AE-801(1)
ROCKETS AND MISSILES

UNIT-I ROCKETS SYSTEM

Types of Ignition System in rockets and types of Igniters – Igniter Design. Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines. Propellant Tanks Outlet and Helium Pressurized and Turbine feed Systems–Propellant Slash and Propellant Hammer–Elimination of Geysering Effect in Missiles–Combustion System of Solid Rockets.

UNIT-II AERODYNAMICS OF ROCKETS AND MISSILES

Airframe Components of Rockets and Missiles – Forces Acting on a Missile While Passing Through Atmosphere– methods of Describing Aerodynamic Forces and Moments – Lateral Aerodynamic Moment – Lateral Damping Moment and Longitudinal Moment of a Rocket – lift and Drag Forces – Drag Estimation – Body Upwash and Downwash in Missiles.

UNIT-III MOTION IN SPACE AND GRAVITATIONAL FIELD

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 Approximations to Burnout Velocity.

UNIT-IV STAGING AND CONTROL

Rocket Vector Control – Methods – Thrust determination – SITVC – Multistaging of rockets – Vehicle Optimization – Stage Separation Dynamics – Separation Techniques.

UNIT-V MATERIALS USED FOR ROCKETS AND MISSILES

Selection of Materials –Special Requirements of Materials to Perform under Adverse Conditions.

TEXT BOOKS

1. Sutton G. P, “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 1993.
2. Cornelisse, J.W., “Rocket Propulsion and Space Dynamics”, J.W., Freeman & Co. Ltd., London, 1982.

REFERENCES

1. Mathur, M., and Sharma, R.P., “Gas Turbines and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1998.
2. Parker, E. R., “Materials for Missiles and Spacecraft”, McGraw-Hill Book Co. Inc., 1982.
3. M. J. Zucrow, “Missile Propulsion”, John Wiley & sons.
4. H. S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing Company Bangalore.

AE-801(2)
FATIGUE AND FRACTURE MECHANICS

UNIT-I FATIGUE OF MATERIALS

S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerber and Soderberg relations and diagrams - Notches and stress concentrations - Neuber's stress concentration factors – Plastic stress concentration factors - Notched S.N. curves.

UNIT-II FATIGUE BEHAVIOUR

Low cycle and high cycle fatigue - Coffin - Manson's relation - Transition life – cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques –Cumulative damage.

UNIT-III PHYSICAL ASPECTS OF FATIGUE

Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations –fatigue fracture surfaces.

UNIT-IV FRACTURE MECHANICS

Strength of cracked bodies - Potential energy and surface energy - Griffith's theory, extension of Griffith's theory to ductile materials - stress analysis of cracked bodies - Effect of thickness on fracture toughness - stress intensity factors for typical geometries.

UNIT-V FATIGUE DESIGN AND TESTINIG

Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materials and structures.

TEXT BOOKS

1. Prasanth Kumar – "Elements of fracture mechanics" – Wheeter publication, 1999.
2. Barrois W, Ripely, E.L., "Fatigue of aircraft structure", Pegamon press. Oxford, 1983.

REFERENCES

1. Sin, C.G., "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983

AE-801(3)
AIRFRAME MAINTENANCE AND REPAIR

UNIT-I WELDING IN AIRCRAFT STRUCTURE

Equipments used in welding shop and their maintenance – Ensuring quality welds –Welding jigs and fixtures – Soldering and brazing.

SHEET METAL REPAIR AND MAINTENANCE

Inspection of damage – Classification – Repair or replacement – Sheet metal inspection – N.D.T. Testing – Riveted repair design, Damage investigation.

UNIT-II PLASTICS AND COMPOSITES IN AIRCRAFT

Review of types of plastics used in airplanes – Maintenance and repair of plastic components – Repair of cracks, holes etc., various repair schemes – Scopes. Inspection and Repair of composite components – Special precautions.

UNIT-III AIRCRAFT JACKING AND RIGGING

Airplane jacking and weighing and C.G. Location. Balancing of control surfaces –Inspection maintenance. Helicopter flight controls. Tracking and balancing of main rotor.

UNIT-IV REVIEW OF HYDRAULIC AND PNEUMATIC SYSTEM

Trouble shooting and maintenance practices–Service and inspection–Inspection and maintenance of landing gear systems. – Inspection and maintenance of air-conditioning and pressurization system, water and waste system. Installation and maintenance of Instruments –handling– Testing – Inspection. Inspection and maintenance of auxiliary systems. Position and warning system

UNIT-V SAFETY PRACTICES

Hazardous materials storage and handling, Aircraft furnishing practices – Equipments. Trouble Shooting - Theory and practices.

TEXT BOOK

1. KROES, WATKINS, DELP, “Aircraft Maintenance and Repair”, McGraw-Hill, New York, 1992.

REFERENCES

1. LARRY REITHMEIR, “Aircraft Repair Manual”, Palamar Books, Marquette, 1992.
2. BRIMM D.J. BOGGES H.E., “Aircraft Maintenance”, Pitman Publishing corp. New York,

AE-801(4)
AIR TRAFFIC CONTROL AND AERODROME DESIGN

UNIT-I BASIC CONCEPTS ATC

Objectives of ATS - Parts of ATC service – Scope and Provision of ATCs–VFR & IFR operations – Classification of ATS air spaces – Varies kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS– Division of responsibility of control.

