



**MATS UNIVERSITY**

**Raipur (C.G.)**

**Syllabus Scheme**

**(7<sup>th</sup> Semester)**

**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

### 7<sup>th</sup> Semester (AERONAUTICAL)

S.No.	Subject Code	Subject Name
1	BE750	Total Quality Management
2	BE751	Avionics
3	BE752	Composite Materials and Structures
4	BE753	Finite Element Analysis
5	Refer Table	<b>Elective – II</b>
6	BE755	Aircraft Design Lab-II
7	BE756	CAD/CAE Lab
8	BE757	Avionics Lab
9	BE758	Project Work Phase-I

### Table – 2

### Elective – II

S.No.	Subject Code	Subject Name
1	BE7540	Professional Ethics and Human Values
2	BE7541	Aircraft General Engineering & Maintenance Practices
3	BE7542	Aero Engine Maintenance and Repair
4	BE7543	Theory of Plates and Shells
5	BE7144	High Temperature Materials



# MATS UNIVERSITY

ARANG, RAIPUR



## Scheme of Teaching & Examination B.E. VII SEMESTER AERONAUTICAL ENGINEERING

S.N.	code	Subject	Periods per week			Scheme of marks		Total Marks
			L	T	P	ESE	IM	
1.	BE750	Total Quality Management	4	1	-	70	30	100
2.	BE751	Avionics	4	1	-	70	30	100
3.	BE752	Composite Materials and Structures	4	1	-	70	30	100
4.	BE753	Finite Element Analysis	4	1	-	70	30	100
5.	Refer Table	<b>Elective – II</b>	4	1	-	70	30	100
6.	BE755	Aircraft Design Lab-II	-	-	3	20	30	50
7.	BE756	CAD/CAE Lab	-	-	3	20	30	50
8.	BE757	Avionics Lab	-	-	3	20	30	50
9.	BE758	Project Work Phase-I	-	-	3	50	100	150
Total			20	5	12	460	340	800

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

**Table – 2**  
**Elective – II**

S.No.	Subject Code	Subject
1	BE7540	Professional Ethics and Human Values
2	BE7541	Aircraft General Engineering and Maintenance Practices
3	BE7542	Aero Engine Maintenance and Repair
4	BE7543	Theory of Plates and Shells
5	BE7544	High Temperature Materials

Note (1) –  $\frac{1}{4}$  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	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Total Quality Management
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 750

### **UNIT-I INTRODUCTION**

Introduction - Need for quality - Evolution of quality - Definition of quality -Dimensions of manufacturing and service quality - Basic concepts of TQM -Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby –Barriers to TQM.

### **UNIT-II TQM PRINCIPLES**

Leadership–Strategic quality planning, Quality statements–Customer focus–Customer orientation, Customer satisfaction, Customer complaints, Customer retention–Employee involvement–Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership–Partnering, Supplier selection, Supplier Rating.

### **UNIT-III TQM TOOLS & TECHNIQUES I**

The seven traditional tools of quality–New management tools–Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT–Bench marking–Reason to bench mark, Bench marking process – FMEA – Stages,Types.

### **UNIT-IV TQM TOOLS & TECHNIQUES II**

Quality circles – Quality Function Deployment (QFD)–Taguchi quality loss function–TPM–Concepts, improvement needs–Cost of Quality– Performance measures.

### **UNIT-V QUALITY SYSTEMS**

Need for ISO 9000- ISO 9000-2000 Quality System –Elements, Documentation, Quality auditing - QS 9000 – ISO 14000 – Concepts, Requirements & Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

### **TEXT BOOK**

1. Dale H. Besterfield, et al., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

### **REFERENCES**

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi, L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd. (2006).
4. Janakiraman, B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd. (2006).

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Total Quality Management
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 751

### UNIT-I INTRODUCTION TO AVIONICS

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies.

### UNIT-II PRINCIPLE OF DIGITAL SYSTEMS

Digital computer – Microprocessors – Memories.

### UNIT-III DIGITAL AVIONICS ARCHITECTURE

Avionics system architecture – Databuses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

### UNIT-IV FLIGHT DECKS AND COCKPITS

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touchscreen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

### UNIT-V INTRODUCTION TO AVIONICS SYSTEMS

Communications systems- Navigation systems – Flight control systems – Radar – Electronic Warfare – Utility systems Reliability and maintainability – Certification.

