

COURSE STRUCTURE & SYLLABUS OF BACHELOR OF TECHNOLOGY (B.TECH)

***In* MECHANICAL**

Course Structure

Fourth Year

Seventh Semester

ELECTIVE - I

Paper Code	Name of the Subject
BEME5- I	Mechatronics
BEME5- II	Concurrent Engineering
BEME5- III	Management of Technology
BEME5- IV	Machine Vibration Analysis

BEME5-I:MECHATRONICS

1 INTRODUCTION

What is Mechatronics? , Scope of Mechatronics, Key Issue

2 INTRODUCTION TO MODERN CNC MACHINES AND MANUFACTURING SYSTEMS

Introduction, Advantages of CNC Machines, CNC Machining Centre Developments, Turning Centre Developments, Tool Monitoring on CNC Machines, Other CNC Developments, Advanced Manufacturing Systems, Benefits of an FMS, Trends in Adoption of FMSs

3 ELECTRONICS FOR MECHANICAL ENGINEERS

Introduction, Conductors, Insulators and Semiconductors, Passive Components used in Electronics, Transformers, Semiconductors, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC) , Digital Circuits

4 DESIGN OF MODERN CNC MACHINES AND MECHATRONIC ELEMENTS

Introduction, Machine Structure, Guideways, Feed Drives, Spindle/Spindle Bearings, Measuring Systems, Controls, Software and User Interface, Gauging, Tool Monitoring System

5 DRIVES AND ELECTRICALS

Drives, Spindle Drives , Feed Drives , DC Motors , Servo-principle , Drive Optimisation ,Drive Protection , Selection Criteria for AC Drives , Electric Elements , Wiring of Electrical Cabinets Power Supply for CNC Machines , Electrical Standard , Electrical Panel Cooling (Air Conditioning)

6 CNC SYSTEMS

Introduction , Configuration of the CNC System ,Interfacing , Monitoring , Diagnostics , Machine Data , Compensations for Machine Accuracies , PLC Programming , Direct Numerical Control (DNC)

7 PROGRAMMING AND OPERATION OF CNC MACHINES

Introduction to Part Programming , Coordinate System ,Dimensioning ,Axes and Motion nomenclature ,Structure of a Part Program , Word Addressed Format , G02/G03 Circular Interpolation , Tool Compensation , Subroutines (Macros) , Canned Cycles (G81-G89), Mirror Image, Parametric Programming (User Macros) and R-Parameters , G96 S... Constant Cutting Speed and G97 Constant Speed ,Machining Cycles , Programming Example for Machining Centre ,Programming Example for Turning Centre.

8 INDUSTRIAL DESIGN, AESTHETICS AND ERGONOMICS

Introduction, Elements of Product Design , Ergonomic Factors for Advanced Manufacturing Systems

9 INTRODUCTION TO COMPUTERS AND CAD/CAM

Introduction to Computers, CAD/CAM Systems,

BEME5-II: CONCURRENT ENGINEERING

1. INTRODUCTION TO PRODUCT DESIGN : ASIMOW'S MODEL

Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-Consumption Cycle, The Morphology of Design (The Seven Phases), Primary Design Phases and Flowcharting – The 25 Steps, Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly, Summary of Detailed Design Phase.

2. PRODUCT DESIGN PRACTICE AND INDUSTRY

Introduction, Product Strategies, Time to Market, Analysis of the Product, The Three S's, Standardization, Renard Series (Preferred Numbers), Simplification, The Designer and His Role, The Designer : Myth and Reality, The Industrial Design Organization, Basic Design Considerations, Problems faced by Industrial Designer, Procedure adopted by Industrial Designer, Types of Models designer by Industrial Designers, What the Designer contributes, Roles of Aesthetics in Product design, Functional Design Practice

3. STRENGTH CONSIDERATION IN PRODUCT DESIGN

Principal Stress Trajectories (Force-Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression

4. DESIGN FOR STIFFNESS AND RIGIDITY

Pure Struts and Pure Columns, Structure involving both Tension and Compression members,, Mapping of Principal Stress, Buckling and Instability, Theory of Long Columns, Hollow Columns, Plastic Design, Practical Ideas for material Saving in design, Ribs, Corrugations, Laminates and Membranes

5. PRODUCTION PROCESSES

Introduction, Primary Processes, Machining Processes, Non-traditional Machining Processes.

