (PRACTICAL)**

**ME 314 E**

| L | T | P/D | Total |
|---|---|---|---|
| - | - | 2 | 2 |

**Practical: 25Marks**
**Sessional: 50 marks**
**Duration of Exam: 03 hours**

**LIST OF EXPERIMENT:**

1. To study undamped free vibrations of equivalent spring mass system and determine the natural frequency of vibrations
2. To study the free vibration of system for different damper settings. Draw decay curve and determine the log decrement and damping factor. Find also the natural frequency
3. To study the torsional vibration of a single rotor shaft system and to determine the natural frequency.
4. To determine the radius of gyration of given bar using bifilar suspension.
5. To verify the dunker ley's rule
6. To study the forced vibration of system with damping. Load magnification factor vs. Frequency and phase angle vs frequency curves. Also determine the damping factor.
7. To study the pressure distribution of a journal bearing using a journal bearing apparatus.
8. To determine the rate of wear of a metallic pin from the plot of displacement vs time curves by using friction and wear monitor apparatus.
9. To determine abrasion index of a material with the help of dry abrasion test rig.
10. To evaluate the load wear index and the weld point of a lubricant with the help of a four ball stream pressure tester.
11. To determine the two frequencies of torsional spring type double pendulum & compare them with theoretical values.
12. To determine the radius of gyration of a compound pendulum.
13. To determine the radius of gyration of disc using trifilar suspension.

**Note: Total Ten experiments must be performed. At least eight experiments should be performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Seventh semester) Aeronautical Engineering**

**HELICOPTER DYNAMICS**
**ARE-401E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 |
| L | T | P | Theory | : | 100 |
| 3 | 1 | - | Total | : | 150 |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**ELEMENTARY BLADE MOTION**
Historical development of helicopter and overview, Basic concepts, Introduction to hovering and forward flight theory, Rotor blade motion – flapping, feathering and lagging motion, Composite structures.

**UNIT-2**

**AERODYNAMICS OF THE ROTOR IN MOTION**
The actuator-disc theory, Working states of rotor, Optimum rotor, Efficiency of rotor, Ground effect on lifting rotor, The effect of finite number of blades, Induced velocity and induced power in forward flight – Mangler and Squire method, flight and wind tunnel test, The vortex wake, Aerofoil characteristics in forward flight.

**UNIT-3**

**HELICOPTER TRIM AND PERFORMANCE IN MOTION**
Blade forces and motion in forward flight, Force, torque and flapping coefficient, Helicopter trim analysis, Performance in forward flight.

**UNIT-4**

***DYNAMIC STABILITY AND CONTROL***
Longitudinal and lateral stability, Equations of motion, Stability characteristics, Auto stabilization, Control response.

***HELICOPTER VIBRATIONS***

Exciting forces, Fuselage response, Vibration absorbers, Measurement of vibration in flight.

**BOOKS:**

1. Helicopter Dynamics : Bramwell, A.R.S.
2. Principles of Helicopter Engineering :Jacob Shapiro

**References:-**

1. Aerodynamics of Helicopter, Gessow, A, and Myers GC

**AIRPLANE DESIGN**

**ARE-403E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 |
| Theory | : | 100 |
| Total | : | 150 |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**Introduction**

Aircraft design, requirements and specifications, airworthiness requirements. Weight: It's importance. Aerodynamic and structural design considerations. Classifications of airplane, Concept of configuration, features of special purpose airplanes. Unmanned aerial vehicles and their features.

**Air Loads In Flight**

Classical methods of estimating symmetrical maneuvering loads on a wing in flight, basic flight loading conditions, Load factor, V-n diagram, gust loads, estimation of gust loads, structural effects. use of panel methods to estimate air load distribution on a wing.

**UNIT-2**

**Airplane Weight Estimation**

Estimation of airplane weight based on airplane type / mission and material used. trends in wing loading, iterative approach

**Wing Design Considerations**

Factors influencing selection of airfoil and plan form. Span wise air loads variation with span and planform, stalling, take-off and landing considerations. BM and SF. Design principles for the structure of all metal, stressed skin wing (Civil & Military airplane).estimation of wing drag, effect of flaps.

**UNIT-3**

**Structural Layout And Integration**

Structural layout of straight, tapered swept (fwd and aft) wings. fuselage, empennage, Engine locations, Cockpit and passenger cabin layout, layout of flight and engine controls.wing-fuselage jointing methods, all metal airplane considerations, use of composite materials. Preparation of 3-views .CG location.

**UNIT-4**

**Landing Gears**

Requirement of landing gears, different arrangements ,mechanism for retraction into fuselage and wing. absorption of landing loads, calculations of loads.

**Airframe Power plant integration**

Estimation of Horizontal and vertical tail volume ratios, number of engines, location for inlets and considerations their of. Revised CG location.

**BOOKS:**

1. Airplane Design- A Conceptual Approach : Daniel P Raymer.
2. Design of Airplane : D.Stinton

**Reference**:

1. Fundamentals of Aircraft Design: L.M.Nikolai



**B. Tech. (Seventh semester) Aeronautical Engineering**

**AUTOMATIC FLIGHT CONTROL**

**ARE-405E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 |
| L | T | P | Theory | : | 100 |
| 4 | 2 | - | Total | : | 150 |

Duration of Exam. : 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**Introduction**

Open Loop and Closed Loop (Feed Back) control systems. Types of feedback control systems. Laplace's transform.

**Feed Back Control System**

Transfer function of linear systems. Impulse response of linear systems, Block diagrams of feed back control systems, Multivariable systems, Block diagram algebra.

**UNIT-2**

**Analysis Of Feedback Control Systems**

Typical test input signals, Time domain performance characteristics of feedback control systems. Effects of derivative and integral control. Steady State response of feedback control systemsteady State error, Frequency response.

