



MATS UNIVERSITY

Raipur (C.G.)

Syllabus Scheme

(6thSemester)

For

Bachelor of Engineering

In

AERONAUTICAL



MATS School of Engineering & Technology

ARANG, RAIPUR (C.G.)



MATS UNIVERSITY

ARANG, RAIPUR



Subject Code for School of Engineering & Technology

6th Semester (AERONAUTICAL)

S.No.	Subject Code	Subject Name
1	BE650	Aircraft Stability and Control
2	BE651	Propulsion-II
3	BE652	Heat and Mass Transfer
4	BE653	Experimental Stress Analysis
5	BE654	Microprocessor and Applications
6	Refer Table	Elective – I
7	BE656	Aircraft Design Lab-I
8	BE657	Propulsion-II Lab
9	BE658	Aero Engine Repair and Maintenance Lab
10	BE659	Non Destructive Testing Lab

Table – 1

Elective – I

S.N.	Subject Code	Subject Name
1	BE6550	Vibrations and Aero elasticity
2	BE6551	Space Mechanics
3	BE6552	Theory of Vibration
4	BE6553	Wind Tunnel Techniques
5	BE6554	Theory of Elasticity



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Scheme of Teaching & Examination B.E. VI SEMESTER AERONAUTICAL ENGINEERING

S.N.	Code	Subject	Periods per week			Scheme of marks		Total Marks
			L	T	P	ESE	IM	
1.	BE650	Aircraft Stability and Control	4	1	-	70	30	100
2.	BE651	Propulsion-II	4	1	-	70	30	100
3.	BE652	Heat and Mass Transfer	4	1	-	70	30	100
4.	BE653	Experimental Stress Analysis	4	1	-	70	30	100
5.	BE654	Microprocessor and Applications	4	1	-	70	30	100
6.	Refer Table	Elective – I	4	1	-	70	30	100
7.	BE656	Aircraft Design Lab-I	-		3	20	30	50
8.	BE657	Propulsion-II Lab	-		3	20	30	50
9.	BE658	Aero Engine Repair and Maintenance Lab	-		3	20	30	50
10.	BE659	Non Destructive Testing Lab	-		3	20	30	50
Total			24	6	12	500	300	800

L – Lecture, T – Tutorial, ESE – End Semester Examination,
P – Practical, IM – Internal Marks (Include Class Test & Teacher’s Assessments)

Table – 1
Elective – I

S.N.	Subject Code	Subject
1	BE6550	Vibrations and Aero elasticity
2	BE6551	Space Mechanics
3	BE6552	Theory of Vibration
4	BE6553	Wind Tunnel Techniques
5	BE6554	Theory of Elasticity

Note (1) – ¼ of total strength of students subject to minimum of twenty Students is required to offer an elective in the college in a particular academic session.

Note (2) – Choice of elective course once made for an examination cannot be changed in future examinations.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Aircraft Stability and Control
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 650

UNIT-I GENERAL

Degrees of freedom of a system, Static and dynamic stability Need for stability in an airplane, purpose of controls, inherently and marginally stable airplanes.

UNIT-II STATIC LONGITUDINAL STABILITY

Stick fixed: Basic equations of equilibrium, Stability criterion, Wing and tail moments, Effect of fuselage and nacelles, Effect of C.G. location, Power effects, Stabiliser setting and C.G. location, Elevator effects, stick fixed neutral point. Stick free: Hinge moment coefficients, Stick free neutral point symmetric maneuvers, stick force gradients and stick force per cg. Aerodynamic balancing of control surfaces.

UNIT-III STATIC LATERAL STABILITY AND STATIC DIRECTIONAL STABILITY

Dihedral effect, coupling between rolling moment and yawing moment, Adverse yaw, Aileron power, Aileron reversal. Weather cocking effect, rudder requirements. One engine inoperative conditions, rudder lock.

UNIT-IV DYNAMIC LONGITUDINAL STABILITY

Equation of motion, Stability derivatives, Routh's discriminant, solving the stability quadratic, Phugoid motion, factors affecting the period and damping.

UNIT-V DYNAMIC LATERAL AND DIRECTION STABILITY

Dutch roll and spiral instability Auto rotation and spin, two control airplane.