6. DESIGN FOR PRODUCTION – METAL PARTS

Producibility Requirements in the Design of the Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease

of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design of Powder Metallurgical Parts, Expanded Metals and Wire Forms

7. OPTIMIZATION IN DESIGN

Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design

8. ECONOMIC FACTORS INFLUENCING DESIGN

Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in Relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model)

9. HUMAN ENGINEERING CONSIDERATIONS IN PRODUCT DESIGN

Introduction, Human Being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Control, The Design of Displays, Man/Machine Information Exchange.

10. VALUE ENGINEERING AND PRODUCT DESIGN

Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis job plan, Creativity, Steps to Problem – solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Check list, Cost reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.

11. ROLE OF COMPUTER IN PRODUCT DESIGN, MANUFACTURING AND MANAGEMENT

CAD/CAM: Some Definitions, Product Cycle and CAD/CAM, Role of Computer in Manufacturing, Role of Computer in Design Process, Creation of a Manufacturing Database, Computer Integrated Manufacturing, Communication Networks, Group Technology, Production Flow Analysis (PFA), Computer Aided Process Planning (CAPP), Material Requirement Planning (MRP), Moving Towards Total Automation: Role of Artificial Intelligence, Flexible Manufacturing Systems, Just-In-Time (JIT) Manufacturing

12. MODERN APPROACHES TO PRODUCT DESIGN

Concurrent Design, Quality Function Development (QFD), Rapid Prototyping

13. QUALITY ASSURANCE IN PRODUCT DESIGN AND MANUFACTURING

Evolution of Quality Concepts and Applications, Quality and Design Spiral, Theory of Sampling Inspection, Control Charts and In-process Monitoring of Quality, Quality of Performance: Reliability and Allied Topics Taguchi Method of Robust Design of Products, Six-Sigma Quality Concepts.

BEME5-III: MANAGEMENT OF TECHNOLOGY

1. NATURE OF ORGANIZATION

Introduction, objectives, the need for corporate objectives, the mission statement, managing by objectives, the legal establishment of organizations., companies, franchising, strategies for survival, strategic marketing, simultaneous engineering , manufacturing strategies

2. FUNCTIONS OF ORGANIZATION

Introduction, objectives, purchasing, the role of the purchasing function, organization of the purchasing function, activities in purchasing, management activities in the operations area, organization of manufacturing, market research, customers and markets, sales, finance, organization of the finance department, Activities of the finance department, product development, Activities of the product development function, organization of the product development function, research , quality, quality systems, management activities in the quality function, organization of the quality function, personnel, manpower planning, employee appraisal, recruitment and selection, company operation and the role of engineers.

3. PRODUCT DEVELOPMENT

Introduction, objectives, customer and product development, product life cycles and gap analysis, gap analysis, the ideal product development process, managing the product development process, models of the process, pugh, pahl and beitz, company structure for product development, research, development, engineering and manufacturing (rdem), project approach, matrix, finance and product development, management techniques in product development, identifying customer needs, product design specification (pds), decision making, drawings and drawing management, drawing in practice, the drawing office, preparation, drawing release, drawing modification, design reviews, intellectual property rights, trade marks.

4. OPERATIONS MANAGEMENT

Introduction, objectives, organization of manufacturing, job production, batch production, flow production, group technology, production planning and control, part specifications, product data, economic batch quantity, the schedules, materials management, purchasing, centralization and decentralization of purchase department, purchasing procedure, stores, material requirement planning (mrp), terms used in material requirements planning, dependent demand, lumpy demand, lead time, how mrp uses lead time information, master production schedule (mps), bill of material (bom) file, inventory status file, output of mrp, benefits of mrp, drawbacks of mrp, just in time (jit) in production system, push system vs pull system, kanban and pull system, calculation for number of kanban, an analogy to jit, requirements for implementing jit, preliminaries to jit production, jit production process, evaluation of jit production.

5. QUALITY MANAGEMENT

Introduction, objectives, inspection and test, quality control, quality assurance and iso 9000, total quality management (tqm), what is quality, dimensions of quality, total quality management (tqm), quality gurus, deming's approach to tqm, joseph m. Juran, principal objectives of tqm, principal objectives of tqm, management in tqm, elements of tqm, Customer satisfaction evaluation, seven qc tools for improvement, implementation of tqm, iso 9000, iso 9000 vs tqm, standards indian standard institution, his publications.