**UNIT-3**

**Longitudinal Auto-Pilots**

Longitudinal Auto Pilots: Brief description through Block diagrams and Root Locus of Displacement Auto Pilot, Pitch Orientational Control System. Acceleration control system. Fly-By- Wire control system, Instrument Landing System.

**UNIT-4**

**Lateral AutoPilot**

Introduction, Damping of the Dutch Roll, Methods of Obtaining coordination, Yaw orientational control system

**System Stability**

Routh-Hurwitz Criterion, the Root Locus Method.

**BOOKS:**

1. Automatic Control of aircraft and Missiles : John H.Blackelock,John Wiley & Sons

**Reference:**

1. Airplane Performance Stability and Control: C.D.Perkins And.E.Hage,John Wiley & Sons



**B. Tech. (Seventh semester) Aeronautical Engineering**
**COMPUTATIONAL FLUID DYNAMICS**

**ME 441 E**

| L | T | P |
|---|---|---|
| 4 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 |
| Theory | : | 100 |
| Total | : | 150 |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT I

Methods of prediction: comparison of experimental investigation Vs theoretical calculation; Mathematical description of physical phenomena; significance of governing differential equations; the general form of governing differential equation. Classification of problems: Physical classification: Equilibrium problems and Marching problems; Mathematical classification: Elliptic, parabolic and hyperbolic partial differential equations; Nature of co-ordinates; one way and two-way co-ordinates; Proper choice of co-ordinates.

## UNIT II

The concept of discretisation; Finite differences; Taylor series formulation; Finite difference discretisation of ordinary and partial derivatives; Truncation error, round-off error, discretisation error; Consistency and stability of numerical schemes; Variation formulation; Method of weighted Residuals, control volume formulation.

## UNIT III

Steady one- dimensional Conduction, The inter-face conductivity, Non linearity, Source-Term Linearization, Types of Boundary Conditions. Unsteady one-dimensional Conduction: Explicit, Crank-Nicolson and Fully Implicit scheme's Discretisation of two and threedimensional problems, Stability analysis.

## UNIT IV

Steady one dimensional convection and diffusion, The up wind scheme, Generalized Formulation, Discretisation equation for two and three dimensional problems, The outflow Boundary condition, false Diffusion. Basic difficulty, Vorticity Based methods, Representation of the continuity equation, the staggered grid: the momentum equations, the pressure velocity corrections, and SIMPLE algorithm.

**Reference and Text Books:**

1. Computational Fluid Dynamics
- By Anderson, McGraw-Hill
2. Numerical Heat Transfer and fluid flow- By Patankar, McGraw-Hill

**B. Tech. (Seventh semester)Aeronautical Engineering**
**AIRCRAFT MAINTENANCE LAB**
**ARE-407E**

| L | T | P |
|---|---|---|
| 0 | 0 | 3 |

| | | |
|---|---|---|
| Sessional | : | 25 |
| Practical | : | 25 |
| Total | : | 50 |
| Duration of Exam. | : | 3 Hrs. |

**List of experiments**

1. Study of standard operating procedures of safely in aircraft maintenance.
2. Ground running precautions and carry out checks on gas turbine and air intakes prior and after the ground run with the fibroscope
3. Carry out Engine oil system replenishment.
4. Carry out Hydraulic oil system replenishment / checks by CM-20 and patch kit for contamination.
5. Air / oxygen charging procedure and precautions during charging.
6. Study of Mooring, Lashing and picketing procedures.
7. Crack detection with NDT checks – Magnetic, eddy current and vibro acoustic techniques.
8. Inhibition / deinhibition of Aero engines.

**Note: Total eight experiments must be performed. At least six experiments should be**

**performed from the above list. Remaining two experiments may either be performed from the above list or outside the list.**

**B. Tech. (Seventh semester) Aeronautical Engineering**
**AEROMODELLING LAB-I**
**ARE-409E**

L T P
0 0 3

Sessional : 25 Marks
Practical : 25 Marks
Total : 50 Marks
Duration of Exam : 3 Hours

Each student is assigned the design of an Airplane (or Helicopter or any other flight vehicle), to a given preliminary specifications. The following are the assignments to be carried out:

**List of experiments**

1. Comparative studies of different types of airplanes and their specifications and performance details.
2. Preliminary weight estimations, selection of main parameters, Power plant selection, Aerofoil selection, Wing, tail and control surfaces.
3. Preparation of lay outs of balance diagram and three view drawings.
4. Drag estimation, Detailed performance, Calculations and Stability Estimates.V-n diagram.

**NOTE**

1. Validation of data may be done on wind Tunnel.
2. Suitable Software may be used to develop the design data.

**B. Tech. (Seventh Semester) Aeronautical Engineering**
**Minor Project I**
**ARE 411 E**

| P/D | Total | |
|---|---|---|
| 7 | 7 | Viva voce : 100 marks<br>Sessional : 100marks<br>Duration of Exams. : 03 hours |

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full academic session. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.

**B. Tech. (Seventh Semester) Aeronautical Engineering**
**Practical training report**
**ARE 413 E**

| P/D | Total | |
|---|---|---|
| - | - | **Sessional : 125 marks** |
| | | **Duration of Exams. : 03 hours** |

Student will submit summer training (about 8 weeks' industrial training) report for his/her assessment.

**Electives I and II Seventh Semesters**
**(Aeronautical Engineering)**

**ELECTIVE – I**
**(For Aeronautical Engineering Students)**

1. ARE 415 E Introduction To Avionics Technology
2. ARE 417 E Aeroelasticity
3. ARE 419 E Air Plane Stability & Control
4. ARE 437 E Maintenance Engineering

**ELECTIVE - II**

1. ME-421 E Finite Element
2. ARE-421 E Compressible Aerodynamics
3. ME-430 E Energy Management
4. ME-425 E Gas Dynamics

Elective - I & II will be offered as departmental elective for Mechanical Engineering Students.