TEXT BOOKS

1. Perkins, C.D., and Hage, R.E., "Airplane Performance stability and Control", John Wiley & Son, Inc, New York, 1988.

REFERENCES

1. Etkin, B., "Dynamics of Flight Stability and Control", Edn. 2, John Wiley, New York, 1982.
2. Babister, A.W., "Aircraft Dynamic Stability and Response", Pergamon Press, Oxford, 1980.
3. Dommasch, D.O., Shelby, S.S., and Connolly, T.F., "Aeroplane Aero dynamics", Third Edition, Issac Pitman, London, 1981.
4. Clancy, L.J., "Aerodynamics", Pitman, 1986
5. Nelson, R.C. "Flight Stability and Automatic Control", McGraw-Hill Book Co., 1998.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Propulsion –II
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 651

UNIT-I NOZZLES FOR JET ENGINES

Real flow in nozzles and nozzle efficiency – losses in nozzles – equilibrium flow and frozen flow in nozzles- two phase flow in nozzles – Ejector and variable area nozzles- Interaction of nozzle flow with adjacent surfaces – thrust reversal.

UNIT-II RAMJET PROPULSION

Operating principle of ramjet engine– various components of ramjet engines and their efficiencies – Combustion in ramjet engine – critical, subcritical and supercritical modes of operation - ramjet engine and its performance characteristics – sample ramjet design calculations – flame stability problems in ramjet combustors –integral ram rockets.

UNIT-III HYPERSONIC AIR BREATHING PROPULSION

Introduction to hypersonic air breathing propulsion, hypersonic vehicles and supersonic combustion- need for supersonic combustion for hypersonic propulsion –salient features of scramjet engine and its applications for hypersonic vehicles–problems associated with supersonic combustion – engine/airframe integrationaspects of hypersonic vehicles –various types scramjet combustors–fuel injection schemes in scramjet combustors–one dimensional models for supersonic combustion using method of influence coefficients.

UNIT-IV CHEMICAL ROCKET PROPULSION

Operating principle – specific impulse of a rocket – internal ballistics – rocket performance considerations – solid propellant rockets – selection criteria of solidpropellants – propellant grain design considerations – erosive burning in solid rockets– liquid propellant rockets – selection of liquid propellants–various feed systems for liquid rockets-thrust control in liquid rockets–cooling in liquid rockets and theassociated heat transfer problems – advantages of liquid rockets over solid rockets-introduction to hybrid propulsion –advantages and limitations of hybrid propulsion -static testing of rockets and safety considerations.

UNIT-V ADVANCED PROPULSION TECHNIQUES

Introduction to nozzle less propulsion and basic concepts - Electric rocket propulsion – Ion propulsion – Nuclear rocket – comparison of performance of these propulsionsystems with chemical rocket propulsion systems - Solar sail.

TEXT BOOKS:

1. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.
2. Mathur, M.L., & Sharma, R.P., “Gas Turbine, Jet & Rocket Propulsion”, Standard Publishers and Distributors, Delhi, 1988.

REFERENCES:

1. David H. Heiser and David T. Pratt., “Hypersonic Air breathing Propulsion”, AIAA Education Series, 1999.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Heat and Mass Transfer
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 652

UNIT-I FUNDAMENTALS

Modes of heat transfer: Conduction – Convection - Radiation

UNIT-II HEAT CONDUCTION

Steady and unsteady state heat conduction in solids - Effect of variation of thermal conductivity on heat transfer in solids – conduction with heat generation – Heat transfer problems in infinite and semi infinite solids–Critical radius of insulation-Extended surfaces-Application of numerical techniques.

UNIT-III FREE AND FORCED CONVECTION

Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis

Free Convection: Laminar boundary layer equation- Free convection in atmosphere free convection on a vertical flat plate – Integral method - Empirical relation in free convection – External flows.

Forced convection: Forced convection - Laminar and turbulent convective heat transfer analysis in flows between parallel plates, over a flat plate and in a circular pipe. Empirical relations - numerical techniques in problem solving.

UNIT-IV RADIATIVE HEAT TRANSFER AND HEAT EXCHANGERS

Concept of black body-Intensity of radiation-Laws of Black body Radiation-Radiation from non black surfaces- real surfaces – Radiation between surfaces-Radiation shape factors-Radiation shields.

HEAT EXCHANGERS: Types-overall heat transfer coefficient- LMTD- NTU method of heat exchanger Analysis.

