JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

II Year B.Tech. AE. II Semester	L	T/P/D	C
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(54040) AERODYNAMICS – I

Tables, plots required to be supplied to candidates for reference during examination:

- *Typical three bladed propeller charts as follows.*
- *1. Propeller geometry:*
- *2, 3, 4, VI/nD vs C_T, C_P, η; 5. C_s vs ç.*

UNIT – I:
REVIEW OF FLUID MECHANICS

Aerodynamics – importance, the flow field, fundamental aerodynamic variables, aerodynamic force & moment coefficients, dimensional analysis, flow similarity, classification of fluid flows. The continuity, momentum and energy equations in integral form and in differential form. Euler's equation. Methods of determination of flow – analytical and numerical methods.

UNIT – II:
INVISCID, INCOMPRESSIBLE FLOW

Angular velocity, vorticity and circulation. Kelvin's theorem. Irrotational flow. The velocity potential. Stream function for two dimensional incompressible flow. Laplace's equation. Boundary conditions at infinity and at the wall. Elementary flows and their combinations, non-lifting flow over a circular cylinder, vortex flow, lifting flow over a cylinder. D'Alembert's paradox. Kutta Joukowski theorem and generation of lift. Non-lifting flows over arbitrary bodies – numerical source panel method. Real flow over a circular cylinder.

UNIT – III:
VISCOUS FLOW AND BOUNDARY LAYERS

Role of viscosity in fluid flow. The Navier-Stokes' equation, boundary layer approximation. Boundary layer thicknesses, growth along a flat surface. Laminar boundary layers. Surface friction drag. Boundary layer separation. Transition. Turbulent boundary layers, turbulence modelling, eddy viscosity and mixing length concepts. The momentum integral equation. Approximate solutions for laminar, turbulent and mixed boundary layers - computational methods. Thermal boundary layer. Reynolds's analogy.

UNIT – IV:

INCOMPRESSIBLE FLOW OVER AIRFOILS

Theoretical solutions of low speed flow over airfoils - the vortex sheet representation. The Kutta condition. Kelvin's circulation theorem and the starting vortex. The thin airfoil theory. The aerodynamic centre. Lifting flows over arbitrary bodies – the vortex panel numerical method. Airfoil design for prescribed lift distribution. Real flow over an airfoil. Effect of boundary layer transition and surface roughness on the aerodynamic forces.

UNIT – V:

INCOMPRESSIBLE FLOW OVER WINGS & BODIES - I

Downwash and induced drag. The vortex filament – Biot-Savart's law, Helmholtz's theorems. The starting, bound and trailing vortices. Prandtl's classical lifting line theory for unswept wings– determination of lift, vortex induced drag. Nonlinear lifting-line, lifting surface and vortex lattice numerical methods.

UNIT VI:

INCOMPRESSIBLE FLOW OVER WINGS AND BODIES - II

The mechanism of lift generation on delta wing in subsonic flow. Leading edge extensions to wings. Three dimensional flow – source, doublet, flow over a sphere. General three dimensional flows – panel techniques. Real flow over a sphere. Asymmetric loads on fuselage at high angles of attack – asymmetric vortex shedding, wake-like flows. Flow field about aircraft at high angles of attack.

UNIT – VII

AERODYNAMIC CHARACTERISTICS OF AIRFOILS AND WINGS

Aerodynamic force and moment coefficients. The drag polar. The lift curve slope, maximum lift coefficient, minimum drag coefficient, lift drag ratio - effect of airfoil and wing geometry parameters, Reynolds' no., boundary layer transition and surface roughness. NACA airfoils, laminar flow airfoils, supercritical airfoils. Aerodynamics of drag reduction and lift augmentation methods - flap systems, leading edge devices, multi-element airfoils, power augmented lift, circulation control, laminar flow control, winglets.

UNIT VIII

PROPELLERS

Geometry of the propeller, Rankine - Froude momentum theory of propulsion, airscrew coefficients, thrust, torque, power coefficients, propulsive efficiency, activity factor, airscrew pitch; geometric pitch, experimental mean pitch, effect of geometric pitch on airscrew performance, blade element theory, the vortex

system of an airscrew, rotational inflow and outflow, performance of a blade element, compressibility effects, use of propeller charts, propeller selection, propeller design.

TEXT BOOKS

1. Aerodynamics for Engineers, fourth edition, Bertin, J.J., Pearson Education, 2002, ISBN: 81-297-0486-2
2. Fundamentals of Aerodynamics, Anderson, Jr., J.D., International edition, McGraw-Hill, 2001, ISBN: 0-07-118146-6.
3. Kuethe, A.M., and Chow, C., Foundations of Aerodynamics, 5th Edn., Wiley, 1998,ISBN: 0-471-12919-4.