# DEPARTMENT ELECTIVE-I

**B. Tech. (Seventh semester) Aeronautical Engineering**

## INTRODUCTION TO AVIONICS TECHNOLOGY

**ARE-415E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 |
| L | T | P | Theory | : | 100 |
| 3 | 1 | - | Total | : | 150 |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

### UNIT-1

Processors, Memory Devices Digital Data Buses –MIL-STD-1553B, ARINC 429, ARINC 629, Fiber Optic Buses. LRU architecture for avionics packaging, software, environ mental effects, difference in avionics architecture of commercial and military aircraft

***SENSORS :****Air Data Sensing* – Use of pitot static probe, static probe to derive air dataCindications; Role of Air Data Computer (ADC) *Magnetic Sensing* – Magnetic Heading Reference System (MHRS) Inertial Sensing – Position Gyros, Rate Gyros, Accelerometers Radar Sensing - Rada rAltimeter(RADALT),DopplerRadar, Weather Radar

### UNIT-2

***DISPLAY***

Comparison of earlier flight deck (Electromechanical type instruments) to modern flight deck (glass fight deck), Cathode Ray Tube (CRT), Active Matrix Liquid Crystal Display (AMLCD), Head Down Display (HDD), Head Up Display (HUD),Helmet Mounted Display (HMD), Integrated Standby Instrument System (ISIS)

### UNIT-3

***COMMUNICATION*** HF, U/VHF, Satellite Communication , Air Traffic Control (ATC) Transponder, Traffic Collision & Avoidance System(TCAS),Identification Of Friend & Foe (IFF)

**UNIT-4**

***NAVIGATION :*** Automatic Direction Finding, Very High Frequency Omni-Range (VOR), Distance Measuring Equipment (DME), Tactical Air Navigation (TACAN), VORTAC (VOR+TACAN) Satellite Navigation System-Global Positioning System (GPS), Differential GPS Instrument Landing System (ILS), Transponder Landing System (TLS), Microwave Landing System (MLS), Astronavigation.

**B. Tech. (Seventh semester) Aeronautical Engineering**
**AEROELASTICITY**
**ARE-417E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 |
| L | T | P | Theory | : | 100 |
| 3 | 1 | - | Total | : | 150 |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

***Introduction***

Definition and historical background, Static and dynamic aeroelastic phenomenon, integretion of aerodynamic, elastic and inertia forces, influence of aeroelstic phenomenon on air craft design, comparison of critical speeds.

**UNIT-2**

***Divergence Of Lifting Surface***

The phenomenon of divergence, divergence of 2-D wing section, divergence of an idealized cantilever wing, solution based on semi-rigid assumptions, solution to generalized co-ordinates Method of successive approximation, use of Numerical Methods.

**UNIT-3**

***Steady State Aero-Elasticity Problems In General***

Loss and reversal of aileron Control: 2D case, aileron reversal general case. Lift distribution on a rigid and elastic wing. Effect on Static Longitudinal stability of airplane.

***Introduction To Flutter And Buffeting***

The phenomenon of flutter, flutter of a cantilever wing. Approximate determination of critical speed by Galerkin's Method, buffeting and stall flutter--an introduction

**UNIT-4**

***Non Aeronautical Problems***

Some typical example in civil engineering, Flow around an oscillating circular cylinder applications to H-shaped sections, Prevention of aero-elastic instabilities.

**BOOK:**

1. An introduction to the Theory Of Aeroelasticity : Y.C. Fung, Dover Publications 1st Ed.1967

**REFERENCES:**

1. Aeroelasticity : R.L Bisplinghoff Holt Ashley R.L Halfman Addison –Wesley Publishing Co. Reading Mass ,1st Ed,1965

**B. Tech. (Seventh semester) Aeronautical Engineering**
**AIRPLANE STABILITY AND CONTROL**

**ARE-419E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 |
| L | T | P | Theory | : | 100 |
| 3 | 1 | - | Total | : | 150 |
| | | | Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**Stick Fixed Static Longitudinal Stability** Introduction to stability of airplane, stick fixed longitudinal stability, effect of power, Neutral point, Centre of gravity limits. In flight measurement of stick fixed neutral point.

**Control Surfaces And Aerodynamic Balancing** Control surface hinge moments, floating and restoring tendencies, different types of tabs used on airplanes. Frise Aileron, Spoiler Controls.

**UNIT-2**

**Stick Free Static Longitudinal Stability** Effect of free elevator on airplane stability, Elevator Control force, stick force gradients, Neutral point, Controls free center of gravity limit. In flight measurement of stick free neutral point.

**Maneuvering Flight)** Effect of acceleration on airplane balancing, Elevator angle per g, and stick force per g, Maneuver margins.

**UNIT-3**

**Directional Stability and Controls** Assymetric flight, Weather cock stability, contribution of different parts of Airplane, Rudder Fixed and Rudder free static directional stability, rudder lock.

**Lateral Stability and Control** Dihedral Effect. Contribution of different. Parts of airplane controls in Roll, Aileron control power, cross coupling of lateral and directional effects.

**UNIT-4**

**Dynamic Stability** Introduction to dynamics, spring-mass system. Equations of motion without derivation, stability derivatives, Longitudinal Dynamic Stability, Lateral and Directional Dynamic Stability, analysis of different stability modes

**BOOK:** 1. Airplane Performance Stability and Control :Perkins And Hage, John Wiley, 1949
**REFERENCES:** 1. Dynamics of flight : Bernard Etkin, John Wiley 1989

**B. Tech. (Seventh Semester) Aeronautical Engineering**
**MAINTENANCE ENGINEERING**

**ME 437 E**

| L | T | P | T |
|---|---|---|---|
| 3 | 1 | - | 4 |

Total Sessional : 50 marks
Theory : 100 marks
Duration of Exam : 3 hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## UNIT I

Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept, maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance.
Classification of maintenance programs, corrective preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance-concept, functions, benefits, limitations.