UNIT-V HEAT TRANSFER PROBLEMS IN AEROSPACE ENGINEERING

Heat transfer problems in gas turbine combustion chambers - Rocket thrust chambers - Aerodynamic heating - Ablative heat transfer.

TEXT BOOKS:

- 1 Sachdeva, S.C. Fundamentals of Engineering, Heat and Mass Transfer, Wiley Eastern Ltd., New Delhi, 1981.
2. Lienhard, J.H., “A Heat Transfer Text Book”, Prentice Hall Inc., 1981.
3. Holman, J.P., “Heat Transfer”, McGraw Hill Book Co., Inc., New York, 6th Edn, 1991.

REFERENCES

1. Sachdeva, S.C., “Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Ltd., New Delhi, 1981.
2. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley and Sons, 5th Edn. 1986.
3. Mathur, M. and Sharma, R.P., “Gas Turbine and Jet and Rocket Propulsion”, Standard Publishers, New Delhi 1988.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Experimental Stress Analysis
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 653

UNIT-I EXTENSOMETERS

Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT-II ELECTRICAL RESISTANCE STRAIN GAUGES

Principle of operation and requirements, Types and their uses, Materials for strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheatstone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT-III PHOTOELASTICITY

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photo elastic effects, stress optic law, Transmission and Reflection polariscopes, Interpretation of fringe pattern, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT-IV BRITTLE COATING AND MOIRE METHODS

Introduction to Moiré techniques, Brittle coating methods and Holography

UNIT-V NON – DESTRUCTIVE TESTING

Fundamentals of NDT, Radiography, Ultrasonics, Eddy Current testing, Fluorescent Penetrant Testing, Acoustic Emission Technique,

TEXT BOOKS

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.

REFERENCES

1. Hetenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall, 1993.
3. Max Mark Frocht, Photo Elasticity, John Wiley and Sons Inc., New York, 1968
4. A.J.Durelli, Applied Stress Analysis, Prentice Hall of India Pvt Ltd., New Delhi, 1970.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Microprocessor and Applications
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 654

UNIT-I ELECTRONIC COMPONENTS AND DEVICES

Resistors, Capacitors, Inductors and Transformers - properties, types. Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor and Field Effect Transistors – operating principles and characteristics. Other Devices – UJT, SCR, LED, Photo detectors.

UNIT-II ANALOG CIRCUITS

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) – properties and typical circuits like differentiator, integrator, summer, comparator, single-stage BJT's and FET's amplifiers – Multistage Amplifier Principles (Qualitative Treatment only).

UNIT-III DIGITAL CIRCUITS

Basics of Boolean Logic – Logic Gates, Flip-Flops, Shift-Registers, Counters, Decoders/Drivers, Timer, Display Devices, A/D and D/A Converter.

UNIT-IV MEASUREMENTS AND INSTRUMENTS

Definitions of Accuracy, Precision, Sensitivity, Resolution, Linearity, Range, Measurement of Electrical Quantities – Voltmeter, Ammeter, Watt-Meter, DMM, CRO, DSO, Transducers and signal conditioning systems for pressure, temperature, acceleration measurements (Qualitative Treatment only).

UNIT V MICROPROCESSORS AND APPLICATIONS 8

Architecture of 8085 processors, Address Modes, Instruction set, simple programming like addition, subtraction, multiplication, logical operation, Peripherals and Interfacing – 8255, 8251. Applications like motor control, keyboard and PC interface, Introduction to Microcontrollers.

TEXT BOOK

1. Millman, J. and Halkias, C., “Integrated Electronics”, Tata McGraw Hill, 2004.
2. Paul Horowitz and Wilfred Hill “The Art of Electronics”, Cambridge University press, 1989.

REFERENCES

1. Donald P Leach, Albert Paul Malvino and Goutam Saha, ” Digital Principles & Applications”, 6E, Tata McGraw Hill, 2006.
2. A. K. Sawhney, A course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai and Sons, New Delhi, 1999
3. Helfrick, A. D., & Cooper, W. D., “Electronic Instrumentation and Measurement techniques ”, Prentice Hall of India, 1998.
4. Gaonkar. Ramesh S, “Microprocessor Architecture Programming & Applications with 8085 ”, 5th Ed. Penram International Publishing (India), 2003.
5. Kenneth J. Ayala., “The 8051 Microcontroller Architecture Programming and Applications”, 2ed, Penram International Publishing (India), 2004.