UNIT-II AIR TRAFFIC SERVICES

Area control service, assignment of cruising levels minimum flight altitude ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report.

UNIT-III FLIGHT INFORMATION ALERTING SERVICES AND RULES OF THE AIR

Radar service, Basic radar terminology – Identification procedures using primary /secondary radar – performance checks – use of radar in area and approach control services – assurance control and co ordination between radar / non radar control –emergencies – Flight information and advisory service – Alerting service – Co-ordination and emergency procedures – Rules of the air.

UNIT-IV AERODROME DATA AND PHYSICAL CHARACTERISTICS

Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc.

UNIT-V VISUAL AIDS FOR NAVIGATION, VISUAL AIDS FOR DENOTING OBSTACLES EMERGENCY

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area –Markings, general requirements–Various markings–Lights, general requirements – Aerodrome beacon, identification beacon –Simple approach lighting system and various lighting systems – VASI & PAPI – Visual aids for denoting obstacles; object to be marked and lighter – Emergency.

TEXT BOOK

1. AIP (India) Vol. I & II, “The English Book Store”, 17-1, Connaught Circus, New Delhi.

REFERENCES

1. “Aircraft Manual (India) Volume I”, latest Edition –The English Book Store, 17-1, Connaught Circus, New Delhi.
2. “PANS – RAC –ICAO DOC 4444”, Latest Edition, the English Book Store, 17-1, Connaught Circus, New Delhi

AE 802
HELICOPTER AERODYNAMICS

UNIT I-ELEMENTS OF HELICOPTER AERODYNAMICS

Configurations based on torque reaction-Jet rotors and compound helicopters- Methods of control — Collective and cyclic pitch changes - Lead - Lag and flapping hinges.

UNIT II- ROTOR THEORY

Hovering performance - Momentum and simple blade element theories – Figure of merit - Profile and induced power estimation - Constant chord and ideal twist rotors.

UNIT III -POWER ESTIMATES

Induced, profile and parasite power requirements in forward flight-Performance curves with effects of altitude- Preliminary ideas on helicopter stability

UNIT IV-LIFT, PROPULSION AND CONTROL OF VTOL and STOL AIRCRAFT

Various configuration - Propeller, rotor, ducted fan and jet lift - Tilt wing and vectored thrust - Performance of VTOL and STOL aircraft in hover, transition and forward motion.

UNIT V-GROUND EFFECT

Types - Hover height, lift augmentation and power calculations for plenum chamber and peripheral jet machine - Drag of hovercraft on land and water. Applications of hovercraft.

TEXTBOOKS

1. Gessow, A., and Myers, G, C., “Aerodynamics of Helicopter”, Macmillan & Co., N.Y. 1987.
2. McCormick, B, W., “Aerodynamics of V/STOL Flight”, Academic Press, 1987

REFERENCES

1. Johnson, W., “Helicopter Theory,” Princeton University Press, 1980.
2. McCormick, B, W., “Aerodynamics, Aeronautics and Flight Mechanics” John Wiley, 1995.
3. Gupta, L., “Helicopter Engineering

AE-803
COMPUTATIONAL FLUID DYNAMICS

UNIT-I FUNDAMENTAL OF COMPUTATIONAL FLUID DYNAMICS

Introduction - Basic Equations of Fluid Dynamics - Incompressible In viscid flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations -Elliptic, Parabolic and Hyperbolic equations - Well posed problems - Discretization of partial Differential Equations -Transformations and grids.

UNIT-II PANEL METHODS

Introduction to Panel Methods – Source panel method – Vortex panel method – advantages of Panel Methods and Applications.

UNIT-III DISCRETIZATION

Boundary layer Equations and methods of solution -Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation –Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems.

UNIT-IV FINITE ELEMENT TECHNIQUES

Finite Element Techniques in Computational Fluid Dynamics; introduction - Strong and Weak Formulations of a Boundary Value Problem-Strong formulation–Weighted Residual Formulation-Galerkin Formulation - Weak Formulation – Variational Formulation - Piecewise defined shape functions - Implementation of the FEM.

UNIT-V FINITE VOLUME TECHNIQUES

Finite Volume Techniques - Cell Centered Formulation - ~ Lax - Vendor off Time Stepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping -Accuracy- Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques - Central and Up-wind Type Discretizations - Treatment of Derivatives.

TEXT BOOK

1. Fletcher, C.A.J., “Computational Techniques for Fluid Dynamics”, Vols. I and II, Springer - Verlag, Berlin, 1988.
2. “Computational Fluid Dynamics”, T. J. Chung, Cambridge University Press, 2002.