## UNIT II

Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, coil debris/spectroscopy, thermography and corrosion monitoring, steps in implementation of CBM, benefits of CBM.
RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

## UNIT III

Purpose and challenges: Techniques, visual aids-boroscopes, endoscopes, fiber optics scanners, magnetic particles inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT technique, metrits/demerits and applications of various techniques.
Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance-productivity areas for improvement

## UNIT IV

Techniques for improvement of operational reliability, safety and availability of machines and production systems, maintainability criteria, checklist to assess the maintainability of a system, maintainability programs, objectives, key issues in availability improvements program, fault diagnosis, Pareto principle Ishikawa diagram.
Data processing systems for integrated maintenance, maintenance information and reporting systems.

**Text Books:**

1. Maintenance Planning and Control by Higgin L.R., McGiaw Hill Book Co1,1900
2. Maintenance Planning and Control by Kelly Anthony, East West Press Private Ltd, New Delhi, 1991.
3. Maintainability principle and practices by Blanchard B.S. and Lowey E.E. McGrawHill Book co.
4. Practical NOT by Raj B. Jaya Kumar T and Thavasimulyi K., Narora Publishing House, New Delhi, 1996.
5. Engineering Maintenance Management by Niebel Benjamin W. Marcel Dekher,1994.



## DEPARETMENT ELECTIVE-II

**B. Tech. (Seventh Semester) Aeronautical Engineering**

**FINITE ELEMENT METHOD**

**ME 421 E**

| L | T | P | T |
|---|---|---|---|
| 3 | 2 | - | 5 |

Total Sessional : 50 marks
Theory : 100 marks
Duration of Exam : 3 hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

Basic Concept, Historical background, Engineering applications, general description, Comparison with other methods. Need for weighted-integral forms, relevant" mathematical concepts and formulae, weak formulation of boundary value problems, variational methods, Rayleigh-Ritz method, and weighted residual approach.

**UNIT II**

Model boundary value problem, finite element discretization, element shapes, sizes and node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing, compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Langrange and Hermite polynomials.

**UNIT III**

External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, axis-symmetric and three dimensional stress-strain problems, strain displacement relations, boundary conditions, compatibility equations, computer programs.

**UNIT IV**

Variational approach, Galerkin approach, one-dimensional and two-dimensional steady-state problems for conduction, convection and radiation, transient problems. In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream functionvorticity formulation, Solution of incompressible and compressible fluid film lubrication problems

**Reference and Text Books:**

1. The Finite Element Method
- By Zienkiewicz, Tata McGraw
2. The Finite Element Method for Engineers
-By Huebner, John Wiley
3. An Introduction to the Finite Element Method
-By J.N.Reddy, McGraw Hill



**B. Tech. (Seventh Semester) Aeronautical Engineering**

**COMPRESSIBLE AERODYNAMICS**

**ARE 421 E**

| L | T | P | T |
|---|---|---|---|
| 3 | 2 | - | 5 |

Total Sessional : 50 marks
Theory : 100 marks
Duration of Exam : 3 hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

## Unit – I

**Shock Waves**

Introductory remarks, point source in a compressible flow,Mach waves and shock waves.

1. Normal Shock waves: equation of motion for a normal shock,normal shock relations for a perfect gas,stagnation conditions,RH relations,propagating shock waves,weak shock, reflected shock wave,centered expansion waves,shock tube. Numerical examples

2. Oblique Sock waves: Introduction, oblique shock relations,M-□□□ relations, shock polar,supersonic flow over wedge,weak oblique shock,supersonic compression, detached shock. Numerical examples.

## Unit-II

**Expansion waves**

Supersonic expansion by turning, Prandtl-Meyer flow, Numerical problems. Simple and non simple regions,reflection and intersection of shocks and expansion waves, Mach reflections,Method of characteristics, numerical examples

## Unit-III

**Lift and drag in supersonic flows:**

Shock –Expansion theory, flow field in supersonic,flowfield in supersonic flows, numerical problems,thin airfoil theory,analytical determination of lift and drag coefficients on flat plate, biconvex, and diamond shaped sections in supersonic flows,numerical problems, supersonic leading and trailing edges.

## Unit-IV

**Potential equation for compressible flows:**

Introduction, Crocco's theorem, derivation of basic potential equation foe compressible flows, linearization of governing equation, boundary conditions,small perturbation theory, application to wavy wall, bodies of revolution.

**Unit-V Airfoils in compressible flow:**

Introduction, linearized compressible flow, airfoils in subsonic flow, Prandtl-Glauert ransformation, critical Mach number,supercritical flows,airfoils in transonic flow, governing equations,shock wave boundary layer inter action,stability and control problems.

**Unit-VI Measurements in Compressible flows:**

Rayleigh's supersonic Pitot formula, Equipment used in supersonic flows,supersonic wind tunnels,heat transfer tunnels,shoch tunnels,Aero-ballistic ranges,terminal ballistic range,rocket sled facility,special instrumentation for these types of tunnels.

**BOOK:**

1. Aerodynamics and thermodynamics of compressible fluid flow: Shapiro A.H., Vols I& II

**REFERENCES**:


- Elements of Gas Dynamics : Lieppmann and Rosheko ,John Wiley 1957
- Modern compressible Flow with historical perspective: John D. Anderson
- Experimental Methods in Hypersonic flows: J. Lucasiewisz.

