

Fourth Year First Semester

Prod/T/411 NON-TRADITIONAL MACHINING

Introduction to new methods of production; Need and capability analysis of various processes; Classification and selection of non-traditional machining technologies. Abrasive processes of machining including Abrasive Jet machining (AJM), Water Jet Machining (WJM) and ultrasonic machining (USM). Chemical machining (CHM), Hot chlorine machining, Electrochemical machining (ECM): Electrochemical deburring and honing: Electrochemical Grinding (ECG); Electrochemical Discharge Machining (ECDM); Electrochemical Arc Machining (ECAM). Electrical discharge machining (EDM); wire EDM, Electron beam machining (EBM); Plasma arc machining (PAM); Laser beam machining (LBM); Ion beam machining (IBM), Neutral particle etching. Cryogenic machining; Hot machining, stretched turning; Dynamic cutting; Magnetic

cutting; Oscillating turning; Ballistic machining. Selecting the most suitable process for a product; Economic analysis of non-traditional machining processes.

Prod/T/412 PRODUCTION ECONOMICS AND FINANCIAL MANAGEMENT

Interaction between economics theory and production and management decision making, concept of firm, industry and economy. Consumer behaviour utility, indifference curves and maps, consumers' surplus, demand determinations, demand function. Production function, economy of scale, effect of technology, equilibrium condition, optimal expansion path, short and long run cost functions. Perfect competition and monopoly, equilibrium of firm and industries, different models of firm. Determination of price, price discrimination, pricing of joint products. Form of business organizations Analysis and interpretation of financial statements, Capital structure, Working capital management, Depreciation and taxes, cash flow modeling (deterministic & risky), Capital budgeting, Project evaluation and comparison, Cost of Capital, replacement Analysis, utility of projects.

Prod/T/413 CNC MACHINES AND ROBOTICS

Basic principles of numerical control; Methods of coding Computer Numerical Control (CNC) System, Machine Structure, drive system, motion elements, Incremental and Absolute position encoders, velocity sensors CNC programming G and M code, Turning centre, Machining centre canned cycle, Subprogram, loops, CNC Tooling. Economics of numerical control and DNC. Introduction to Robotics: Robot anatomy; Hydraulic, pneumatic and electrical manipulators; Controllers with microprocessors of fluidics; Sensors; End effectors and their design; Performance analysis of industrial robots; Economics of robotics.

Prod/T/414 PLANT AND MAINTENANCE ENGINEERING

Introduction: Emphasising the functional similarity as a conversion medium of different types of plants; Common features in terms of infrastructural input requirements; some typical plant, and their system configurations. Climatological, economic, social legal, political, industrial determinants of site selection; Establishing various kinds of weighing coefficients of these factors in relation to the nature of the plant. Techno-economic viability study, Depreciation, LCC, Replacement analysis Concept of reliability, availability and maintainability (RAM); System reliability; Reliability improvement; FTA, FMEA, FMECA, Maintenance Planning and Control, Design of maintenance systems; Spare parts managements, Kaizen,

Terotechnology, SWOT analysis; Multipractice of safety engineering. An executive overview of six sigma, gearing up and adapting six sigma to plants, implementing six sigma; Introduction to benchmarking, the strategic application of benchmarking for best practice, the process of benchmarking in practice. Performance evaluation of plants

Prod/T/415 OPERATIONS RESEARCH

Linear Programming, Simplex method, Duality and Sensitivity analysis, Transportation model and its variants, network models, Revised simplex methods, Integer programming: Game Theory, Queueing systems, simulation Modeling, Markovian Decision Process, Non linear models

Prod/S/411 AUTOMATION, CNC MACHINES AND ROBOTICS LABORATORY

Experiments to demonstrate: A) Principles of automation B) Limit stops and CAM control devices C) Pneumatic, hydraulic, electrical systems in automation D) Microprocessor applications in automated systems E) CNC machines and programming F) Robotic Systems and Programming G) Automated transfer devices.

Prod/S/412 MACHINE TOOLS AND METAL CUTTING LABORATORY

(A) Experiments will be performed to illustrate: a) Kinematic structures of machine tool drives, b) Compliance characteristics c) Tribological behaviours of machine tool slideways d) Hydraulic and pneumatic control systems e) Use of mass production machine tools, f) Acceptance tests. (B) Experiments to illustrate: a) Chip formation characteristics b) Dynamometry and force measurement during machining c) Wear and tool life d) Grinding and lapping

Prod/S/413 MANUFACTURING PROJECT

Assignment of individual/ Group project involving manufacturing/Production of an engineering product

Prod/S/414 SEMINAR

Each student will be required to give a seminar talk along with a report on any current topic with audiovisual aids, graphs, charts and models as assigned to them on individual basis.

