RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Aircraft Maintenance Engineering, IV Semester

Subjec **AF 401 - NUMERICAL METHODS**

GOAL

To create the awareness and comprehensive knowledge in numerical solutions.

OBJECTIVES

The course should enable the students to:

1) Learn the techniques of solving the algebraic and transcendental equations.
2) Learn to interpolate using Newton's forward and backward difference formulae for equal and unequal intervals
3) Understand the use of numerical differentiation and understands to find the approximate area using numerical integration.
4) Understand solving numerically the initial value problems for ordinary differential equations using single step and multi step method.
5) Learn the methods of solving second order partial differential equations numerically and use it to solve initial and boundary value problems for partial differential equations.

OUTCOME

The students should be able to:

1) Find out the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations by direct and indirect methods.
2) Solve problems where huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.
3) Use the numerical differentiation and integration when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
4) Solve engineering problems which are characterized in the form of nonlinear ordinary differential equations, since many physical laws are couched in terms of rate of change of oneindependent variable
5) Solve the initial and boundary value problems related heat flow, both one and two dimensional and vibration problems. Understands the numerical techniques of solving the partial differential equation in engineering applications.

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

Linear interpolation methods (method of false position) - Newton's method - Statement of Fixed Point Theorem - Fixed point iteration: x=g(x) method. Solution of linear algebraic system of equations - Direct methods - Gauss-Jordon method and Crout's method - Iterative method: Gauss-Seidel method.

UNIT II INTERPOLATION AND APPROXIMATION

Interpolation - equal intervals - Newton's forward and backward difference formulae - problems. Interpolation-unequal intervals - Newton's divided difference formula - Lagrange's and inverse interpolation-problems.

UNIT III NUMERICAL DIFFERENTIATIONAND INTEGRATION

Numerical differentiation - Newton's forward and backward difference - Divided differences and finite differences - Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules. Two and Three point Gaussian quadrature formulae - Double integrals using trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

Single step methods: Taylor series method - first order-second order and simultaneous - Euler and Modified Euler methods. Fourth orderRunge - Kutta method for solving first and second order equations - Multi-step methods: Milne's and Adam's predictor and corrector methods.

UNIT V INITIAL AND BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS

Finite difference solution of second order ordinary differential equation - classification of partial differential equations - Finite difference solution of two dimensional heat flow equations Laplace and Poisson equations. One dimensional heat equation by explicit and implicit methods - One dimensional wave equation

TEXT BOOKS

1. Kandasamy P, Thilagavathy K, Gunavathy K, "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003.
2. Chandrasekaran A. and Beena James, "Numerical Methods", Dhanam publications, Chennai, 2011.

REFERENCES

1. Burden R.L, and Faires T.D, "Numerical Analysis", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.
2. Gerald C.F, Wheatley P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
3. Balagurusamy E, "Numerical Methods", Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.

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New Scheme Based On AICTE Flexible Curricula

Aircraft Maintenance Engineering, IV Semester

AF 402-AIRCRAFT SYSTEMS AND INSTRUMENTS

GOAL

To make the student to understand the principle and working of aircraft systems and Instruments.

OBJECTIVES

The course should enable the students to :

1. Know the various types of Airplanes control systems, its components & its applications.
2. Know the working principle of Autopilot system, ILS & communication system.
3. Understand the purpose of hydraulic system & its component requirement in a modern aircraft.
4. Study of piston and gas turbine engine system and the various components of engines, its material requirements.
5. Know the various auxiliary system used in the modern Jet aircraft & its purpose.
6. Study the various instruments used in a modern aircraft and its purpose.

OUTCOME

The students should be able to :

1. Understand the working principle of modern control system & its advantages.
2. Describe the working principle of communication & navigation system.
3. Draw a schematic diagram of a hydraulic system for a modern aircraft and explain its function in detail.
4. Describe the various systems of piston & gas turbine engines and the purpose of each system.
5. Describe the working principle of air-conditioning system & Fire protection system.
6. Understand the working principle of aircraft instruments and engine instruments in detail.

UNIT I AIRPLANE CONTROL SYSTEMS

Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems - Engine control systems - Push pull rod system, flexible push pull rod system - Components - Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, Communication and Navigation systems Instrument landing systems, VOR - CCV case studies.

UNIT II AIRCRAFT SYSTEMS

Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers - Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system - Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification - Shock absorbers - Retractive mechanism.

UNIT III ENGINE SYSTEMS

Fuel systems for Piston and jet engines, - Components of multi engines. lubricating systems for piston and jet engines - Starting and Ignition systems - Typical examples for piston and jet engines.

UNIT IV AUXILLIARY SYSTEM

Basic Air cycle systems - Vapour Cycle systems, Boost-Strap air cycle system - Evaporative vapour cycle systems - Evaporative air cycle systems - Oxygen systems - Fire protection systems, De-icing and anti icing systems.