**B. Tech. (Seventh semester) Aeronautical Engineering**
**ENERGY MANAGEMENT**

**ME 430 E**

| L | T | P |
|---|---|---|
| 3 | 2 | - |

| | | |
|---|---|---|
| Sessional | : | 50 |
| Theory | : | 100 |
| Total | : | 150 |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

Inerlialion phase, audit and analysis phase, implementation phase, general methodology for building and site energy audit, site survey, methodology, site survey-electrical system, steam and water systems, building survey methodology, basic energy audit instrumentation, measurement for building surveys. General principles, the requirements for human comfort, description of

typical systems-dual duct HVAC system. Multi zone HVAC systems, variable and volume systems, terminal repeat system, evaporative systems, package system, basic principle governing HVAC system, package system, basic principle governing HVAC system operation, energy management opportunities in HVAC systems, modeling of heating and cooling loads in buildings, problems.

**UNIT II**

General principles, illumination and human comfort, basic principles of lighting system, typicalillumination syst3em and equipment, fundamentals of single phase and 3 phase A.C. circuits, energy management opportunities for lighting systems, motors and electrical heat, electrical and analysis and their parameters, peak, demand control, problems. General principles, process heat, combustion, energy saving in condensate return, steam generation and distribution, automotive fuel control, hot water and water pumping, direct and indirect fired furnaces over, process electricity, other process energy forms-compressed air and manufacturing processes, problems.

**UNIT III**

General consideration, life cycle costing, break-even analysis, cost of money, benefit/cost analysis, pay back period analysis, prospective rate of to return, problems. Environmental conformation, passive design, conservation building envelope design consideration, integration of building system, energy storage problems.

**UNIT IV**

Energy management principle involving computers, basics of computer use, analysisengineering and economic calculations, simulation, forecast, CAD/CAM controls - microprocessor and minicomputers, building cycling and control, peak demand limiting and control: industrial power management, problems.

**Text Book:**

1. Energy Management Principles by Criag B. Smith, Published by Pergamon Press.
2. Energy systems and developments – Jyoti Parikh, Oxford University Press.

**B. Tech. (Seventh Semester) Aeronautical Engineering**
**GAS DYANAMICS**
**ME-425E**

| L | T | P | total | |
|---|---|---|---|---|
| 3 | 2 | | 5 | |

Sessional Marks : 50
Theory : 100
Duration of Exam: 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit - I**

Introduction, units, thermodynamics concepts for control mass analysis flow dimensionality and average velocity comment on entropy-pressure energy equation. The stagnation concept, stagnation pressure, energy equation, momentum equation problems.

Introduction, Objectives, speed of propagation of pressure front, Mach Number, sonic velocity, field due to a moving source of disturbance, mach cone mach, angle equation for a perfect gas in terms of mach. number. h. s.& t. s. diagram problems.

**UNIT II**

Introduction, adiabatic flow with and without losses, the reference concept, isentropic tables, conversant & divergent nozzles, diffuser performance, frictional effects on nozzle flow problems.

Introduction, shock analysis-general fluid, working equations for perfect gas, normal-shocks tables, shocks in nozzles, supersonic wind tunnel operation, thermodynamic directions of a normal shock, Rankins-Hugoniat relation, strength of shock, operation of nozzles, problems.

**UNIT III**

Introduction, normal shocks tangential velocity superposition -oblique shocks, oblique-shocks, analysis, oblique-shock tables and charge, boundary conditions of flow direction, boundary condition of pressure equilibrium, introduction to Prandtl Mayer expansion, problems.

Introduction, analysis for general fluid, working equations for a perfect gas, reference state and fanno tables, application, correlation with shocks, friction chocking, Rayleigh flow. Analysis for a general fluid, working equations for a perfect gas reference state and Rayleigh tables, applications, correlation with shocks, thermal shocking, and summary problems

**UNIT IV**

Introduction, Brayton cycle, propulsion engines. thrust power and efficiency, thrust consideration power consideration, power conskloiftlion and efficiency consideration, open Brayton cycle for propulsion systems, turbojet, turbo propulsion, ram jet, pulse jet, numerical.

**Text Books:**

1. Fundamentals of Gas Dynamics- YAHA, S.M. TMI-I, India.
2. Fluid Mechanics-A.K. Mohanty, Prentice Hall of India.

**Reference Books:**

1. Fundamentals of Fluid Mechanics- YUAN, S.W. Prentice Hall of India.
2. Fundamentals of Gas Dynamics - Robert D. Zucker, Met tire Publication.
3. Gas Dynamics -E-., Radha Krishnan, prentice Hall of India.
4. Gas Dynamics Vol. -I Zucrotuf, Wiley.
5. Gas Dynamics - Shapiro Wiley.

**B. Tech. (Eighth Semester) Aeronautical Engineering**

**SPACE DYANAMICS**

**ARE-402E**

| L | T | P | total | |
|---|---|---|---|---|
| 3 | 1 | | 4 | |

Sessional Marks : 50
Theory : 100
Duration of Exam: 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**Introduction**

Initial works in Germany for space travel. russian and American campaigns, man in space, profile of flight from earth to a destination in space and back. The space shuttle.

**Particle Dynamics**

Introduction, Newton's laws, velocity and acceleration, coordinates and rotation, the spherical pendulum, energy for one particle, angular momentum, energy for systems of particles, angular momentum , the N-body problem.

**UNIT-2**

**The Two–Body problem**

Introduction , the two body problem, energy and angular momentum, orbit equation, Kepler's laws, orbit determination and satellite tracking.

**The earth satellite operations**

The Hohmann transfer, inclination-change maneuver, launc to rendezvous, decay life time, earth oblateness effect, low thrust orbit transfer.

**UNIT-3**

**Rigid Body Dynamics**

Introduction, choice of origin, angular momentum and energy, principal-body-axis frame, particle axis theorem, Euler's equations, Orientational angle, the simple Top.

**Satellite attitude Dynamics**

Torque –Free-axisymmetric Rigid body, The general torque free rigid body, semi-rigid space craft, attitude control: Spinning and Non spinning space craft. The Yo-Yo mechanism, gravity gradient satellite, The dual spin space craft.