### TEXT BOOKS:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J., U.S.A. 1987.

### REFERENCES:

1. Malvino, A.P. and Leach, D.P. Digital Principles and Applications, Tata McGrawHill, 1990.
2. Gaokar, R.S. Microprocessors Architecture-Programming and Applications, Wiley and Sons Ltd., New Delhi, 1990.

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Composite Materials and Structures
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 752

### UNIT-I MICROMECHANICS

Introduction-Advantages and application of composite materials- reinforcements and matrices - Micro mechanics – Mechanics of materials approach, elasticity approach to determine material properties–Fibre Volume ratio–Mass fraction–Effect of voids, hygro thermal effects on a lamina.

### UNIT-II MACROMECHANICS

Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials - Macro Mechanics – Stress-strain relations with respect to natural axis, arbitrary axis – Determination of material properties - Experimental characterization of lamina.

### UNIT-III LAMINATED PLATES

Governing differential equation for a unidirectional lamina and general laminate, angle ply and cross ply laminate, Failure criteria for composites.

### UNIT-IV FABRICATION PROCESS

Various open and closed mould processes, Manufacture of fibres, Types of resins, properties and applications, netting analysis.

### UNIT-V SANDWICH CONSTRUCTIONS

Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels - Bending stress and shear flow in composite beams.

### TEXT BOOKS

1. Jones, R.M., "Mechanics of Composite Materials," Taylor & Francis, II Edition, 2000.
2. Madhuji Mukhopadhyay, Mechanics of Composite Materials and Structures, University Press, 2004.

### REFERENCES

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., Handbook on Advanced Plastics and Fibre Glass, Von Nostrand Reinhold Co., New York, 1989.
3. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
4. Calcote, L R. "The Analysis of laminated Composite Structures", Von –Nostrand Reinhold Company, New York 1998
5. Allen Baker, Composite Materials for Aircraft Structures, AIAA Series, II Edition, 1999.

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Finite Element Methods
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 753

### UNIT-I INTRODUCTION

Review of various approximate methods –Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

### UNIT-II DISCRETE ELEMENTS

Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis. Beam element - problems for various loadings and boundary conditions - longitudinal and lateral vibration. Use of local and natural coordinates.

### UNIT-III CONTINUUM ELEMENTS

Plane stress, Plane strain and axisymmetric problems, constant and linear strain, triangular elements, stiffness matrix, axisymmetric load vector,

### UNIT-IV ISOPARAMETRIC ELEMENTS

Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffnessmatrix and consistent load vector, Gaussian integration

### UNIT-V FIELD PROBLEM

Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems

### TEXT BOOKS

1. Tirupathi R. Chandrapathala and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Prentice Hall India, Third Edition, 2003.
2. Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001

### REFERENCES

1. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K. J. and Wilson, E. L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
4. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
5. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wileyand Sons, Inc. 1984.

## MATS UNIVERSITY, RAIPUR

Semester : 7th BE Course  
Branch : Aeronautical  
Subject : Aircraft Design Lab-II  
Code : BE 756

### LIST OF EXPERIMENTS

1. V-n diagram for the design study
2. Gust and maneuverability envelopes
3. Critical loading performance and final V-n graph calculation
4. Structural design study – Theory approach
5. Load estimation of wings
6. Load estimation of fuselage.
7. Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads.
8. Detailed structural layouts
9. Design of any two components of wings, fuselage
10. Preparation of a detailed design report with CAD drawings.