UNIT V AIRCRAFT INSTRUMENTS

Flight Instruments and Navigation Instruments - Gyroscope - Accelerometers, Air speed Indicators - TAS, EAS- Mach Meters - Altimeters - Principles and operation - Study of various types of engine instruments - Tachometers - Temperature gauges - Pressure gauges - Operation and Principles.

TEXT BOOKS

1. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair", McGraw-Hill, 1993.
2. "General Hand Books of Airframe and Powerplant Mechanics", U.S. Dept. of Transportation, Federal Aviation Administation, The English Book Store, New Delhi1995.

REFERENCES

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants", McGraw-Hill, 1993.
2. Pallet, E.H.J., "Aircraft Instruments & Principles", Pitman & Co., 1993.
3. Treager, S., "Gas Turbine Technology", McGraw-Hill, 1997.

Topics for the laboratory :

1. Measurement of low resistance using Kelvin's Double bridge
2. Measurement of medium resistance using Wheatstone's bridge
3. Measurement of high resistance by loss of charge method
4. Measurement of Insulation resistance using Megger
5. Measurement of earth resistance by fall of potential method and verification by using earth tester
6. Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method
7. Calibration of a dynamometer type of wattmeter with respect to a standard/Sub Standard wattmeter
8. Calibration of single phase digital/ Electronic type energy meter.
9. Calibration of a dynamometer type of wattmeter by Phantom Loading method.
10. Measurements using Instrument Transformers.
11. Study of various types of Indicating Instruments.
12. Measurement of Power in three phase circuit by one, two & three wattmeters.

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Aircraft Maintenance Engineering, IV Semester

Subject code – AF 403 - MECHANICS OF MACHINES

GOAL –

To expose the students the different mechanisms, their method of working, Forces involved and consequent vibration during working.

OBJECTIVE

The subject should enable the student to:

1. The Kinematic analysis of simple mechanisms and its velocity and accelerations.
2. Know the various belt and rope drives and friction in screw and nut.
3. Know the Gear and cam profile and geometry.
4. Study the Static and dynamic balancing of the various masses
5. Study the vibrations of single degree of freedom systems and Vibration isolation and absorption

OUTCOME

The students should be able to :

1. Understand the various mechanisms and its degree of freedom
2. Learn to find out the effect of centrifugal and initial tension in both drives and Condition for maximum power transmission.
3. Learn to determine the speed and torque of the various types of gear geometry and also the follower motions of cam profile.
4. Understand the concept of balancing in rotating mass and Balancing of radial V engine (reciprocating mass).
5. Understand the Free, forced and damped vibrations and its force transmitted to supports

UNIT I MECHANISMS

Machine Structure - Kinematic link, pair and chain - Grueblers criteria - Constrained motion - Degrees of freedom - Slider crank and crank rocker mechanisms - Inversions - Applications - Kinematic analysis of simple mechanisms - Determination of velocity and acceleration.

UNIT II FRICTION

Friction in screw and nut - Pivot and collar - Thrust bearing - Plate and disc clutches - Belt (flat and V) and rope drives. Ratio of tensions - Effect of centrifugal and initial tension - Condition for maximum power transmission - Open and crossed belt drive.

UNIT III GEARING AND CAMS

Gear profile and geometry - Nomenclature of spur and helical gears - Gear trains: Simple, compound gear trains and epicylic gear trains - Determination of speed and torque - Cams - Types of cams - Design of profiles - Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions

UNIT IV BALANCING

Static and dynamic balancing - Single and several masses in different planes -Balancing of reciprocating masses- primary balancing and concepts of secondary balancing - Single and multi cylinder engines (Inline) - Balancing of radial V engine - direct and reverse crank method

UNIT V VIBRATION

Free, forced and damped vibrations of single degree of freedom systems - Force transmitted to supports - Vibration isolation - Vibration absorption - Torsional vibration of shaft - Single and multi rotor systems - Geared shafts - Critical speed of shaft.

TEXT BOOKS

1. Rattan.S.S, "Theory of Machines", Tata McGraw-Hill Publishing Co, New Delhi, 2004.
2. Ballaney.P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

REFERENCES

1. Rao, J.S and Dukkipati, R.V, "Mechanism and Machine Theory", Second Edition, Wiley Eastern Ltd., 1992.
2. Malhotra, D.R and Gupta, H.C., "The Theory of Machines", SatyaPrakasam, Tech. India Publications, 1989.
3. Gosh, A. and Mallick, A.K., "Theory of Machines and Mechanisms", Affiliated East West Press, 1989.
4. Shigley, J.E. and Uicker, J.J., "Theory of Machines and Mechanisms", McGraw-Hill, 1980.
5. Burton Paul, "Kinematics and Dynamic of Planer Machinery", Prentice Hall

LIST OF EXPERIMENT

1. Diagrams of cam and followers for different applications
2. Gears and gear trains transmission diagrams, analytical and graphical applications
3. To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
4. To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil.
5. Study of various types of Cams and followers and drawing the cam profile with the help of test kit.
6. Study of various first order vibration systems.
7. To study working of friction clutches using models

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AF 404 - AIRCRAFT STRUCTURES - I

GOAL

Analysis and design simple a/c structural components

OBJECTIVES

The course should enable the students to :

1. Understand various structural elements
2. Understand statically determinate and indeterminate structural analysis.
3. Understand various energy method
4. Able to understand columns with various end condition.
5. Understand various failure theories.