REFERENCES

1. John F. Wendt (Editor), “Computational Fluid Dynamics - An Introduction”, Springer – Verlag, Berlin, 1992.
2. Charles Hirsch, “Numerical Computation of Internal and External Flows”, Vols. I and II, John Wiley & Sons, New York, 1988.
3. Klaus A Hoffmann and Steve T. Chiang. “Computational Fluid Dynamics for Engineers”, Vols. I & II Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 – 1078 USA, 1993.
4. Anderson, John D., “Computational Fluid Dynamics”, McGraw-Hill, 1995.

LIST OF EXPERIMENT

1. Introduction to Modeling and Simulation Software to Aerodynamic problems.
2. Solution for the one dimensional wave equations using explicit method of Lax Using Finite Difference Method (code development)
3. Solution for the one dimensional Heat Conduction Equation using Explicit Method using Finite Difference Method (Code Development)
4. Generation of the Algebraic Grid (Code Development)
5. Generation of the Elliptic Grids (Code Development)
6. Numerical Simulation of flow over an airfoil using commercial software Packages.
7. Numerical Simulation of supersonic flow over a Wedge using commercial Software packages.
8. Numerical Simulation of flat Plate Boundary Layer using commercial Software packages.
9. Numerical Simulation of laminar flow through pipe using commercial Software packages.
10. Numerical Simulation of flow past cylinder using Commercial Software packages.

AE-804
AIR TRANSPORTATION AND AIRCRAFT MAINTENANCE

UNIT-I INTRODUCTION

Development of air transportation, comparison with other modes of transport – Role of IATA, ICAO – The general aviation industry airline – Factors affecting general aviation, use of aircraft, airport: airline management and organisation – levels of management, functions of management, Principles of organisation planning the organisation –chart, staff departments & line departments

UNIT-II AIRLINE ECONOMICS AND PLANNING

Forecasting – Fleet size, Fleet planning, the aircraft selection process, operating cost, passenger capacity, load factor etc. – Passenger fare and tariffs – Influence of geographical, economic & political factors on routes and route selection.

FLEET PLANNING: The aircraft selection process – Fleet commonality, factors affecting choice of fleet, route selection and Capitol acquisition – Valuation & Depreciation – Budgeting, Cost planning – Aircrew evaluation – Route analysis – Aircraft evaluation.

UNIT-III AIRLINES SCHEDULING

Equipment maintenance, Flight operations and crew scheduling, Ground operations and facility limitations, equipments and types of schedule –hub & spoke scheduling, advantages/ disadvantages & preparing flight plans – Aircraft scheduling in line with aircraft maintenance practices.

UNIT-IV AIRCRAFT RELIABILITY

Aircraft reliability – The maintenance schedule & its determinations – Condition monitoring maintenance – Extended range operations (EROPS) & ETOPS – Ageing aircraft maintenance production.

UNIT-V TECHNOLOGY IN AIRCRAFT MAINTENANCE

Airlines scheduling (with reference to engineering) – Product support and spares –Maintenance sharing – Equipment and tools for aircraft maintenance – Aircraft weight control – Budgetary control. On board maintenance systems – Engine monitoring – Turbine engine oil maintenance – Turbine engine vibration monitoring in aircraft – Life usage monitoring – Current capabilities of NDT – Helicopter maintenance – Future of aircraft maintenance.

TEXT BOOKS

1. FEDRIC J.H., “Airport Management”, 2000.
2. C.H. FRIEND, “Aircraft Maintenance Management”, 2000.

REFERENCES

1. Gene Kropf, “Airline Procedures”.
2. Wilson & Bryon, “Air Transportation”.
3. Philip Locklin D, “Economics of Transportation”.
4. “Indian Aircraft manual” – DGCA Pub.
5. Alexander T Wells, “Air Transportation”, Wadsworth Publishing Company, California, 1993.

LIST OF EXPERIMENT

1. Aircraft “Jacking Up” procedure
2. Aircraft “Leveling” procedure
3. Control System “Rigging check” procedure
4. Aircraft “Symmetry Check” procedure
5. “Flow test” to assess of filter element clogging
6. “Pressure Test” To assess hydraulic External/Internal Leakage
7. “Functional Test” to adjust operating pressure
8. “Pressure Test” procedure on fuel system components
9. “Brake Torque Load Test” on wheel brake units
10. Maintenance and rectification of snags in hydraulic and fuel systems.

AE-805
MAJOR PROJECT

The objective of the project work is to enable the students in convenient groups of not more than 4 members on a project involving theoretical and experimental studies related to the Aeronautical branch of study. Every project work shall have a guide who is the assigned faculty member of the institution. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines. The continuous assessment shall be made as prescribed by the regulation.

AE-807
SEMINAR & GROUP DISCUSSION

Objective of GD and seminar is to improve the mass communication and convincing / understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves. Evaluation will be done by assigned faculty based on group discussion and power point presentation.

AE-806
Energy Conversion Lab

LIST OF EXPERIMENT

- Study of direct and diffused beam solar radiation
- Study of green house effect
- Performance evaluation of solar flat plate collector
- External flow over Ahmed body
- Performance evaluation of solar funnel