### LIST OF EQUIPMENTS

(For a batch of 30 students)

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



## MATS UNIVERSITY, RAIPUR

Semester : 7th BE Course  
Branch : Aeronautical  
Subject : CAD/CAE Lab  
Code : BE 757

### LIST OF EXPERIMENTS

1. Scaling, rotation, translation, editing, dimensioning – Typical CAD command structure.
2. Wire frame modeling – surface modeling
3. Solid Modeling
4. Advanced modeling
5. CFD/FEM Fundamentals
6. Flow Simulation over a Symmetrical Airfoil Using CFD
7. Flow Simulation over a Cambered Airfoil Using CFD
8. Flow Simulation over a Turbine Blade (static analysis) Using CFD
9. Stress Analysis of a Turbine Blade (Rotation only and no pressure loads)
10. Stress Analysis of Any Aircraft Component

### LIST OF EQUIPMENTS

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Computers	30	1 to 10
2	Pro-E -Wildfire, AutoCAD(latest), CATIA,SOLIDWORKS	30 licenses	1 to 10
3	ANSYS- 11 with Fluent, NASTRAN, CFX	30 licenses	1 to 10
4	UPS 10 KV <sub>a</sub> 3 Phase	1	1 to 10

**MATS UNIVERSITY, RAIPUR**

Semester : 7th BE Course  
Branch : Aeronautical  
Subject : Avionics Lab  
Code : BE 758

**LIST OF EXPERIMENTS**

**DIGITAL ELECTRONICS**

1. Addition/Subtraction of binary numbers.
2. Multiplexer/ Demultiplexer Circuits.
3. Encoder/Decoder Circuits.
4. Timer Circuits, Shift Registers, Binary Comparator Circuits.

**MICROPROCESSORS**

5. Addition and Subtraction of 8-bit and 16-bit numbers.
6. Sorting of Data in Ascending & Descending order.
7. Sum of a given series with and without carry.
8. Greatest in a given series & Multi-byte addition in BCD mode.
9. Interface programming with 4 digit 7 segment Display & Switches & LED's.
10. 16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.

**AVIONICS DATA BUSES**

11. Study of Different Avionics Data Buses.
12. MIL-Std – 1553 Data Buses Configuration with Message transfer.
13. MIL-Std – 1553 Remote Terminal Configuration.

**LIST OF EQUIPMENTS**

(For a batch of 30 students)

S. No.	Details of Equipments	Qty Req.	Expt. No.
1	Adder/Subtractor Binary bits Kit	6	1
2	Timer Kit	6	1
3	Encoder Kit	6	3
4	Decoder Kit	6	3
5	Comparator Kit	6	4
6	Multiplexer Kit	6	2
7	Demultiplexer Kit	6	2
8	Shift Registers Kit	6	4
9	Electronic Design Experimeter	6	6,7,9,10
10	Microprocessor 8085 Kit	9	5,6,7,8,9,10
11	4 Digit 7 Segment Display	3	6
12	Switches & LED's Circuit	3	6
13	16 Channel AD Converter	6	10,9
14	Digital to Analog Converter	6	10
15	Cathode Ray Oscilloscope	3	9,10
16	Regulated Power Supply (5V DC)	9	1, 2,3,4
17	MIL-Std 1553B Setup with Remote Terminal	1	12,13
18	Computers	2	11,12,13

## **MATS UNIVERSITY, RAIPUR**

Semester : 7th BE Course  
Branch : Aeronautical  
Subject : Project Work Phase-I  
Code : BE 759

### **LIST OF EXPERIMENTS**

The objective of the phase – I of the students project work is to prepare themselves to undertake lively project which will found end application to the industry /society. Preparation for the project work involve

- ✓ Form a team of like minded students (not more than 4 in number) to carry out the project.
- ✓ Make a preliminary survey and data collection or literature review of the project proposed in the next semester.
- ✓ Conduct a thorough literature survey and publish or present a paper of the proposed work in any one of the forthcoming National seminars.
- ✓ Plan for necessary supports, facilities, analytical tools and fixation of faculties /supervisors for the final semester project work.

## LIST OF ELECTIVE-II SUBJECTS FOR 7<sup>th</sup> SEMESTER

### MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Professional Ethics and Human Values
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	BE 7540

#### UNIT-I HUMAN VALUES

Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage –Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character –Spirituality.

#### UNIT-II ENGINEERING ETHICS

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry – moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest - customs and religion - uses of ethical theories.

#### UNIT-III ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as experimentation-engineers as responsible experimenters-codes of ethics-balanced outlook on law - the challenger case study.