Fourth Year Second Semester

Prod/T/421 COMPUTER INTEGRATED MANUFACTURING

Concept of computer integrated manufacturing (CIM); Basic components of CIM; Distributed data base system; Distributed communication system, Computer networks for manufacturing; Future automated factory; Social and economic factors. Computer Aided Design (CAD); CAD hardware and software; Product modelling; Automatic drafting; Engineering analysis; FEM design review and evaluation; Group technology centre. Computer Aided Manufacturing (CAM): Computer assisted NC-part programming; Computer assisted robot programming; Computer aided process planning (CAPP); Computer-aided material requirements planning (MRP); Computer aided production scheduling; Computer aided inspection planning; Computer aided inventory planning.

Flexible manufacturing system (FMS); Concept of flexible manufacturing; Integrating NC machines, robots, AGVs, and other NC equipment; Computer aided quality control; Business functions; Computer-aided forecasting; Office automation.

Prod/T/422 ECOLOGY AND ENVIRONMENT

Development dynamics in environment perspective; Macro principles of eco- development; Continuing, renewable, non-renewable and extrinsic sources in eco- systems; Bio-sphere cycle, o₂ - co₂ cycles and other natural eco-systems. Demographic structure; Population growth and other human factors in development processes; The economics of eco-development; Cost-benefit analysis of pollution abatement. Problems of technological choice and technological transfer; Extent, ideals, exogenies and policies of alternative development systems; Eco-development desideration; Devising strategies and operational tactics for planning of projects compatible to eco-systems. Systems approach to modelling of eco-systems in general. UNO and ISO directives on protection of environment. Design for Environment. Environmental pollution and its control strategies.

Prod/T/423 PLANNING AND EVALUATION OF PROJECTS

Project Definition: Project study techniques: Project management features; Management information and control systems for projects; Project organization design: Plant location analysis models; Project scheduling; Gantt charts, PERT, CPM, RAMPS, multi-project control; Project cost optimization time cost Trade off: Crashing; decompression, Resources and resource allocation; Decision making theories in management under certainty, risk, uncertainty and competitive situations; Application of the methodologies and formation in project decision making problem solutions; Project capital, cost estimation: Breakeven analysis, Cost-benefit analysis: Profitability analysis, commercial and notional profitability; Management and human factor analysis, Project Risk Management.

Prod/T/424 ELECTIVE-I (TECHNOLOGY ELECTIVES)

1. TRIBOLOGY

2. TEROTECHNOLOGY

3. ROBOTIC TECHNOLOGY

4. PRODUCT DESIGN

5. FINITE ELEMENT METHOD AND APPLICATIONS

6. CONCURRENT ENGINEERING AND AGILE MANUFACTURING 7. PRECISION ENGINEERING

Prod/T/424A TRIBOLOGY

Introduction to Tribological Systems and their Characteristic Features: Physico- mechanical interactions at interfacial contact surfaces: Analysis and assessment of topography; Deterministic and stochastic tribo-models for asperity contact, frictional



resistance and wear; Frictional instability and stick-slip phenomenon; Models of adhesion-diffusion wear process; kinetics of solid state interfacial interactions. Principles of Lubrication: Hydro-dynamic, hydro-static, elasto-hydrodynamic cases; Boundary film lubrication; Solid lubricants; Tribological design of machine elements and systems; Principles of life-cycle analysis and their application.

Prod/T/424B TEROTECHNOLOGY

Life cycle cost analysis of plants and concept of terotechnology; Various maintenance management strategies; Production maintenance interface and Terotechnology based planning and control; Maintenance policy determination; Fixed time replacement of repair prior to failure; Concept of health and usage monitoring of plants (HUM); Condition based maintenance; Opportunity maintenance; Design-out maintenance; Preventive maintenance programme; Corrective maintenance guide-lines; Maintenance organization; Analysis of reliability, maintainability and availability of plants and equipment; Replacement strategies; Trade force mix, trade force location and trade force size for maintenance resource structure; Quantitative techniques, such as, queueing theory, simulation, etc, for determining optimum disposition and size of maintenance resources; Network analysis like CPM, PERT etc. for planning and control of Terotechnology; Condition monitoring methods in terotechnology, LEO approach for formalised assessment of monitoring techniques; Management techniques in terotechnology; Logical fault finding; Behavioural science and terotechnology, Maintenance indices, Computer application in terotechnology based critical analyses.