REFERENCES

1. Kuchemann, D., The Aerodynamic Design of Aircraft, Pergamon, 1978.
2. Shevell, R.S., Fundamentals of Flight, Indian reprint, Pearson Education, 2004, ISBN: 81-297-0514-1.
3. McCormick, B.W., Aerodynamics, Aeronautics & Flight Mechanics, second edition John Wiley, 1995, ISBN: 0-471-57506-2.

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(54041) AIRCRAFT PRODUCTION TECHNOLOGY

UNIT – I

INTRODUCTION

Classification and comparison (merits and limitations) of manufacturing process, criterion for selection of a process

General principles of various Casting Processes - Sand casting, die-casting, centrifugal casting, investment casting, shell molding types

UNIT – II

WELDING AND BONDING TECHNIQUES

Principles and equipment used in arc welding, gas welding, resistance welding, thermit welding, recent advances in welding technology, Soldering and brazing techniques.

UNIT - III

MACHINING

General Principals (with schematic diagram only) of working and types-lathe, shaper, milling machines, grinding, drilling m/c, CNC machining and general principles.

UNIT - IV

SHEET METAL FORMING

Sheet metal operations-shearing, punching, dropstamp forming, Advanced metal forming (super plastic forming and diffusion bonding). Bend correction for bending in single plane, Automation in bend forming and different operations in bending like stretch forming spinning drawing etc.

UNIT- V

UNCONVENTIONAL MACHINING

Principles (with schematic diagram only) of working and applications of abrasive jet machining, ultrasonic machining, electric discharge machining, electro chemical machining, laser beam/electron beam/plasma arc machining

UNIT-VI

HEAT TREATMENT AND SURFACE FINISHING

Heat treatment of Aluminum alloys, titanium alloys, steels, case hardening,

Initial stresses and the stress alleviation procedures. Corrosion prevention, protective treatment for aluminum alloys, steels, anodizing of titanium alloys, organic coating, and thermal spray coatings. Grinding and Polishing, Burnishing, Lapping.

UNIT - VII

AIRCRAFT ASSEMBLY

Aircraft Tooling Concepts, Jigs, fixtures, stages of assembly, types and equipment for riveted joints, bolted joints (only).

UNIT - VIII

QUALITY CONTROL AND ASSURANCE

Concepts and definitions of quality, reliability, quality circles, zero defect program: international standards, six-sigma quality.

NDT AND OTHER INSPECTION TECHNIQUES

Dye Penetrant Test, X - ray, magnetic particle and ultrasonic testing, Accoustic holography.

TEXTBOOKS:

1. "Air craft production techniques" Keshu S.C, Ganapathy K.K., Interline Publishing House, Banglore-1993
2. "Manufacturing Engineering and Technology" by Kalpakajam – Addison Wesley.

REFERENCES:

1. "Production technology"- R.K. Jain – Khanna Publishers – 2002.
2. "Production technology"-O.P.Khanna and lal. M.Dhanpat rai publications-New Delhi-1997

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II Year B.Tech. AE. II Semester	L	T/P/D	C
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(54042) ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT - I

ELECTRICAL CIRCUITS: Basic definitions, Types of elements, Ohm's Law, Resistive networks,

Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits and Star-delta and

delta-star transformations.

UNIT - II

DC MACHINES : Principle of operation of DC Generator – emf equation - types – DC motor types –

torque equation – applications – three point starter.

UNIT - III

TRANSFORMERS : Principle of operation of single phase transformers – emf equation – losses –

efficiency and regulation

UNIT - IV

AC MACHINES : Principle of operation of alternators – regulation by synchronous impedance method –

Principle of operation of induction motor – slip – torque characteristics – applications.

UNIT - V

INSTRUMENTS : Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments.

UNIT - VI

DIODE AND IT'S CHARACTERISTICS : P-n junction diode, symbol, V-I Characteristics, Diode

Applications, Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems)

UNIT - VII

TRANSISTORS : PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics

and applications

UNIT - VIII

CATHODE RAY OSCILLOSCOPE : Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity,

Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements.

TEXT BOOKS:

1. Essentials of Electrical and Computer Engineering by David V. Kerns, JR. J. David Irwin/Pearson.
2. Principles of Electrical and Electronics Engineering by V.K.Mehta, S.Chand & Co.

REFERENCES:

1. Introduction to Electrical Engineering – M.S Naidu and S. Kamakshaiah, TMH Publ.
2. Basic Electrical Engineering by Kothari and Nagarath, TMH Publications, 2nd Edition.