#### UNIT-IV SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk -the Three Mile Island and Chernobyl case studies. Collegiality and loyalty - respect for authority-collective bargaining-confidentiality-conflicts of interest-occupational crime-professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

#### UNIT-V GLOBAL ISSUES

Multinational corporations - Environmental ethics - computer ethics – weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

#### TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

#### REFERENCES

1. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics –Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

## **MATS UNIVERSITY, RAIPUR**

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Aircraft General Engineering and Maintenance Practices
Total Theory Periods	:	40
Total Tutorial Periods	:	15
Code	:	BE 7541

### **UNIT-I AIRCRAFT MAINTENANCE PRACTICES**

General knowledge of procedure of jacking, leveling and mooring of aircraft. Knowledge of maintenance and handling of ground equipment such as engine starting trolley, hydraulic trolley, air condition trolley used in the maintenance of aircraft. Knowledge of safety and fire precautions to be observed during maintenance, refueling and defueling of aircraft. Knowledge of aircraft fire extinguishers Maintenance safety.

### **UNIT-II WORKSHOP PRACTICES**

Uses of Hand tools in aircraft maintenance, precision measuring instruments. Knowledge & terminology, of aircraft bolts, nuts, rivets, screws and locking devices. Knowledge of various types of gears and bearings, their use and common defects. Knowledge of various types of threads, drills, taps, reamers.

### **UNIT-III Aircraft Materials**

Principal of Heat treatment of aircraft steel, Heat treatment of non ferrous metal –solution hardening ,precipitation hardening ,forms of corrosion , & factor affecting corrosion. Process and material used in corrosion control – electroplating, Parco lubrizing, alodizing, anodizing.

### **UNIT-IV INSPECTION**

Purpose –type-inspection interval & inspection schedule. Special inspection. FAR Air worthiness directive Type certificate data sheet, service bulletin.

### **UNIT-V AIRCRAFT ENGINE, ELECTRICAL & INSTRUMENT**

Theory & construction of aircraft engines- reciprocating & turbojet engine, Knowledge of lead & cadmium Batteries and their maintenance, Knowledge of principle of operation of aircraft fuel flow meter, oil temperature indicator, oil pressure indicator.

### **TEXT BOOKS:**

1. Air frame & power plant Mechanics (General Hand book EA-AC 65 -9A)
2. U S Department of transportation Air frame & power plant Mechanics (Power plant Hand book EA-AC 65 -12A) U S Department of transportation.

### **REFERENCES:**

1. James Anderson, Earl E. Tatro, “Shop Theory”.
2. Larry Reithmaier, “Standard Aircraft handbook”.
3. E H J Pallet, “Aircraft Electrical Systems”.
4. Aircraft materials & processes by Titterton
5. Aviation Maintenance and Technical series,
  - a) General – Dale Crane
  - b) Power plant – Dale Crane Published by Aviation supplies & Academic, DC.

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Aero Engine Maintenance and Repair
Total Theory Periods	:	40
Total Tutorial Periods	:	15
Code	:	BE 7542

### UNIT-I CLASSIFICATION OF PISTON ENGINE COMPONENTS

Types of piston engines – Principles of operation – Function of components – Materials used – Details of starting the engines – Details of carburetion and injection systems for small and large engines – Ignition system components – Spark plug details – Engine operating conditions at various altitudes – Maintenance and inspection check to be carried out.

### UNIT-II INSPECTIONS OF PISTON ENGINES

Inspection and maintenance and troubleshooting – Inspection of all engine components– Daily and routine checks – Overhaul procedures – Compression testing of cylinders–Special inspection schedules – Engine fuel, control and exhaust systems– Engine mount and super charger – Checks and inspection procedures.

### UNIT-III INSPECTIONS OF PISTON ENGINES

Symptoms of failure – Fault diagnostics – Case studies of different engine systems –Tools and equipment requirements for various checks and alignment during overhauling–Tools for inspection – Tools for safety and for visual inspection – Methods and instruments for non destructive testing techniques – Equipment for replacement of part and their repair. Engine testing: Engine testing procedures and schedule preparation – Online maintenance.

