AE -701(A) Elective

Total Quality Management

UNIT I: INTRODUCTION

Time Management, Stress Management, Goals and Career Planning – Interpersonal interaction. Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques, Basic concepts of Total Quality Management, Principles of TQM, Leadership Concepts, Role of Senior Management, Quality Council, Deming Philosophy, Barriers to TQM Implementation.

UNIT II: TQM PRINCIPLES

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III: STATISTICAL PROCESS CONTROL (SPC)

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV: QUALITY SYSTEMS

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

UNIT V: MANGEMEMENT

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

TEXT BOOK

1. Dale H. Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc. 2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCES

1. James R. Evans & William M. Lidsay, “The Management and Control of Quality”, (5thEdition), South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum. A.V. “Total Quality Management”, McGraw-Hill, 1991
3. Oakland. J.S. “Total Quality Management”, Butterworth Heinemann Ltd., 1989
4. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International.

AE -701(B) Elective
Wind Tunnel Techniques

UNIT I: PRINCIPLES OF MODEL TESTING
Buckingham Theorem – Non-Dimensional Numbers – Scale Effect Types of Similarity.

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
Pressure and velocity measurements – Force measurements – Three component and six component balances – Internal balances.

UNIT V: FLOW VISUALIZATION TECHNIQUES
Smoke and Tuft grid techniques – Dye injection special techniques – Optical methods of flow visualization.

TEXT BOOK

1. Rae, W.H. and Pope, A. "Low Speed Wind Tunnel Testing", John Wile Publication, 1914.

REFERENCE

1. Pope, A., and Goin, L., "High Speed wind Tunnel Testing", John Wiley, 1915

AE – 701(C) Elective
Theory of plates and shells

UNIT I: INTRODUCTION TO CLASSICAL PLATE THEORY
Classical Plate Theory – Assumptions – Differential Equation – Boundary Conditions.

UNIT II: PLATES OF VARIOUS SHAPES
Navier's Method of Solution for Simply Supported Rectangular Plates – Leavy'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: STABILITY 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: THEORY OF 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 BookCo. 1999.

AE -702
Industrial Aerodynamics

UNIT I: ATMOSPHERIC WIND
Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

UNIT II: WIND TURBINE
Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory.

UNIT III: VEHICLE AERODYNAMICS
Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft.

UNIT IV: BUILDING AERODYNAMICS
Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics.

UNIT V: AIR FLOW INDUCED VIBRATIONS
Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, galloping and stall flutter.

TEXT BOOKS

1. M. Sovran (Ed), "Aerodynamics and drag mechanisms of bluff bodies and road vehicles", Plenum press, New York, 1978.
2. P. Sachs, "Winds forces in engineering", Pergamon Press, 1978.

REFERENCES

1. R.D. Blevins, "Flow induced vibrations", Van Nostrand, 1990.
2. N.G. Calvent, "Wind Power Principles", Charles Griffin & Co., London, 1979.

AE-703
FINITE ELEMENT METHODS

UNIT I: INTRODUCTION TO FEM AND ITS APPLICABILITY

Review of mathematics: Matrix algebra, Gauss elimination method, Uniqueness of solution, Banded symmetric matrix and bandwidth. Structure analysis Two-force member element, Local stiffness matrix, coordinates transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions, Properties of stiffness matrix.

UNIT II: ONE-DIMENSIONAL FINITE ELEMENT ANALYSIS

Basics of structural mechanics, stress and strain tensor, constitutive relation, Principle of minimum Potential, General steps of FEM, Finite element model concept /Discretization, Derivation of finite elements equations using potential energy approach for linear and quadratic 1-D bar element and beam element, shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain.

UNIT III: TWO DIMENSIONAL FINITE ELEMENT ANALYSIS

Finite element formulation using three nodded triangular (CST) element and four nodded rectangular element, Plane stress and Plain strain problems, Shape functions, node numbering and connectivity, Assembly, Boundary conditions, Isoparametric formulation of 1-D bar elements, Numerical integration using gauss quadrature formula, computation of stress and strain.

UNIT IV: FINITE ELEMENT FORMULATION

Method of Weighted Residuals ,Collocation, Sub domain method, Least Square method and Galerkin's method, Application to one dimensional problems, one-dimensional heat transfer, etc. introduction to variation formulation (Ritz Method.)

UNIT V: HIGHER ORDER ELEMENTS

Lagrange's interpolation formula for one and two independent variable, Convergence of solution, compatibility, element continuity, static condensation, p and h methods of mesh refinement, Aspect ratio and element shape, Application of FEM, Advantages of FEM, Introduction to concept of element mass matrix and Damping matrix in dynamic analysis, Calculation of natural frequencies and modes.

TEXT BOOK

1. Text Book of Finite Element Analysis, Seshu P., Prentice Hall India.
2. Finite Element Procedure in Engineering Analysis, Bathe K.J., Prentice Hall India.

REFERENCE BOOKS

1. An Introduction to the Finite Element Method, Reddy J.N., Tata McGraw-Hill, New Delhi.
2. Concepts & Applications of Finite Element Analysis, Cook, Malkus, Plesha and Witt,

Willey India, New Delhi.
3. Introduction to Finite Elements in Engineering, Chandupatla and Belegundu, Prentice Hall.