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(54043) AEROSPACE VEHICLE STRUCTURES – I

UNIT I

REDUNDANT STRUCTURES

Indeterminate structures and order of redundancy , Introduction to redundant analysis, Statically determinate models, Use of free body diagrams to explain compatibility and redundant analysis principles. Matrix methods of redundant analysis utilizing (a) equilibrium equations / compatibility conditions and (b) Singularity method for uniform beams with various boundary and support conditions (props, hinges and fixities) subjected to distributed / discrete loads (including moments).

UNIT II

BEAMS WITH ELASTIC SUPPORTS AND INITIAL CURVATURE:

Direct solution of beams on elastic foundation, Deflection of beams with discrete elastic supports using singularity methods and modeling concepts. Equation of equilibrium for curved beam stress and deflections of a typical curved beam (Bulk Head segments on fuselages).

UNIT III

STABILITY

Stability of Structural systems, Modes of instability of columns. Euler's formula for critical loads of column. Slenderness ratio, Effect of boundary conditions on mode shapes and critical loads. Column with initial curvature, effect of eccentricity. Long, medium and short column ranges. Rankine and Jhonson's formulae. Eigen values and Eigen modes. Effect of intermediate supports. Concept of beam column.

UNIT IV

INTRODUCTION TO THEORY OF ELASTICITY

Equilibrium and Compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain and generalized plane strain cases Airy's stress function. Simple problems in plane stress / plane strain using Cartesian and polar coordinates. Super position techniques Examples include

(a) panels subjected to a generalized plane strain Biaxial loading (b) Uniform/ Linearly varying edge loads on elastic half plane (c) Thick cylindrical shells.

UNIT V

Stresses and Strains on arbitrary planes and transformations. Concept of principal planes, stress and Strains, Construction of Mohr's circle, Failure mechanism and fracture modes.

UNIT - VI

ENERGY PRINCIPLES AND METHODS

Introduction to energy principles and methods. Principles of Virtual Displacement and Principle of Virtual Force Castigliano's theorems, Maxwell's reciprocal theorem and Unit load method. Direct application of energy principles to beams and trusses.

UNIT – VII

The displacement method (Rayleigh Ritz method). Admissible functions energy and work expressions for redundant analysis of 1-D structures (rods, shafts and beams). Various 1D Structures subjected to Complex loading. Stresses of errors and convergence.

UNIT - VIII

SHEAR FLOW IN CLOSED SECTIONS

Bredt-Batho formula. Single and multi-cell closed box structures. Semi monocoque and moncoque structures. Approximate method for box beams. Shear flow in single and multicell monocoque and semi monocoque box beams subject to torsion.

TEXTBOOKS:

1. Timoshenko S. P. and J.N. Goodier, "Theory of Elasticity McGraw Hill Book Co.
2. Megson THG, "Aircraft Structures for Engineering students", Edward Arnold Publication.
3. David J. Peery" Aircraft Structures" McGRAW-HILL Book Company.

REFRENCES

1. Shames I. H. and Dym C. L, Energy and finite element methods structural analysis McGraw Hill

2. B.C.Punmia, "Theory of Structures", Laxmi Publication.

3. S.Ramamrutham, R.Narayanan, "Theory of Structures" – Dhanpat Rai Publishing Co, 2003.

4. Argyris J. H. and Kelsey S. Energy theorems and structural analysis, Butterworths Scientific Publications.1960

5. Donaldson, B. K. Analysis of Aircraft Structues-An introduction "McGraw Hill.

6. David H. Allen, and Walter E. Haiseler Introduction to Aeronautical Stuructre Analysis, John Wiley & Son, 1985.

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(54044) INTRODUCTION TO SPACE TECHNOLOGY

UNIT-I

INTRODUCTION

Space Mission-Types-Space Environment-Launch Vehicle Selection

UNIT II

FUNDAMENTALS OF ROCKET PROPULSION

Introduction to rocket propulsion-fundamentals of solid propellant rockets-Fundamentals of liquid propellant rockets-Rocket equation

UNIT-III

ASCENT FLIGHT MECHANICS OF ROCKETS AND MISSILES

Two-dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two stage Multi-stage Rockets-Trade-off Ratios-Single Stage to Orbit- Sounding Rocket-Aerospace Plane-Gravity Turn Trajectories-Impact point calculation-Injection conditions-Flight dispersions

UNIT-IV

ATMOSPHERIC REENTRY

Introduction-Steep Ballistic Reentry-Ballistic Orbital Reentry-Skip Reentry-"Double-