**UNIT-4**

**Re-entry dynamics**

Introduction, ballistic re-entry, skip re-entry, double dip re-entry, Aero braking, lifting re-entry.

**The Space Environment**

Introduction, The atmosphere, Light and space craft temperature, charged particle motion, magnetic mirrors, The van-atten Belts, radiation effects, Meteors, Meteorites and impact. Our local neighborhood

**BOOKS:**

1. Space Flight Dynamics : William E. Wiesel , Mcgraw Hill

**Reference:**

1. Materials for missiles and Space Craft, Parker ER

**B. Tech. (Eighth Semester) Aeronautical Engineering**

**COMPUTATIONAL AERODYNAMICS**

**ARE-404E**

| L | T | P | total | | |
|---|---|---|---|---|---|
| 3 | 1 | | 4 | Sessional Marks | : 50 |
| | | | | Theory | : 100 |
| | | | | Duration of Exam: 3 Hrs. | |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**INTRODUCTION**

Numerical experiments in aerodynamics v/s wind tunnel testing, merits and advantages, limitations, reliability and accuracy of the results, comparisons in safety, risks, cost and time factors.initial break throughs, usage of packages for plottings and graphics. Current status

**UNIT-2**

**THE NAVIER-STOKES EQUATIONS**

Stress and strain in a viscous fluid, strain versus rotation, isotropy, the rate of strain tensor,the two coefficients of viscosity, the N-S equations

**THE BOUNDARY LAYER**

The laminar boundary layer, velocity, displacement and momentum thickness, Karman's momentum integral equation, velocity profile fitting, Thwaits method , for laminar boundary layer, Velocity profile fitting ,Head's method, separation of BL, The development of circulation about a sharp-tailed airfoil, Computation of boundary layer growth along an airfoil.

**UNIT-3**

**FD SOLUTION OF BL EQUATIONS:**

Statement of the problem,similar solutions of thelaminar incompressible boundary layer,FD method or Falkner –Skan equation, iterative solution of nonlinear equations,FD methods based on second order differential equation,based on a system of first order equations.Transformation of laminar boundary layer equations for arbitrary pressure gradients.turbulent BL, separated flows.

**UNIT-4**

**COMPRESSIBLE POTENTIAL FLOW PAST AIRFOILS:**

Shock waves and sound waves,equations of compressible steady potential flow,P-G equation, subsonic flow past thin airfoil, supersonic flow past thin airfoils and transonic flow past thin airfoils; aerodynamics in the transonic range,solution of TSP equation: sub critical flow,conservation v/s non conservation difference schemes. Super critical flow and upwind differencing,the relaxation iteration,the Poisson iteration

**BOOKS:**

1. Computational Aerodynamics : Jack Moran, john Wiley, 1984

**REFERENCES:**

1. Computational Fluid Flow and Heat Transfer : Anderson, Tannehill and Pletcher McGraw Hill,1984.

**B. Tech. (Eighth Semester) Aeronautical Engineering**

**ROCKETS AND MISSILES**

**ARE-406E**

| L | T | P | Total | |
|---|---|---|---|---|
| 4 | 2 | | 6 | |

Sessional Marks : 50
Theory : 100
Duration of Exam: 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT-1**

**1. Ignition system in Rockets** - Types of igniters - Igniter design considerations – Design consideration of liquid rocket combustion chamber, injector propellant feed lines, valves, Propellant tanks outlet and helium Pressurized and turbine feed systems - Propellant slosh and propellant hammer - Elimination of geysering effect in missiles .

**2. Combustion system of solid rockets.**

Airframe components of rockets and missiles - Forces acting on a missile while passing through atmosphere -

**Classification of missiles** - Method of describing aerodynamic forces and moments - Lateral aerodynamic moment - Lateral Damping moment and longitudinal moment of a rocket - Lift and drag forces – Drag

**UNIT-1I**

**3. Estimation** - body upwash and downwash in missiles - rocket dispersion – Numerical problems. One dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields - Description of vertical, inclined and gravity turn trajectories - Determination of range and altitude Simple

**4. Approximations to burnout velocity:-**

Rocket vector control - Methods - Thrust termination - SITVC - Multistage of rockets – Vehicle optimization - Stage separation dynamics - Separation techniques.

**UNIT-1II**

**5. Selection of materials** - Special requirements of materials to perform under adverse conditions.

**6. Solid Rocket Motors**: General description, interior ballistics component design techniques.

**UNIT-1V**

**7. Liquid Rocket Engines**: General description, engine cycles, power balance calculation , component design fundamentals.

**8. Electric Propulsion** : Classification of electric propulsion systems.

**9. Trajectory Analysis** : The rocket equation , vertical trajectories, multistage rockets, generalized 2D trajectory.

**BOOKS:**

1. Sutton, G.P., et al., " Rocket Propulsion Elements " John Wiley & Sons Inc., NewYork, 1993.
2. Mathur, M., and Sharma, R.P., " Gas Turbines and Jet and Rocket Propulsion ", Standard Publishers, New Delhi, 1998.

**Reference:**

1. Cornelisse, J.W.., " Rocket Propulsion and Space Dynamics ", J.W., Freeman & Co., Ltd., London, 1982.
2. Parket, E.R., " Materials for Missiles and Spacecraft ", McGraw Hill Book Co., Inc., 1982

**Major Project I**
**ARE 408 E**

| P/D | Total | |
|---|---|---|
| 9 | 9 | Viva voce : 100marks<br>Sessional : 100 marks<br>Duration of Exams. : 03 hours |

The students expected to take up a project under the guidance of teacher from the college. The project must be based on mechanical engineering problems, which can be extended up to the full academic session. The students may be asked to work individually or in a group not more than four students in a group. Viva- voce must be based on the preliminary report submitted by students related to the project.