Prod/T/424C ROBOTIC TECHNOLOGY

A. INTRODUCTION TO ROBOTICS: Basic concepts, Major components, Work-environment, Payload, Degree of freedom, Classification of Robot Systems. B. DRIVE AND CONTROL SYSTEMS: Types of drive system - hydraulic, pneumatic and electric, Open loop and closed loop control systems for robot drive. C. ROBOT END-EFFECTORS: Grippers and Tools, Types of robot grippers - mechanical, magnetic, vacuum, adhesive. D. ROBOT KINEMATIC: Homogeneous coordinates and homogeneous transformations, Direct and indirect kinematics in robotics. E. SENSOR SYSTEMS IN ROBOTICS: Internal external sensors, Contact and non-contact sensors; Position and velocity sensors; Touch and slip sensors, Force and torque sensors, Tactile sensors, Proximity and range sensors. F. ROBOT VISION SYSTEM: Imaging devices and image acquisition, Image processing and analysis - preprocessing, segmentation, feature extraction and object recognition, Robot vision applications. G. ROBOT PROGRAMMING: Robot programming methods - lead-through programming methods and textual robot languages, Elements and functions of a robot language. H. ROBOT APPLICATIONS: General applications of robots in material handling, machine loading and unloading, welding, spray painting and assembly.

Prod/T/424D PRODUCT DESIGN

Role of Products in Manufacturing Systems: Increasing emphasis on product orientation in design of manufacturing systems. Engineering design principles. Role of quantification. Interaction between production-design-market status and technological progress. Elements analysis and value engineering - their implication in financial parameters. Modular Design Concepts, Inversions.

Prod/T/424E FINITE ELEMENT METHOD AND APPLICATIONS

One dimensional problems: Finite elements modelling, Co-ordinates and shape functions, Potential Energy Approach, Galerkin Approach, Assembly of Global Stiffness Matrix and Load Vector, Finite Element equations. Truss problems: Plane trusses, Three- dimensional trusses, Two dimensional problems: Finite element modelling, constant strain triangle, Problem modelling and Boundary conditions, Axisymmetric Solids subjected to axisymmetric loading, Two dimensional isoparametric elements, Beams and Frames, Three-dimensional problems: Finite element formulation, mesh preparation, Stress evaluation. Scalar field problems: Steady state Heat Transfer, Torsion, Potential flow, Seepage, Electric and Magnetic fields, fluid flow in ducts. Dynamic considerations: Element mass matrices, Eigenvalues and Eigenvectors, determining critical speeds of shafts. Pre-processing and post-processing.

Prod/T/424F CONCURRENT ENGINEERING AND AGILE MANUFACTURING

1. Concurrent Engineering: Concept, definitions and issues - (Organizational & managerial issues, Design Maturity) 2. Product introduction Process: Variety in structure and processes 3. Essential Techniques for CE: QFD, DFM, DFA, RP 4. Information Technology Approach to CE: design to Distribution 5. People issue in CE: Restructuring the organization. 6. Product Design, Support & management Tools for CE. 7. Basic Flexible Manufacturing considerations.

Prod/T/424G PRECISION ENGINEERING

Precision Engineering: Fundamentals and Principles. Precision Machine Design: Analysis and Synthesis of mechanical systems, Micro-systems, Sensor and actuator applications, Mechatronic technology, etc. Application of ultra precision motion controls for Micro Engineering, magnetostrictive actuators, piezoelectric systems. etc. Precision Manufacturing: Conventional Methods of Micromachining: Advanced Machine Tools , Mirror machining of soft materials, ultraprecision Mirror polishing of hard and brittle materials, finish turning, Boring, Grinding and Honning techniques etc. Non- conventional methods of micro machining: Chemical Micro machining (CMM) Plasma Etching, Chemical Etching, Laser Micro machining, Electrochemical Micro machining (EMM): Micro EDM, Electron Beam Lithography (EBL) Plasma Arc Micro Machining and Focused Ion Beam (FIB), etc. Precision Measurement & Quality Assurance: In process measurement and inspection, precision measurement techniques, Computer-aided measurement testing and diagnostics, surface integrity and other related measurements, etc.

Prod/T/425 ELECTIVE-II (MANAGEMENT ELECTIVES)

- 1. LOGISTICS AND SUPPLY CHAIN MANAGEMENT**
- 2. BEHAVIOURAL SCIENCE AND HUMAN RESOURCE MANAGEMENT**
- 3. RELIABILITY ENGINEERING**
- 4. DECISION SUPPORT SYSTEMS**
- 5. PRODUCTIVITY ENGINEERING**
- 6. TOTAL QUALITY MANAGEMENT**
- 7. ENTREPRENEURSHIP DEVELOPMENT**

Prod/T/425A LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Building blocks of a supply chain network. Business processes in supply chains. Types of supply chains and examples. Strategic, tactical, and operational decisions in supply chains. Supply chain performance measures. Supply chain inventory management: Newsboy, Base-stock, and (Q,r) models, multi-echelon supply chains, Performance modeling of supply chains using Markov chains and queueing networks. Mathematical programming models for supply chain planning, design and optimization. Best practice supply chain solutions. Internet-enabled supply chains: e-marketplaces, e-procurement, e- logistics, customer relationship management, web services, ERP an supply chains, supply chain automation, and supply chain integration.