OUTCOME

The students should be able to:

1. Analysis structural elements in aircraft.
2. Solve three moment equation and moment distribution.
3. To make simplified analysis of a/c structures & apply energy methods.
4. Understand and solve the column problems.
5. Apply failure theories for various loading conditions.

UNIT I STATICALLY DETERMINATE STRUCTURES

Analysis of plane truss - Method of joints - 3 D Truss - Plane frames

UNIT II STATICALLYINDETERMINATE STRUCTURES

Composite beam - Clapeyron's Three Moment Equation - Moment Distribution Method.

UNIT III ENERGYMETHODS

Strain Energy due to axial, bending and Torsional loads - Castigliano's theorem - Maxwell's Reciprocal theorem, Unit load method - application to beams, trusses, frames, rings, etc.

UNIT IV COLUMNS

Columns with various end conditions - Euler's Column curve - Rankine's formula - Column with initial curvature - Eccentric loading - South well plot - Beam column.

UNIT V FAILURE THEORY

Maximum Stress theory - Maximum Strain Theory - Maximum Shear Stress Theory - Distortion Theory - Maximum Strain energy theory - Application to aircraft Structural problems.

TEXT BOOK

1. Donaldson, B.K., "Analysis of Aircraft Structures - An Introduction", McGraw-Hill, 1993.

REFERENCE

1. Timoshenko, S., "Strength of Materials", Vol. I and II, Princeton D. Von Nostrand Co, 1990.
2. FAA 15A.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of steel using mechanical extensometers.
2. Determination of Young's modulus of aluminum using electrical extensometers
3. Deflection of beams with various end conditions.
4. Verification of Maxwell's Reciprocal theorem & principle of superposition
5. Column - Testing and South - well's plot.
6. Shear centre location for open sections and closed saections
7. Unsymmetrical bending of beams
8. Stresses in circular discs and beams using photoelastic techniques
9. Vibrations of beams
10. Wagner beam - Tension field beam

Subject code – AF 405-
AERODYNAMICS - I

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AF 405 - Aerodynamics-I

GOLE –

To study aerodynamic concepts and understanding motion of air around an object enables the calculation of forces and moments acting on the object.

OBJECTIVES

The course should enable the students to :

1) Understand the fluid mechanics concepts for advanced applications
2) Study two dimensional flows in aerodynamics
3) Integrate the mathematics with aerodynamics
4) Study ideal flows over wings
5) Study real time viscous flows

OUTCOME

The students should be able to :

1) Should be able to apply fluid mechanics concepts.
2) Should be able to model flow over wing.
3) Should be able to differentiate between ideal and real flows
4) Develops mathematical modelling ability.
5) Understand the real time viscous flow and Boundary Layer behaviour.

UNIT I REVIEW OF BASIC FLUID MECHANICS

Continuity, momentum and energy equations.

UNIT II TWO DIMENSIONAL FLOWS

Basic flows - Source, Sink, Free and Forced vortex, uniform parallel flow. Their combinations,Pressure and velocity distributions on bodies with and without circulation in ideal and real fluidflows. KuttaJoukowski's theorem.

UNIT III CONFORMAL TRANSFORMATION

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

UNIT IV AIRFOIL AND WING THEORY

Joukowski, Karman - Trefftz, Profiles - Thin aerofoil theory and its applications. Vortex line, Horse shoe vortex, Biot and Savart law, Lifting line theory and its limitations

UNIT V VISCOUS FLOW

Newton's law of viscosity, Boundary Layer, Navier-Stokes equation, displacement, Momentum thickness, Flow over a flat plate, Blasins solution.

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.

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.

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AF- 406 - COMPUTER AIDED DESIGN AND MODELLING LAB

List of exercises using software capable of design and modelling:

1. Study of capabilities of software for drafting and modelling -Co-ordinate system-Creation of simple figures like polygon and general multi line figures
2. Drawing a title block with necessary text and projection symbols
3. Drawing of curves like parabola, spiral, involute using B spline or cubic spline
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder,cone.etc
5. Drawing of front view, side view and top view of objects from the given pictorial views
6. Drawing of a plan of residential building
7. Drawing of a simple steel truss
8. Drawing sectional views of prism,pyramid,cylinder,cone.etc,
9. Drawing isometric projection of simple objects
10. Creation of 3D models of simple objects and obtaining 2D and multi view drawing of 3D models