**B. Tech. (Eighth Semester) Aeronautical Engineering**
**Seminar**
**ARE 410 E**

| P/D | Total | |
|---|---|---|
| 2 | 2 | **Sessional: 25 marks** |

Student will give a talk on some technical topics.

**Note: The seminar will continue in eighth semester and will be evaluated in eighth semester**.



**Electives III and IV Eighth Semester**
**(Aeronautical Engineering)**

**ELECTIVE – III**
**(For Aeronautical Engineering Students)**

1. ARE 414 E Ergonomics & Work Place Design
2. ARE 416 E Modern Manufacturing Processes
3. ARE 418 E Boundry Layer Therory

**ELECTIVE - IV**

1. ME-406 E Operation Research
2. ARE-432 E Management Information System

Elective - III & IV will be offered as departmental elective for **Aeronautical Engineering Students**.



## DEPARTMENT ELECTIVE-III

**B. Tech. (Eighth semester) Aeronautical Engineering**

**ERGONOMICS AND WORK PLACE DESIGN**

**ARE-414E**

| | | | | | |
|---|---|---|---|---|---|
| | | | Sessional | : | 50 Marks |
| L | T | P | Theory | : | 100 Marks |
| 3 | 1 | - | Total | : | 150 Marks |

Duration of Exam. : 3 Hrs.

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit I**

Basic Principles of Ergonomics, Anthropometry, Posture and Health; Anthropometry Practical; Displays, Controls and HMI; Tools and Equipment Design; Workplace Design and Assessment; Task Analysis; Questionnaire and Interview Design; Product Design and Evaluation; Designing for manufacture and maintenance; Health and Safety Legislation and Ergonomics.

**Unit II**

Application of Ergonomics Principles, Cognitive Ergonomics, Human Information Processing; Memory; Reading; Perception; Navigation; Problem Solving; Decision Making, Human-Computer Interaction, Input/Output Technology, Usability; Evaluation; Health problems.

**Unit III**

Future Systems, Job Design, Scientific Management, Enrichment, Enlargement, Rotation, Cells, Shift work, Management Style and Job Design, Change Management. New Technology, Unemployment, Deskilling, Introducing new technology. Questionaire design and assessment. Task analysis techniques. Measurement of human error and risk. Use of simulation and prototypes. Product Evaluation. Experimental Design.

**Unit IV**

Case Studies: A set of case studies will be used to demonstrate how ergnomics has lead to changes in work activity, safety and product design. Case studies will include advanced computer applicatons, workplace assessment and re-design, accident analysis and industrial inspection, and in manufacturing. Students will be required to apply the principles to a real life ergonomic design as applied to a product, service or computer application.

**Text Books:**

1. Work Design: Industrial Ergonomics – Knoz, Stephan A., Johnson, Steven, Holcomb Hathaway, Scottsdale, AZ.
2. Human factors in engineering and design – Sanders, M.S. & McCormick, E.J., 6th ed., McGraw-Hill, New York.

**Reference Books:**

1. Ergonomics: Man in his working environment- Murrell, K.F.H, Champan & Hall, London.
2. Man – Machine Engineering – Chapanis A: Wordsworth Publishing Co.
3. The Practice and Management of Industrial Ergonomics – Alexander, D.C., Prentice-Hall, Englewood Cliffs, NJ.
4. Textbook of Work Physiology – Astrand, P.O. & Rhodahl, K.– McGraw-Hill, New York.
5. Human Factors in Lighting – Boyce, P.R. Macmillan, New York.
6. The Ergonomics of Workspaces and Machines : A design manual – Clark, T.S. & Corlett, E.N. Taylor & Francis, London.
7. Ergonomics at work. Oborne, D Wiley, London.
8. Bodyspace–Anthropometry, Ergonomics and Design. – Pheasant, S. Taylor & Francis,.

**B. Tech. (Eighth semester) Aeronautical Engineering**
**MODERN MANUFACTURING PROCESSES**

**ARE-416E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit I**

Mechanical Processes: Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.

**Unit II**

Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding - Material removal, surface finish, accuracy, advantages, applications.

**Unit III**

Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications. Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

**Unit IV**

Plasma Arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron Beam Machining (EBM) - Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations.

**Text Books :**

1. Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill
2. Machining Science- Ghosh and Malik, Affiliated East-West Press

**Reference Books :**

1. Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker
2. Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall



\

**B. Tech. (Eighth semester) Aeronautical Engineering**
**BOUNDRY LAYER THEORY**
**ARE-418E**

| L | T | P |
|---|---|---|
| 3 | 1 | - |

| | | |
|---|---|---|
| Sessional | : | 50 Marks |
| Theory | : | 100 Marks |
| Total | : | 150 Marks |
| Duration of Exam. | : | 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**Unit-I**

**BASICS**

Basic laws of fluid flow- Continuity, momentum and energy equations as applied to system and control volume –Concept of flow fields- Viscous fluid flow with historical out lines of viscous flow, Boundary conditions for viscous flow problems, Development of boundary layer- Prandtl's hypothesis, Estimation of boundary layer thickness- Displacement thickness, momentum and energy thickness for two-dimensional flows. Viscosity and thermal conductivity, thermodynamic properties.

**Unit-II**

**DERIVATION OF THE NAVIER-STOKES EQUATIONS**

General stress system in a deformable body, the rate at which the fluid element is strained in a flow, Relation between stress and rate of deformation, Stoke's hypothesis, bulk viscosity and thermodynamic properties, The Navier – Stokes Equation (N-S) –General properties of Navier – Stokes Equation.

**SOLUTIONS OF THE NAVIER-STOKES EQUATIONS**

Two dimensional flow through a straight channel. Hagen- Poiseulle flow, Suddenly accelerated plane wall, Stagnation in plane flow (Hiemenz problem), Flow near a rotating disk, Very slow motion, Parallel flow past a sphere.

