BE-401 (AE)
ENGINEERING MATHEMATICS – II

Unit 1

Concept of Probability : Probability Mass function, Probability density function. Discrete
Distribution: Binomial, Poisson's, Continuous Distribution: Normal Distribution, Exponential
Distribution,Testing of Hypothesis |:Students t-test, Fisher's z-test, Chi-Square Method.

Unit 2

Functions of complex variables : Analytic functions, Harmonic Conjugate, Cauchy-Riemann
Equations, Line Integral, Cauchy's Theorem, Cauchy's Integral Formula, Singular Points, Poles
& Residues, Residue Theorem , Application of Residues theorem for evaluation of real integrals.

Unit 3

Introduction of Fourier series: Fourier series for Discontinuous functions, Fourier series
for even and odd function, Half range series Fourier Transform: Definition and properties of Fourier. Fourier transform, Sine and Cosine transform.

Unit 4

Laplace Transform: Introduction of Laplace Transform, Laplace Transform of elementary functions,properties of Laplace Transform, Change of scale property, second shifting property, Laplace transformof the derivative, Inverse Laplace transform & its properties, Convolution theorem, Applications of L.T. to solve the ordinary differential equations.

Unit 5

Vector Calculus: Differentiation of vectors, scalar and vector point function, geometrical meaning ofGradient, unit normal vector and directional derivative, physical interpretation of divergence and Curl. Line integral, surface integral and volume integral, Green's, Stoke's and Gauss divergence theorem.

References:

1)Higher Engineering Mathematics by B.S. Grewal, Khanna Publication.
2)Engineering mathematics volume II & III by D.K. Jain
3)Engineering mathematics volume II by D.C.Agrawal

AE-402
AERODYNAMICS - I

UNIT I

TWO DIMENSIONAL FLOWS

Basic flows – Source, Sink, Free and Forced vortex, uniform parallel flow.Their combinations,Pressureand velocity distributions on bodies with and without circulation in ideal and real fluid flows.Kutta Joukowski's theorem.

UNIT II

CONFORMAL TRANSFORMATION

Joukowski transformation and its application to fluid flow problems, Kutta condition, Blasius theorem.

UNIT III

AIRFOIL AND WING THEORY

Circulation and the generation of Lift, Bound vortex and starting vortex, Kutta condition, Glauert's thin airfoil, theory, thin symmetric flat plate airfoil, Circular arc foil, general thin airfoil section, the flapped airfoil. Determination of mean camber line shapes for uniform and linear distribution of circulation, flow about multi element airfoils.Vortexline,Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations

UNIT IV

VISCOUS FLOW

Newton's law of viscosity, Boundary Layer Concept and properties, derivation of Prandtl's Boundary Layer equations, Blasius solution, Karman's Integral equation. Navier-Stokes equation, Turbulent Boundary Layer over a plate, skin friction drag, Boundary Layer control.

UNIT V

Computational fluid dynamics :- Basic equation of fluid dynamics, physical classification of fluid dynamics problem, well proposed problems, initial value methods, finite difference methods, integration method, ɵ method , finite element method (Galerkin and collocation) . panel method for compressible subsonic and super sonic flow.

TEXT BOOKS

1. Anderson, J.D., *"Fundamentals of Aerodynamics"*, McGraw-Hill Book Co., New York, 1985.

REFERENCES

1. Houghton, E.L., and Carruthers, N.B., *"Aerodynamics for Engineering students"*, Edward Arnold Publishers Ltd., London, 1989.
2. Milne Thomson, L.H., "*Theoretical aerodynamics*", Macmillan, 1985.
3. Clancey, L.J., "*Aerodynamics"*, Pitman, 1986

AERODYNAMICS LABORATORY

To study experimentally the aerodynamic forces on different bodies at low speeds.

LIST OF EXPERIMENTS

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoil.
4. Pressure distribution over cambered airfoil& thin airfoils
5. Force measurement using wind tunnel balance.
6. Flow over a flat plate at different angles of incidence
7. Flow visualization studies in low speed flow over cylinders
8. Flow visualization studies in low speed flow over airfoil with different angle of incidence
9. Calibration of supersonic wind tunnel.
10. Supersonic flow visualization with Schlieren system.