MATS UNIVERSITY, RAIPUR

Semester : 6th BE Course
Branch : Aeronautical
Subject : Aircraft Design Lab-I
Code : BE 656

LIST OF EXPERIMENTS

1. Comparative configuration study of different types of airplanes.
2. Comparative study on specification and performance details of aircraft.
3. Preparation of comparative data sheets.
4. Work sheet layout procedures.
5. Comparative graphs preparation and selection of main parameters for the design.
6. Preliminary weight estimations, selection of main parameters.
7. Power plant selection, Aerofoil selection, Wing tail and control surfaces.
8. Preparation of layouts of balance diagram and three view drawings.
9. Estimation of various Drags.
10. Detailed performance calculations and stability estimates.

LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Engineering Drawing Board	30	3,4,5
2	Engineering Drawing Instruments	30	3,4,5

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Semester : 6th BE Course
Branch : Aeronautical
Subject : Propulsion-II Lab
Code : BE 657

LIST OF EXPERIMENTS

1. Cascade testing of a model of axial compressor blade row.
2. Study of performance of a propeller.
3. Determination of heat of combustion of aviation fuel.
4. Combustion performance studies in a jet engine combustion chamber.
5. Study of free jet.
6. Study of wall jet.

LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Axial compressor blade row model with pressure tapping	1	1
2	Water tube manometers (20 tubes)	2	5,6,1,2
3	Subsonic wind tunnel	1	1,2
4	Propeller model static and total pressure probes	4	2
5	2-D travers in mechanism	2	5,6
6	Free jet test setup	1	5
7	Wall jet test setup	1	6

MATS UNIVERSITY, RAIPUR

Semester : 6th BE Course
Branch : Aeronautical
Subject : Aero Engine Repair and Maintenance Lab
Code : BE 658

LIST OF EXPERIMENTS

1. Stripping of a piston engine.
2. Engine (Piston Engine) - cleaning, visual inspection, NDT checks.
3. Piston Engine Components - dimensional checks.
4. Piston – Engine reassembly.
5. Propeller Pitch Setting.
6. Stripping of a jet engine.
7. Jet Engine – identification of components & defects.
8. Jet Engine – NDT checks and dimensional checks
9. Jet Engine – reassembly.
10. Engine starting procedures.

LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Piston Engines	2	1,2,3,4
2	Jet Engines	2	6,7,1,9
3	Propeller pitch setting stand	1	5
4	Aircraft with serviceable stand	1	1 to 10
5	Precision instruments (Vernier Caliper, Micro meter, Cylinder bore gauge, depth gauge, Bevel Protector and DTI)	2 each	3,5,1
6	NDT Equipments (Defectoscope, Dye Penetrant method, Hot oil Chalk Method)	1 each	2,1

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Semester : 6th BE Course
Branch : Aeronautical
Subject : Non Destructive Testing Lab
Code : BE 659

LIST OF EXPERIMENTS

1. Hot oil Chalk Powder method.
2. Dye or Liquid Penetrant Testing.
3. Ultrasonic Testing.
4. Magnetic Particle Testing.
5. Radiographic Inspection.
6. Eddy Current Testing.
7. X-Ray Testing.
8. Gamma Rays Testing.
9. Aircraft crack detection methods.
10. Gas Turbine components crack detection.

LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Chalk Powder	1	1
2	Liquid Penetrant	1	2
3	Ultrasonic Testing (UT) Equipment	1	3
4	Iron particles	1	4
5	Magnetic Particle Inspection (MPI) Equipment	1	4
6	Radiographic testing Machine	1	5
7	Eddy Current Testing Machine	1	6
8	X-Ray Machine	1	7
9	Gas Turbine Blade	1	10

LIST OF ELECTIVE-I SUBJECTS FOR 6th SEMESTER

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Vibration and Aero Elasticity
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE6550

UNIT-I BASIC NOTIONS

Simple harmonic motion–Terminologies – Newton’s Law – D’ Alembert’s principle –Energy Methods.

UNIT-II SINGLE DEGREE OF FREEDOM SYSTEMS

Free vibrations – Damped vibrations – Forced Vibrations, with and without damping – support excitation – Vibration measuring instruments.