**Unit-III**

**LAMINAR BOUNDARY LAYER**

Analysis of flow past a flat plate and a cylinder, Integral relation of Karman, Integral analysis of energy equation, Laminar boundary layer equations, Flow separation. Similarity solutions for steady two dimensional flows; Blasius solution for flat- plate flow, Boundary layer temperature profiles for constant wall temperature, Falkner-Skan Wedge flows, Free shear flows- plane laminar jet, plane laminar wake. Integral equation of Boundary layer, Karman-Pohlhausen method.Digital computer solutions. Thermal boundary layer calculations- One parameter (Uo ) and two parameters (U0 and ☐T ) integral methods. Stability of laminar flows.

**Unit-IV**

**TURBULENT BOUNDARY LAYER:**

Two dimensional turbulent boundary layer equations, Integral relations, Eddy-Viscosity theories, Velocity profiles; The law of the wall, The law of the wake. Turbulent flow in pipes and channels.- Turbulent boundary layer on a flat pate, Boundary layers with pressure gradient.

**COMPRESSIBLE BOUNDARY LAYER FLOWS**

Introduction to the compressible boundary layer on a flat plate, shock wave boundary layer interaction.

**BOOKS:**

1. Viscous Fluid Flow 3rd Ed. Frank M White McGraw Hill 2006
2. Boundary Layer theory 6th Ed. H. Schlichting McGraw Hill 1968

**REFERENCES**

1 Aerodynamics for Engineers 4th Ed. John Bertin Pearson 2004

## DEPARTMENT ELECTIVE-IV

**B-Tech. (Eighth Semester) Aeronautical Engineering**
**Operation Research**
**ME 406 E**

L T P/D
3 1 4

Total Theory : 100 Marks
Sessional : 50 Marks
Duration of Exams: 03 hours

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

### UNIT I

Development of operations Research, characteristics and scope of operations Research, operations Research in Management, Models in operations Research, Model Formulation, Types of mathematical models, Limitations of operations Research.
L.P. models, simplex method, the algebra of simplex method. (Minimization and Minimization problems), The big M method, post optimality analysis, essence of duality theory, Application of sensitivity analysis.

### UNIT II

Introduction to model, matrix terminology, Formulation and solution of Transportation model (least cost method, Voyel's Approximation method), Least time transportation problem, Assignment problems.
Introduction to net work logic, Numbering of events (Fulkersen Rule), PERT calculations - Forward path, back-ward path. Slack, probability, comparison with PERT, Critical path, Floats. Project cost, crashing the net work, updating (PERT and CPM).

### UNIT III

Introduction, applications of simulation, advantages and limitations of simulation technique,

generation of random numbers, Time-flow mechanism, simulation languages.
Steps in decision theory approach, Decision Machinery environment, Decision machining under certainty and uncertainty, Decision machining under condition of risk, Decision trees, Minimum enchained criteria, Advantages and limitations of decision tree solutions, post optimality
Definition of arguments models, comparison with transport model, Mathematical representation of assignment model, Formulation and solution of argument models, variation of the argument model, Alternate optimal solutions

**UNIT IV**

Introduction, Applications of queuing Theory, Waiting time and idle time costs, single channel queuing theory and multi channel queuing theory with Poisson. arrivals and exponential services, Numerical on single channel and multi channel queuing theory.
Theory of games, competitive games, Rules and Terminology in game Theory, Rules for game theory- saddle point, dominance, mixed strategy (2 x2 games) , mixed strategy (2 x n games or m x 2 games), mixed strategy (3 x3 games), two person zero sum games, n-person zero sum games.

**Reference and Text Books:**

1. Introduction to operation research- By Hillier and Lieberman, McGraw-Hill
2. Operations Research - By P.K. Gupta and D.S. Hira
3. Linear Programming -By N.P. Loomba

**B. Tech. (Eighth semester) Aeronautical Engineering**
**MANAGEMENT INFORMATION SYSTEM**
**ME 432 E**

| L | T | P | | |
|---|---|---|---|---|
| 3 | 2 | - | Sessional | : 50 Marks |
| | | | Theory | : 100 Marks |
| | | | Total | : 150 Marks |
| | | | Duration of Exam. | : 3 Hrs. |

**NOTE: In the semester examination, the paper setter will set 8 questions in all, at least two questions from each unit, and students will be required to attempt only 5 questions, selecting at least one from each unit.**

**UNIT I**

What is MIS? Decision support systems, systems approach, the systems view of business, MIS, MIS organization within the company management organizational theory and the systems approach. Development of organizational theory, management and organizational behavior, management information and the system approach. Evolution of an information systems, basic information systems, decision making and MIS, MIS as a technique for making programmed decision assisting information systems ( r ) strategic and project planning for MIS : General business planning, appropriate MIS planning-general, MIS planning -details.

**UNIT II**

Define the problems, set system objectives, establish system constraints, determine information needs, determine information sources, develop alternative conceptual ;designs and select one document the system concept, prepare the conceptual ;design report.

**UNIT III**

Inform and involve the organization, aim of detailed design, project management of MIS detailed design, identify dominant and trade off criteria, define the subsystems, Sketch the detailed operating subsystems and information flow. Determine the degree of automation of each operation, inform and involve the organization again, inputs, and processing, early system testing, software, hardware and tools, propose an organization to operate the

system, document the detailed design, revisit the manager -user.

**UNIT IV**

Plan the Implementation , acquire floor space and plan space layouts, organize for implementation, develop, procedures for implementation, train (ho operating personnel, computer related acquisitions, develop forms for data collection and information dissemination, develop the files, test the system, cutover, document the system, evaluate the MIS control and maintain the system ( r). Pitfalls in MIS development : Fundamental weakness, soft spots in planning, design problems, implementation: The TARPIT.

**Text Books:**

1.. Management Information system by W.S. JawadeKar - Tata McGraw Hill.