Dip" Reentry - Aero-braking - Lifting Body Reentry

UNIT-V

FUNDAMENTALS OF ORBITAL MECHANICS

Two-body motion-Circular, elliptic, hyperbolic, and parabolic orbits-Basic Orbital Elements-Ground Trace

UNIT-VI

ORBITAL MANEUVERS

In-Plane Orbit changes-Hohmann Transfer-Bielliptical Transfer-Plane Changes- Combined Maneuvers-Propulsion for Maneuvers

UNIT-VII

SATELLITE ATTITUDE DYNAMICS

Torque free Axi-symmetric rigid body-Attitude Control for Spinning Spacecraft - Attitude Control for Non-spinning Spacecraft - The Yo-Yo Mechanism – Gravity – Gradient Satellite-Dual Spin Spacecraft-Attitude Determination

UNIT-VIII

SPACE MISSION OPERATIONS

Supporting Ground System Architecture and Team Interfaces - Mission phases and Core operations- Team Responsibilities – Mission Diversity – Standard Operations Practices

TEXT BOOKS

1. "Spaceflight Dynamics", W.E. Wiesel, McGraw-Hill, 1997
2. "Rocket Propulsion and Space flight dynamics", Cornelisse, Schoyer HFR, and Wakker KF, Pitman, 1984
3. Vincet L. Pisacane, " Fundamentals of Space Systems" , Oxford University Press, 2005.

REFERENCES

1. "Understanding Space: An Introduction to Astronautics", J.Sellers, McGraw- Hill, 2000
2. "Introduction to Space Flight", Francis J Hale, Prentice-Hall, 1994
3. "Spacecraft Mission Design", Charles D.Brown, AIAA Education Series, 1998
4. "Spacecraft Mission Design", Charles D.Brown, AIAA Education Series, 1998
5. "Elements of Space Technology for Aerospace Engineers", Meyer Rudolph X, Academic Press, 1999

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(54045) FLIGHT MECHANICS – I

UNIT – I:

INTRODUCTION TO AIRCRAFT PERFORMANCE

The role and design mission of an aircraft. Specification of the performance requirements and mission profile. Importance of performance analysis, estimation and measurement and operational safety and economy. Scheduled performance and operational performance of aircraft. The Standard Atmosphere. Off-standard and design atmosphere. Measurement of air data. Air data computers.

UNIT – II:

THE FORCE SYSTEM OF THE AIRCRAFT

Equations of motion for performance - the aircraft force system. The lift force, side force, the drag force. Total airplane drag - drag estimation, drag reduction methods.

The propulsive forces - the thrust producing engines, power producing engines, variation of thrust, propulsive power and specific fuel consumption with altitude and flight speed. The minimum drag speed, minimum power speed. Aerodynamic relationships for a parabolic drag polar.

UNIT – III:

CRUISE PERFORMANCE

The maximum and minimum speeds in level flight, range and endurance of aircraft with thrust producing engines, and with power producing engines. Cruise techniques: constant angle of attack - constant Mach number, constant angle of attack - constant altitude, constant altitude - constant Mach number methods, comparison of performance. The effect of alternative fuel flow laws, the effect of weight, altitude and temperature on cruise performance. Cruise performance of aircraft with mixed power-plants.

UNIT – IV:

CLIMB AND DESCENT PERFORMANCE

Importance of climb and descent performance, safety considerations. Climb

and descent techniques, generalised performance analysis for thrust producing, power producing and mixed power-plants, maximum climb gradient, climb rate. Energy height and specific excess power, energy methods for optimal climbs – minimum time climbs, minimum fuel climbs. Measurement of climb performance. Descent performance in aircraft operations. Effect of wind on climb and descent performance.

UNIT – V:

AIRCRAFT MANOEUVRE PERFORMANCE

The general equations of accelerated motion of aircraft, the manoeuvre envelope, significance. Longitudinal aircraft manoeuvres, the pull-up manoeuvre, Lateral manoeuvres, turn performance, turn rates, turn radius, limiting factors for turning performance, instantaneous turns and sustained turns, specific excess power, the energy turns. The manoeuvre boundaries. Military aircraft manoeuvre performance. Transport aircraft manoeuvre performance.

UNIT – VI:

AIRCRAFT PERFORMANCE MEASUREMENT AND DATA HANDLING

Purpose of performance measurement in flight. Flight testing. Principal performance variables – weight, altitude and ambient temperature (WAT). Parametric performance data analysis. Dimensional analysis. Measurement of cruise performance, climb, take-off and landing. Performance data reduction. The equivalent weight method. Corrections to cruise, climb, take-off and landing performance for weight and temperature.