UNIT-III MULTI DEGREES OF FREEDOM SYSTEMS

Two degrees of freedom systems – Static and Dynamic couplings vibration absorber-Principal co- ordinates, Principal modes and orthogonal condition – Eigen value problems. Hamilton’s principle- Lagrangean equation and application –Vibration of elastic bodies- Vibration of strings- Longitudinal, Lateral and Torsional vibrations.

UNIT-IV APPROXIMATE METHODS

Rayleigh’s and Holzer Methods to find natural frequencies.

UNIT-V ELEMENTS OF AEROELASTICITY

Concepts – Coupling – Aero elastic instabilities and their prevention – Basic ideas on wing divergence, loss and reversal of aileron control – Flutter and its prevention.

TEXT BOOKS

1. “Mechanical Vibrations”, S. S. Rao, Pearson Education Inc, 4th Edition, 2003.
2. “Mechanical Vibrations”, V. P. Singh, Dhanpat Rai & Company Pvt Ltd, 3rd Edition, 2006.

REFERENCES

1. Bisplinghoff R.L., Ashely H and Hogman R.L., “Aero elasticity” –Addision Wesley Publication, New York, 1983.
2. TSE. F.S., Morse, I.F., Hunkle, R.T., “Mechanical Vibrations”, –Prentice Hall, New York, 1984.
3. Scanlan R.H. & Rosenbaum R., “Introduction to the study of Aircraft Vibration & Flutter”, John Wiley and Sons. New York, 1982.
4. Benson H. Tongue, “Principles of Vibration”, Oxford University Press, 2000.
5. Fung Y.C., “An Introduction to the Theory of Aero elasticity” – John Wiley & Sons, New York, 1995.
6. Timoshenko S., “Vibration Problems in Engineering”– John Wiley and Sons, New York, 1993.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Space Mechanics
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE6551

UNIT-I BASIC CONCEPTS AND THE GENERAL N- BODYPROBLEM

The solar system – reference frames and coordinate systems – terminology related to the celestial sphere and its associated concepts – Kepler’s laws of planetary motion and proof of the laws – Newton’s universal law of gravitation - the many body problem - Lagrange-Jacobi identity – the circular restricted three body problem –liberation points – the general N-body problem – two body problem – relations between position and time.

UNIT-II SATELLITE INJECTION AND SATELLITE PERTURBATIONS

General aspects of satellite injection – satellite orbit transfer – various cases – orbit deviations due to injection errors – special and general perturbations – Cowell’s method and Encke’s method – method of variations of orbital elements – general perturbations approach.

UNIT-III INTERPLANETARY TRAJECTORIES

Two-dimensional interplanetary trajectories – fast interplanetary trajectories – three dimensional interplanetary trajectories – launch of interplanetary spacecraft –trajectory estimation about the target planet – concept of sphere of influence –Lambert’s theorem

UNIT-IV BALLISTIC MISSILE TRAJECTORIES

Introduction to ballistic missile trajectories –boost phase–the ballistic phase –trajectory geometry –optimal flights–time of flight–re-entry phase–the position of impact point–influence coefficients.

UNIT-V MATERIALS FOR SPACECRAFT

Space environment – peculiarities of space environment – effect of space environment on materials of spacecraft structure – materials required for the construction of space craft – TPS for re-entry space vehicles.

TEXT BOOKS:

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

REFERENCES:

1. Sutton, G.P., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 5th Edition, 1993.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Theory of Vibrations
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE6552

UNIT-I SINGLE DEGREE OF FREEDOM SYSTEMS

Introduction to simple harmonic motion, D'Alembert's Principle, Free vibrations–Damped vibrations –Forced Vibrations, with and without damping – support excitation– Vibration measuring instruments.

UNIT-II MULTI DEGREES OF FREEDOM SYSTEMS

Two degrees of freedom systems - Static and Dynamic couplings – vibration absorber- Principal co-ordinates - Principal modes and orthogonal condition – Eigenvalue problems - Hamilton's principle - Lagrangean equations and application.

UNIT-III CONTINUOUS SYSTEMS

Vibration of elastic bodies - Vibration of strings - Longitudinal - Lateral and Torsional vibrations

UNIT-IV APPROXIMATE METHODS

Approximate methods -Rayleigh's method -Dunkerlay's method – Rayleigh-Ritz method, Matrix Iteration method.