### UNIT-IV CLASSIFICATION OF JET ENGINE COMPONENTS

12 Types of jet engines – Principles of operation – Functions of components – Materials used – Details of starting and operating procedures – Gas turbine engine inspection & checks –Use of instruments for online maintenance – Special inspection procedures: Foreign Object Damage– Blade damage–etc. Maintenance procedures of gas turbine engines–Trouble shooting and rectification procedures–Component maintenance procedures–Systems maintenance procedures. Gas turbine testing procedures – test schedule preparation – Storage of Engines–Preservation and de-preservation procedures.

### UNIT-V OVERHAUL PROCEDURES

Engine Overhaul procedures – Inspections and cleaning of components – Repairs schedules for overhaul – Balancing of Gas turbine components. Troubleshooting - Procedures for rectification – Condition monitoring of the engine on ground and at altitude – engine health monitoring and corrective methods.

### TEXT BOOK

1. KROES & WILD, “Aircraft Power plants”, 7th Edition – McGraw Hill, New York, 1994.

### REFERENCES

1. TURBOMECA, “Gas Turbine Engines”, The English Book Store, New Delhi, 1993.
2. UNITED TECHNOLOGIES PRATT & WHITNEY, “The Aircraft Gas turbine Engine and its Operation”, (latest edition) The English Book Store, New Delhi.

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	Theory of Plates and Shells
Total Theory Periods	:	40
Total Tutorial Periods	:	15
Code	:	BE 7543

### **UNIT-I CLASSICAL PLATE THEORY**

Classical Plate Theory – Assumptions – Differential Equation – Boundary Conditions.

### **UNIT-II PLATES OF VARIOUS SHADES**

Navier's Method of Solution for Simply Supported Rectangular Plates – Levy's Method of Solution for Rectangular Plates under Different Boundary Conditions. Governing Equation – Solution for Axi-symmetric loading – Annular Plates – Plates of other shapes.

### **UNIT-III EIGEN VALUE ANALYSIS**

Stability and free Vibration Analysis of Rectangular Plates.

### **UNIT-IV APPROXIMATE METHODS**

Rayleigh–Ritz, Galerkin Methods– Finite Difference Method–Application to Rectangular Plates for Static, Free Vibration and Stability Analysis.

### **UNIT-V SHELLS**

Basic Concepts of Shell Type of Structures – Membrane and Bending Theories for Circular Cylindrical Shells.

### **TEXT BOOK**

1. Timoshenko, S.P. Winowsky S., and Kreger, “Theory of Plates and Shells”, McGraw-Hill Book Co. 1990.

### **REFERENCES**

1. Flugge, W. “Stresses in Shells”, Springer – Verlag, 1985.
2. Timoshenko, S.P. and Gere, J.M., “Theory of Elastic Stability”, McGraw-Hill Book Co. 1986.

## MATS UNIVERSITY, RAIPUR

Semester	:	7th BE Course
Branch	:	Aeronautical
Subject	:	High Temperature Materials
Total Theory Periods	:	40
Total Tutorial Periods	:	15
Code	:	BE 7544

### **UNIT-I CREEP**

Factors influencing functional life of components at elevated temperatures, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate.

### **UNIT-II DESIGN FOR CREEP RESISTANCE**

Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.

### **UNIT-III FRACTURE**

Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.

### **UNIT-IV OXIDATION AND HOT CORROSION**

Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, interaction of hot corrosion and creep, methods of combat hot corrosion.

### **UNIT-V SUPERALLOYS AND OTHER MATERIALS**

Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Inter metallics, high temperature ceramics.

### **TEXT BOOKS**

1. Raj. R., "Flow and Fracture at Elevated Temperatures", American Society for Metals, USA, 1985.
2. Hertzberg R. W., "Deformation and Fracture Mechanics of Engineering materials", 4th Edition, John Wiley, USA, 1996.
3. Courtney T.H, "Mechanical Behavior of Materials", McGraw-Hill, USA, 1990.

### **REFERENCES**

1. Boyle J.T, Spencer J, "Stress Analysis for Creep", Butterworths, UK, 1983.
2. Bressers. J., "Creep and Fatigue in High Temperature Alloys", Applied Science, 1981.
3. McLean D., "Directionally Solidified Materials for High Temperature Service", The Metals Society, USA, 1985.