UNIT – VII:

SAFETY REQUIREMENTS – TAKE-OFF AND LANDING - PERFORMANCE PLANNING

Flight safety criteria. Performance classification of civil aircraft. Flight planning - performance planning and fuel planning.

Estimation of take-off distances. The effect on the take-off distance, of weight, wind, runway conditions, ground effect. Take-off performance safety factors. Estimation of landing distances - the discontinued landing, baulked landing, air safety procedures and requirements on performance.

Fuel planning, fuel requirements, trip fuel, environmental effects, reserves, tankering.

UNIT – VIII:

THE APPLICATION OF PERFORMANCE DATA

The performance summary for fleet selection - the block performance, payload – range diagram. route analysis and optimisation. Operational analysis procedure.

Operational performance data for flight planning– take-off field performance, runway correction chart, aircraft datum performance (WAT) chart, determination of the maximum take-off weight.

TEXT BOOKS

1. Eshelby, M.E., Aircraft Performance: Theory and Practice, AIAA Education Series, AIAA, 2000, ISBN: 1-56347-398-4.
2. Brandt, S.A. et. al., Introduction to Aeronautics: A Design Perspective, Second Edition, AIAA Education Series, AIAA, 2004, ISBN: 1-56347-701-7
3. Anderson, J.D. Jr., Aircraft Performance and Design, international edition, McGraw-Hill, 1999, ISBN: 0-07-001971-1.

REFERENCES

1. Dole, C.E., Flight Theory and Aerodynamics: a Practical Guide for Operational Safety, Wiley Interscience, 1981, ISBN: 0-471-09152-9.
2. McCormick, B.W, Aerodynamics, Aeronautics and Flight Mechanics, second edition, John Wiley, 1995, ISBN: 0-471-57506-2.
3. Shevel, R.S., Fundamentals of Flight, second edition, Pearson Education, 1989, ISBN: 81-297-0514-1.
4. Raymer, D.P., Aircraft Design: A Conceptual Approach, third edition, AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0
5. Yechout, T.R. et al., Introduction to Aircraft Flight Mechanics, AIAA Education Series, AIAA, 2003, ISBN: 1-56347-577-4.

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II Year B.Tech. AE. II Semester	**L**	**T/P/D**	**C**
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(54632) AIRCRAFT PRODUCTION TECHNOLOGY LAB

Basic Exercises in Lathe, Shaper, Milling, Slotting, EDM, CNC and Grinding machines welding equipment and metallurgy equipment comprising Microscopes polishing disc grinders as under.

PRODUCTION LAB

1. Plain Turning, Taper turning, Facing, Knurling, Thread Cutting.
2. Drilling, boring, counter boring, counter sinking
3. Shaping and planning of square blocks, V-ways and Dovetail ways
4. Plain Milling
5. Gear Milling
6. Cylindrical Grinding / Surface Grinding
7. Simple exercises in EDM
8. Sheet metal joining by rivets, Soldering and brazing.
9. Simple exercises on CNC machines and Programme generation.
10. Simple exercises in Solid State Welding, Gas Welding and Arc Welding.
11. Metal joining Techniques (Brazing and Soldering).
12. Aircraft wood gluing practice
13. Study of properties of sandwich structures

Reference:

1. "Air craft production techniques" Keshu S.C, Ganapathy K.K., Interline Publishing House, Banglore-1993
2. "Manufacturing Engineering and Technology" by Kalpakajam – Addison Wesley.

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II Year B.Tech. AE. II Semester	**L**	**T/P/D**	**C**
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(54633) ELECTRICAL AND ELECTRONICS ENGINEERING LAB

SECTION A: ELECTRICAL ENGINEERING:

The following experiments are required to be conducted as compulsory experiments :

1. Swinburne's test on D.C. Shunt machine. (Predetermination of efficiency of a given D.C. Shunt machine working as motor and generator).
2. OC and SC tests on single phase transformer (Predetermination of efficiecy and regulation at given power factors)
3. Brake test on 3-phase Induction motor (Determination of performance characteristics)
4. Regulation of alternator by Synchronous impedance method.

In addition to the above four experiments, any one of the experiments from the following list is required to be conducted :

5. Speed control of D.C. Shunt motor by

   a) Armature Voltage control b) Field flux control method
6. Brake test on D.C Shunt Motor

SECTION B: ELECTRONICS ENGINEERING :

1. Transistor CE Characteristics (Input and Output)
2. Full wave Rectifier with and without filters.
3. CE Amplifiers.
4. RC Phase Shift Oscillator
5. Class A Power Amplifier
6. Micro Processor