6. PROJECT PLANNING AND MANAGEMENT .

Introduction, objectives, projects and management, network analysis, finding the critical path, project float, gantt charts, resource analysis, planning under uncertainty

7. PERSONNEL MANAGEMENT.

Introduction, objectives, structure of organizations, methods of company organization, deployment of personnel, factors that affect company organization, product and manufacturing system, functions and expertise, definition of personnel management, principles of personnel management, functions of personnel management, recruitment and selection of employees manpower planning, types of manpower planning, steps in manpower planning, procedure of appointing an employee in a factory, training and development, organisation of training programme, principles of training, method of training operating employees, methods of training foreman and supervisors, methods of training executives or managerial executive development, appraisal of employees, the aims of an appraisal scheme, formal appraisal schemes, the appraisal form, the appraisal interview, two- interview appraisals, the implications of an appraisal system, motivation, human needs, maslow's theory of motivation, leadership introduction, different styles of leadership are as follows.

8. TEAM WORKING AND CREATIVITY

Introduction, objectives, overview, team working, holistic teams, group dynamics, the needs of the group, meeting these needs –group dynamics, norms, group culture, managing the creative process, planning innovation, planning techniques for the innovative process, problem solving, brainstorming, decision making, start with objectives

9. COMMUNICATION SKILL

Introduction, objective, communication in the workplace, the purpose of a communication system.

communication methods and aids., information gathering, sources of information, assimilation and organizing information ,written communication, factor affecting written communication, preparation of creative writing, specific writing techniques, using a computer for written communication, oral communications, factors that affect oral communications, active listening, oral presentations, making the presentation, interviews, negotiations, the telephone, managing meetings

10. THE VOCATION OF ENGINEERING MANAGEMENT.

Introduction, objectives, the cu100 project at oxford lasers ltd, customer requirements, recruitment, the design report, detailed design and manufacture, problems and delays, disconnection safety, testing, epilogue, the cu 100 project debrief, communication skills.

BEME5-IV: MACHINE VIBRATION ANALYSIS

1. OSCILLATORY MOTION

Harmonic Motion, Periodic Motion, Vibration Terminology.

2. FREE VIBRATION

Vibration Model, Equations of Motion – Natural Frequency, Energy Method, Rayleigh Method : Effective Mass, Principle of Virtual Work, Viscously Damped Free Vibration, Logarithmic Decrement, Coulomb Damping.

3. HARMONICALLY EXCITED VIBRATION

Forced Harmonic Vibration, Rotating Unbalance, Rotor Unbalance, Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent Viscous Damping, Structural Damping, Sharpness of Resonance, Vibration Measuring Instruments.

4. INTRODUCTION TO MULTI-DEGREE OF FREEDOM SYSTEMS

Normal Mode Vibration, Co-ordinate Coupling, Forced Harmonic Vibration, Digital Computation, Vibration Absorber, Centrifugal Pendulum Vibration Absorber, Vibration Damper.

5. PROPERTIES OF VIBRATING SYSTEMS

Flexibility Matrix, Stiffness Matrix, Stiffness of Beam Elements, Eigenvalues and Eigenvectors, Orthogonal Properties of the Eigenvectors, Repeated Roots, Modal Matrix P, Modal Damping in Forced Vibration, Normal Mode Summation.

6. LAGRANGE'S EQUATION

Generalized Co-ordinates, Virtual work, Lagrange's Equation, Kinetic Energy, Potential Energy, and Generalized Force.

7. NORMAL MODE VIBRATION OF CONTINUOUS SYSTEMS

Vibrating String, Longitudinal Vibration of Rods, Torsional Vibration of Rods, Euler Equation for Beams, Effect of Rotary Inertia and Shear Deformation.

8. APPROXIMATE NUMERICAL METHODS

Rayleigh Method, Dunkerley's Equation, Rayleigh-Ritz Method, Method of Matrix Iteration, Calculation of Higher Modes.

9. NUMERICAL PROCEDURES FOR LUMPED MASS SYSTEMS

Holzer Method, Digital Computer Program for the Torsional System, Myklestad's Method for Beams, Coupled Flexure- Torsion Vibration, Transfer Matrices, Systems with Damping, Geared System, Branched Systems, Transfer Matrices for Beams, Difference Equation.