LIST OF EXPERIMENTS

1. Write flow chart of finite element steps.
2. Study and understand the convergence of the problem.
3. Solve stiffness matrix for bar, beam and frame problems using suitable boundary condition.
4. Plane stress and plane strain condition are used to understand 2d structures.
5. Analysis of beams and frames (bending problems)
6. Analysis of beams and frames (torsion problems)
7. Nodal analysis problem.
8. Heat transfer problems.
9. Problems leading to analysis of three dimensional solids.
10. Problems leading to analysis of axisymmetric solids.

AE -704
Avionics - I

UNIT I: INTRODUCTION
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: AVIONICS ARCHITECTURE
Avionics system architecture – Data buses – MIL – STD - 1553B – ARINC – 420 – ARINC – 629.

UNIT IV: FLIGHT DECKS AND COCKPITS SYSTEM
Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT V: INTODUCTION 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 McGraw-Hill, 1990.
2. Gaokar, R.S. Microprocessors Architecture-Programming and Applications, Wileyand Sons Ltd., New Delhi, 1990.

LIST OF EXPERIMENTS
1. 16 Channel Analog to Digital Converter & Generation of Ramp, Square, Triangular wave by Digital to Analog Converter.
2. Study of Different Avionics Data Buses.
3. MIL-Std - 1553 Data Buses Configuration with Message transfer.
4. MIL-Std - 1553 Remote Terminal Configuration.
5. Multiplexer/ Demultiplexer Circuits.
6. Encoder/Decoder Circuits.
7. Timer Circuits, Shift Registers, Binary Comparator Circuits.
8. Addition and Subtraction of 8-bit and 16-bit numbers.
9. Greatest in a given series & Multi-byte addition in BCD mode.
10. Interface programming with 4 digit 7 segment Display & Switches & LED's

AE-705
Aircraft Materials and Composite

UNIT I: METALS AND ALLOYS

Introduction to Aerospace materials: Classification, composition, properties, heat treatment & application in plain carbon steels, Alloy steels. Stainless steels, heat treatment & application in aluminium and its alloys. Introduction to oxidation and hot corrosion.

UNIT II: COMPOSITE MATERIALS AND PROPERTIES

Introduction to composite materials: Definition – Classification of Composite materials based on structure – based on matrix. Advantages of composites – application of composites – functional requirements of reinforcement and matrix. FIBERS: properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers.

UNIT III: MANUFACTURING OF ADVANCED COMPOSITES

Polymer matrix composites: Metal Matrix Composites, manufacturing and application, Casting – Solid State diffusion technique, Cladding – Hot-iso static pressing.

UNIT IV: CREEPAND FRACTURE

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. Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship. Various types of fracture, brittle & ductile, low temperature & high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides. Fatigue of aircraft materials.

UNIT V: SUPERALLOYS AND HIGH TEMPERATURE MATERIALS

Iron base, Nickel base and Cobalt base super alloys, titanium alloys composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, high temperature ceramics.

TEXT BOOKS

1. Material Science and Technology – Vol 13 – Composites by Cahn – VCH, West Germany Composite Materials – K.K. Chawla.
2. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Noastrand Reinhold Company, New York 1998.
3. Jones, R.M., "Mechanics of Composite Materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1985.
4. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites", John Wiley and sons. Inc., New York, 1995.
5. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.

LIST OF EXPERIMENTS

1. Determination of mechanical properties of plain carbon steel using heat treatment techniques.
2. Solution treatment and hardening of Al-Mg and Al-Cu base alloys.
3. Fatigue and creep behavior iron base alloys.
4. Convert the Load-Displacement data to Stress-Strain data and plot out the Stress versus Strain curve for each specimen.
5. From the Stress-Strain curves, determine the Elastic Modulus (E1) and Ultimate Strength (SU1) for each sample tested.
6. Compare the theoretically determined Longitudinal and Transverse Moduli (EL and ET) obtained in step 2 with the experimentally determined Longitudinal and Transverse Moduli (EL and ET) in step 6. Comment on any differences.
7. Calculate the Elastic Modulus along the loading axis, E1, and the In-Plane Poisson's Ratio along the loading axis, $\nu 12$, for each orientation tested based on the experimentally obtained values of Longitudinal and Transverse Moduli and the calculated values of the In-Plane Shear Modulus and the Major Poisson's Ratio.
8. Compare the stiffness and strength results of the polymers tested with the results of the Graphite /epoxy composite.
9. Calculate the Longitudinal and Transverse Moduli (EL and ET respectively) based on the fiber and matrix property data for IM7/8551.
10. Calculate the Major In-Plane Shear Modulus (GLT) and the Major Poisson's Ratio (ν LT) for the IM7/8551 unidirectional composite being investigated.

AE -706
Minor Project & Seminar

The objective of the project work phase – I/ Minor project is to prepare students for undertaking useful/application oriented project on current topic of the subject concerned. Preparation of the project work involves.

- ✓ Form a team / group of likeminded students (not more than 6 in numbers) to carry out the project.
- ✓ Make a literature survey and data collection or literature review of the project proposed.
- ✓ Publish or present a paper on the proposed work in any one of the National/ International Seminars or Journals.

Plan for necessary supports, facilities, analytical tools and fixation of faculties /supervisors for the final semester Major project/ project work phase – II.