UNIT-V ELEMENTS OF AEROELASTICITY

Vibration due to coupling of bending and torsion-Aero elastic problems – Collars triangle - Wing Divergence - Aileron Control reversal – Flutter – Buffeting.

TEXT BOOKS

1. Thomson W T, 'Theory of Vibration with Application' - CBS Publishers, 1990.
2. G.K. Grover, "Mechanical Vibrations", 7th Edition, Nem Chand Brothers, Roorkee, India, 2003.

REFERENCES

1. Timoshenko S., Vibration Problems in Engineering – John Wiley and Sons, New York, 1993.
2. Bisplinghoff R.L., Ashely H and Hogman R.L., Aero elasticity – Addison Wesley Publication, New York, 1983.
3. William W Seto, 'Mechanical Vibrations' – McGraw Hill, Schaum Series.
4. TSE. F.S., Morse, I.F., Hunkle, R.T., Mechanical Vibrations – Prentice Hall, New York, 1984.
5. Leonard Meirovitch, 'Elements of Vibration Analysis' – McGraw Hill International Edition Clarence W DeSilva, 'Vibration – Fundamentals and Practice', CRCPress, Special Indian Edition, 2005.

MATS UNIVERSITY, RAIPUR

Semester : 6th BE Course
Branch : Aeronautical
Subject : Wind Tunnel Techniques
Total Theory Periods : 45
Total Tutorial Periods : 15
Code : BE6553

UNIT-I PRINCIPLES OF MODEL TESTING

Buckingham Theorem – Non dimensional numbers –Scale effect–Geometric Kinematic and Dynamic similarities.

UNIT-II WIND TUNNELS

Classification – special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameters.

UNIT-III CALIBRATION OF WIND TUNNELS

Test section speed – Horizontal buoyancy – Flow angularities – Turbulence measurements – Associated instrumentation – Calibration of supersonic tunnels.

UNIT-IV WIND TUNNEL MEASUREMENTS

Steady and Unsteady Pressure and velocity measurements –Force measurements –Three component and six component balances – Internal balances – Principles of Hotwire Anemometer.

UNIT-V FLOW VISUALIZATION

Smoke and Tuft grid techniques –Dye injection special techniques –Optical methods of flow visualization.

TEXT BOOKS:

1. Rae, W.H. and Pope, A., Low Speed Wind Tunnel Testing, John Wiley Publication, 1984.

REFERENCES:

1 Pope, A., and Goin, L., High Speed Wind Tunnel Testing, John Wiley, 1985.

MATS UNIVERSITY, RAIPUR

Semester	:	6th BE Course
Branch	:	Aeronautical
Subject	:	Theory of Elasticity
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE6554

UNIT-I BASIC EQUATIONS OF ELASTICITY

Stress – Strain – Stress Strain relationships - Equations of Equilibrium, Compatibility equations and strains, Boundary Conditions, Saint Venant's principle – Principal Stresses Stress Ellipsoid - Stress invariants.

UNIT-II PLANE STRESS AND PLANE STRAIN PROBLEMS

Airy's stress function, Bi harmonic equations, Polynomial solutions, Simple twodimensional problems in Cartesian coordinates like bending of cantilever and simplysupported beams.

UNIT-III POLAR COORDINATES

Equations of equilibrium, Strain displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Kirsch, Michell's and Boussinesque problems – Rotating discs.

UNIT-IV TORSION

Navier's theory, St. Venant's theory, Prandtl's theory on torsion, the semi- inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections.

UNIT-V THEORY OF PLATES

Classical plate theory – Assumptions – Governing equations – Boundary conditions –Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.

TEXT BOOKS

1. Timoshenko, S., and Goodier, T.N., Theory of Elasticity, McGraw – Hill Ltd., Tokyo, 1990.
2. Ansel C Ugural and Saul K Fenster, 'Advanced Strength and Applied Elasticity', 4th Edition, Prentice Hall, New Jersey, 2003.

REFERENCES

1. Wang, C.T., Applied Elasticity, McGraw – Hill Co., New York, 1993.
2. Sokolnikoff, I.S., Mathematical Theory of Elasticity, McGraw – Hill New York, 1978.
3. Enrico Volterra & J.H. Caines, Advanced Strength of Materials, Prentice Hall New Jersey, 1991.