AE-403
PROPULSION - I

UNIT I

AIRCRAFT PISTON ENGINES

The internal combustion engine process, brief historical sketch, spark ignition and compression ignition, engines, 4-stroke and 2-stroke engines. Combustion processes various types of arrangements for multi cylinder aircraft engines. Intake and Exhaust manifolds. IHP, BHP and Engine performance, Effect of altitude and speed, power required and power available. Super charging, types of super chargers.

UNIT II

PROPELLERS

Ideal momentum theory, blade element theory, activity factor, airscrew coefficients, numerical problems on the performance of propellers, selection of propellers, fixed, variable and constant speed propellers, material for propellers, momentum theory applied to helicopter rotor.

UNIT III

ELEMENTS OF HEAT TRANSFER

a) Conduction: Heat Transfer process, Heat conduction, Thermal conductivity, General equation of heat conduction in 1-D and 2-D.
b) Convection and Radiation Heat Transfer: Convection process, free convection heat transfer from vertical flat plate, planes, cylinder and sphere, free convection.
c) Thermal Radiation and Emissive power. The Plank distributive law, Radiation properties

UNIT IV

FUNDAMENTALS OF GAS TURBINE ENGINES

Illustration of working of gas turbine engine–Thrust equation–Factors affecting thrust. Effect ofpressure, velocity and temperature changes of air entering compressor,After burner arrangements for thrust augmentation..High and Low by pass ratio, turbo-fan engines, dual shaft gas turbine engines, its merits over single shaft engines.Characteristics of turboprop, turbofan and turbojet – Performance characteristics

UNIT V

COMPONENTS OF GAS TURBUNE ENGINE

Centrifugal and axial type of compressors, their compressive action, relative merits in operations. Diffuser vane design considerations .Classification of combustion chambers, simplex and duplex burners, expansion process, turbine and its action, constructional details of turbine ,compressor and turbine efficiencies, subsonic and supersonic engine intake and exhaust nozzles .Materials for different components.

TEXT BOOKS

1. Heat transfer: J.P.Holman, McGraw Hill.
2. I.C.Engines: V Ganesan**,** McGraw Hill.
3. Gas Turbine Theory: Cohen, Rogers and Saravanamuttu, Pearson Education .
4. Heat transfer: B.Gebhart,McGraw Hill.

5. Elements of Gas Turbine Propulsion: J.D. Mattingly, McGraw Hill.

REFERENCES

1. Cohen, H. Rogers, G.F.C. and Saravanamuttoo, H.I.H. "*Gas Turbine Theory"*, Longman, 1919.
2. Oates, G.C., "*Aero thermodynamics of Aircraft Engine Components*", AIAA Education Series, New York,1915.
3. "Rolls Royce Jet Engine" – Third Edition – 1913.
4. Mathur, M.L. and Sharma, R.P., *"Gas Turbine, Jet and Rocket Propulsion"*, Standard Publishers &Distributors, Delhi, 1999.
5. I.C.Engines: L.C.Litchy**,** McGraw Hill

LIST OF EXPERIMENTS

1. Study of an aircraft piston engine - assembly of sub systems.
2. Study of an aircraft piston engine - various components, their functions and operating principles.
3. Study of an aircraft jet engine - assembly of sub systems.
4. Study of an aircraft jet engine - various components, their functions and operating principles.
5. Study of forced convective heat transfer.
6. Study of free convective heat transfer.

AE-404

Microprocessor, Microcontroller & Embedded System Design

Unit 1 : Introduction to microprocessors

Architecture, block diagram of 8086, details of subblocks such as EU, BIU; memory segmentation and physical address computations, program relocation, addressing modes, instruction formats, pin diagram and description of various signals.

Unit II : Instruction Sets

Instruction execution timing, assembler instruction format, data transfer instructions, arithmetic instructions, branch instructions, looping instructions, NOP and HLT instructions, flag manipulation instructions, logical instructions, shift and rotate instructions, directives and operators, programming examples.