Prod/T/425B BEHAVIOURAL SCIENCE AND HUMAN RESOURCE MANAGEMENT

Role of Behavioral Science in Man Management system; Cultural anthropology, sociology and industrial psychology in influencing human behaviour; Analysis of behaviour and interfaces required for total organizational functioning: Mc Gregor's: Theory Z, Theory Y and human resource management theory: Group Dynamics, Motivation: Content and process theories of motivation. Organization communication and various communication models; Dynamics of change; various organization behaviour analysis models, eclectic SOBC model: Organization socialization: Leadership styles, environmental influences: adaptation interaction, Intra and Inter group relations, conflict resolution: Management of human resource problems and various models for Human Resource Development (HRD): Application of Behavioural science models related to buyer behaviour. Consumer satisfaction. Organization performance effectiveness with case studies. Planning, recruitment and selection, job design, training and Development of Human Resources. Performance, Appraisal and Reward Systems, Selection of Team. Power and politics in organizations, approaches in labour relations, crisis management.

Prod/T/425C RELIABILITY ENGINEERING

Reliability concept; Reliability and probability; Maintainability availability; The tasks of reliability. Decision making and failure statistics; Failure probability, survival probability and age-specific failure rate; Weibull pdf; Application of failure statistics to reliability prediction for complex plants; FTA, FMEA, FMECA Plant availability assessment;

Stand-by systems, multi-unit stand-by systems; Derating and maintenance; Reliability testing: Accelerated testing; Sequential testing. Project management. Human reliability; Software reliability, Super-reliability; Safety factor and reliability. Reliability allocation; Effects of environment in reliability assessment; Solutions of reliability to a variety of real engineering problems.

Prod/T/425D DECISION SUPPORT SYSTEMS

Definition of System. Decision making and its relevance in management processing and retrieval in an effective way. Information flow analysis. System analysis and design. Framework of management of information system. Some typical DSS for functional areas like production, Finance, marketing and personnel. Application of Computer in DSS.

Prod/T/425E PRODUCTIVITY ENGINEERING

Productivity basic Measurement and evaluation of productivity, Development and implementation of a Productivity management Programme , Quality circle, SPC, total Quality control, CAPP, CIM/ factory automation, robotics, Concurrent engineering, Motivational theory, Participative management competitor analysis, value engineering, BPR Case studies.

Prod/T/425F TOTAL QUALITY MANAGEMENT

Introduction, Definition, the stage for normalcy for Management, concept of quality, the evaluation of quality approaches, SQC, Taguchi's OA, organizational culture, concepts of customer value, measuring customer value, organizing to improve systems; strategic linkage of operations through employees involvement; management role responsibilities. SPC, various quality standards. Kaizen, various quality tools i.e. Pareto chart etc. Quality Audits, Quality certification. Enhancing the quality of Environment: Green & Clean Manufacturing. Quality Design: product, System: QED, etc.

Prod/T/425G ENTREPRENEURSHIP DEVELOPMENT

Opportunity Recognition, Consumer/Market needs, Economics of market, Requirement of an entrepreneur, Negotiations, Book-Keeping, Costs and profits, Income statements, Cash flow statements and Balance Sheet statements, R-O-I, Reading (and using) Stock Market Journals, Selling, Marketing, Market Research, Taking competitive advantage of technology, Development and protection of inventions, Legal structures (of business), Selection of business, Financial strategies, Wholeseller to consumer-usage of Entrepreneurial skills, Banking and Investment, Filing of taxes and returns, Franchising and Licensing, Social Entrepreneurship, Writing a business plan.

Prod/T/426 GENERAL VIVA-VOCE

General Viva-Voce examination based on the laboratory experiments and exercises performed during pre-final and final year semesters.

Prod/S/421 NON-TRADITIONAL MACHINING LABORATORY

Modular experiments to illustrate and study various non-traditional production processes such as: (i) Abrasive jet machining (AJM) and Ultrasonic machining (USM) (ii) Electrochemical machining (ECM), (iii) Electro-discharge machining (EDM) and Electrochemical arc machining (ECAM) (iv) Electron beam machining (EBM) and welding. (v) Laser beam machining (LBM) (vi) Plasma arc machining (PAM) (vii) Wire- Electro-discharge machining (WEDM) (viii) Electrochemical Discharge Machining (ECDM) and other non-traditional production processes.

Prod/S/422 PROJECT & THESIS

The project should be done on a subject related to technology/management topics. A presentation is to be given at the end of the project on the topic covered/study done/experiments conducted.

Prod/S/423 TECHNOLOGICAL ELECTIVE LABORATORIES/PROJECT

Commensurate with PROD/T/424 course.