Unit III : Introduction of Microcontroller:

Different types of microcontrollers: Embedded, microcontrollers, External memory microcontrollers; Processor Architectures: Harvard V/S Princeton , CISC V/S RISC; microcontrollers memory types; microcontrollers features : clocking, i/o pins, interrupts, timers, peripherals. Introduction to PIC microcontrollers, Architecture and pipelining, program memory considerations, Addressing modes, CPU registers, Instruction set, simple operations.

Unit IV : Microcontroller 8051

Architecture, Pin Diagram, I/O Ports, Internal RAM and Registers, Interrupts, Addressing Modes, Memory Organization and External Addressing, Instruction Set, Assembly Language Programming, Real Time Applications of Microcontroller- Interfacing with LCD, ADC, DAC, Stepper Motor, Key Board and Sensors.

Unit V : Embedded System

Introduction, Classification, Processors, Hardware Units, Software Embedded into System, Applications and Products of Embedded Systems, Structural Units in Processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor Memory and I/O Devices, Case Study of an Embedded System for a Smart Card.

References

1. Muhammad Ali Mazidi, The 8051 Microcontroller, Pearson Education.
2. Kenneth J Ayala, The 8051 Microcontroller, Penram International
3. Ramesh S Goankar, Microprocessors and Architecture:
4. John Uffenbeck, Microcomputers and Microprocessors, PHI
5. V. Deshmukh: Microcontroller (Theory and Application), TMH.
6. D. V. Hall: Microprocessors and Interfacing, TMH
7. Predko, Programming and Customizing the 8051 Microcontroller, TMH.

AE-405

Fluid Mechanics

Unit-I

Review of Fluid Properties: Engineering units of measurement, mass, density, specific weight, volume and gravity, surface tension, capillarity, viscosity, bulk modulus of elasticity, pressure and vapor pressure. Fluid Static's : Pressure at a point, pressure variation in static fluid, Absolute and gauge pressure, manometers, Forces on plane and curved surfaces (Problems on gravity dams and Tainter gates); buoyant force, Stability of floating and submerged bodies, Relative equilibrium.

Unit-II

FLIUD KINEMATICS AND FLUID DYNAMICS :

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms).Equation of streamline – stream function - velocity potential function – circulation.

Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter,Pitot tube - dimensional analysis - Buckingham's π theorem-applications - similarity laws and models.

Unit-III

Introduction to Viscous Flows: Introduction to laminar & turbulent flow, Reynolds experiment & Reynoldsnumber, relation between shear & pressure gradient, laminar flow through circular pipes,laminar flow between parallel plates, laminar flow through porous media, Stokes law, lubrication principles.Transition from laminar to turbulent flow.Turbulent flow in circular pipe.

Unit - IV

Elements of Compressible Flows: Compressible flow properties, total Enthalpy, total temperature, temperature and pressure ratio as function of mach number. Mass flow parameter (MFP), velocity - area variation, 2-D small amplitude wave propagation,. Description of flow regimes,

Unit –V

HYDRAULIC TURBINES AND HYDRAULIC PUMPS:

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine – Kaplan turbine - working principles.

Pumps: definition and classifications - Centrifugal pump: Classifications, working principles.

References: -

1. Modi& Seth; Fluid Mechanics; Standard Book House, Delhi
2. Streeter VL, Wylie EB, Bedford KW; Fluid Mechanics; TMH
3. Som and Biswas; Fluid Mechnics and machinery; TMH
4. Cengal; Fluid Mechanics; TMH
5. White ; Fluid Mechanics ; TMH
6. Gupta; Fluid Mechanics; Pearson
7. JNIK DAKE; Essential of EnggHyd; Afrikan Network &ScInstt. (ANSTI)
8. R Mohanty; Fluid Mechanics; PHI
9. S W Yuan, Foundations of Fluid Mechanics, Prentice Hall

List of Experiments (Pl. expand it)

1. To determine the local point pressure with the help of pitot tube.
2. To find out the terminal velocity of a spherical body in water.
3. Calibration of Orifice meter and Venturi meter
4. Determination of Cc, Cv, Cd of Orifices
5. Calibration of Nozzle meter and Mouth Piece
6. Reynolds experiment for demonstration of stream lines & turbulent flow
7. Determination of meta-centric height
8. Determination of Friction Factor of a pipe
9. To study the characteristics of a centrifugal pump.
10. Verification of Impulse momentum principle.