THIRD YEAR

IM 303 PRODUCTION MANAGEMENT

Production Management & Systems:
Introduction to production Management; System concept; Functions of management; Managerial decision making; Models as decision aids.

Plant Location & Plant Layout:
Selection of region; Selection of community; Site selection; Location factor dependence; Sources of assistance; Plant location trends; Quantitative analysis; Plant layout; Product & process layout analysis and comparison; Material handling considerations in layout.

Production Planning & Control:
Formalized production planning; Production planning methods; Master scheduling; MRP; MRP inputs, MRP outputs; Product structures; Types of MRP; Capacity planning and control; Production control systems; Job shop scheduling; Production control charts; Scheduling techniques; Purchasing and procurement.

Planning & control Techniques:
Inventory control; types of inventory; Inventory costs; Independent versus dependent demand; EOQ/EPQ models; Types of control systems; Selective inventory control; Inventory system development; Project planning; CPM/PERT; Network development; Determination of activity times; Establishment of critical path; Probabilistic statements.

Cost Estimating:
Element of cost; Material cost, direct and indirect labour cost and Over head cost. Cost structure; Prime cost, Factory cost, Manufacturing cost, Total cost, Selling price; Estimation of cost elements; Methods of estimation; Economics of tooling.

Maintenance:
Types of maintenance; Breakdown maintenance; Preventive maintenance; Individual versus group replacement; Internal versus external maintenance.

IM 307 ADVANCE MANUFACTURING PROCESSES

Mechanics of Orthogonal Metal Cutting:
Chip formation; Thin-zone models for analysis; Shear angle relationships; Role of friction in metal cutting; Prediction of forces; Velocity relationships; Force and stress relationships.

Tool Life & Tool Wear:
Forms of wear in metal cutting, Tool life criteria, Variables affecting tool life, Taylor's tool life equation, Generalized tool life equation, Methods of tool life testing data. Economics of Metal Cutting: Application
of minimum cost per piece, maximum production rate, and maximum profit rate criteria in turning operations.

**Metal Forming:**

**Work Hardening:**
Tensile test, Mechanical properties, Nominal & true stress-strain curves, Work hardening expression, Behavior after necking, Direct compression, Bulge test, Plane-strain compression test.

**Bulk Forming Analysis:**
Ideal work method, efficiency factors, extrusion and rod drawing, force balance or slab analysis, deformation zone geometry, sheet drawing, flat rolling, direct compression in plane strain, sheet bending, formability.

**Hot & Cold Working of Metals:**
Advantages and limitations of Hot working and Cold working processes; Methods of Forging; Hammer forging; Die forging; Drop, Press and Upset forging; Construction of drop forging hammers; Forging defects and their causes.

**IM 308 OPERATIONS RESEARCH**

**Linear Programming:**

**Special Types of LP Problems:**
The transportation problem, North-west corner rule, Vogel’s approximation method, Russell’s method, Transshipment problem, Assignment problem.

**Queuing Theory:**
Basic Queuing process, Assumptions for analysis, Queuing discipline and characteristics, Service mechanism, The birth and death process, Steady-state measures of performance, Single-server models, Multiple-server models, Machine servicing model.

**Dynamic programming:**
Recursive nature of computations in DP, Forward and backward recursion, Selected DP applications.

**Simulation:**
Introduction to simulation and its application in manufacturing.
**ME 309  MACHINE DESIGN & CAD**

**Design of Machine elements:**
Shafts and columns; Fluctuating and shock loads; Torsional stiffness; Critical speeds; Introduction to flexible shafting; Connecting rods and crank shafts.

Bearing; Details design of journal bearing and roller bearings including spherical and tapered roller bearings; Theory and application of lubrication and its methods.

**Design of Drive Units and Assemblies:**
Gearing; Design of the spur, helical, worm and bevel gear, Design of gear boxes. Chain drives; Design of chains including drag chain conveyer, apron feeders; Belt drives and belt conveyors; Motors and brakes.

**Fundamentals of CAD:**
Introduction, the design process, application of computers for design, creating the manufacturing data base, benefits of CAD.

**Computer Graphics Software and Data Base:**
Constructing the geometry, defining the graphic elements, editing the geometry, display control & windowing functions, data base structure and content, wire-frame versus solid modeling: wire frame models, solid models, other CAD features and CAD/CAM integration.

**Mathematical Elements of CAD:**
Transformation: Two & three dimensional transformations, Translation, Scaling, and Rotation, Concatenation, plane curves, space curves, surface description & generation, various techniques for design optimization.

**IM 310  TOOL DESIGN**

**Jigs and Fixtures:**

**Locating and Clamping Methods:**

**Design of Cutting Tools:**
Design of tools for cutting operations. Single point tools for lathe and boring operations. Multiple point tools for milling and drilling operations.

**Design of Dies and Moulds:**
dies. **Design of Moulds for plastic and Rubber Parts.** Pressure, Die Casting, Injection and Blow moulding.

**IM 311  INDUSTRIAL QUALITY CONTROL**

**Fundamentals of Probability & Statistics:**
Set theory & set operations; Venn diagram; Definition of probability; Probability laws; Conditional probability.

Deterministic & probabilistic data; Grouping of data; Measures of central tendency & dispersion; calculation of mean, mode, median; standard deviation, & range, weighted average, & coefficient of variation.

Random variable; discrete & continuous random variable; Mathematical expectation; Laws of expectation.

**Probability Distributions:**
Discrete probability distributions: Uniform, Binomial, Multinomial, Hyper geometric & Poisson distribution.

Continuous probability distributions: Normal & Exponential distributions; Transformation of variables; Random sampling; Sampling distribution of mean; Central limit theorem.

**Control Charts:**

**Acceptance Sampling:**
Introduction, OC curve, consumer & producer risks, AQL & LTPD, sampling errors, acceptance sampling for continuous production, acceptance by variables, single, double, & sequential sampling.

**Quality, Reliability, & Maintainability:**
Definitions, management of quality control, total quality control, Taguchi loss function, economic aspects of quality decisions, process capability & variability analysis, various aspects of life testing, reliability, & maintainability, Introduction to ISO 9000.

**ME 302  SOLID MECHANICS - II**

**Bending Stress:**
Asymmetrical bending; Shear stress in thin-walled open sections and shear center; General case of bending of a thin-walled open section; Bending of initially curved bars; Beams with small radii of curvature.

**Elastic Strain Energy:**
Strain energy under direct stress and in pure shear; Strain energy in bending and in torsion in bending and in torsion; Maximum stress due to a suddenly applied load and due to impact; Bending deflection of a beam from an impact shear deflection; Theorems of Gastiglians and Maxwell’s Reciprocal Theorem.
Theory of Torsion:
Torsion of a thin tube of non-circular cross-section; Torsion of thin-rectangular strip; torsion of solid-rectangular and square cross-sections; Helical springs.

Statically Indeterminate Beams and Frames:
Double integration method; Superposition method; Virtual work; Compatibility and equilibrium methods.

Buckling Instability:
Struts having initial curvature; Empirical formulae; Crinkling; Members subjected to axial and transverse loading.

Stress and Strain Transformations and Relationships:
Two-directional stress systems; Mohr’s stress circle; principal stresses and planes; combined bending and torsion; Two-directional strain analysis; Normal and shear strain in terms of coordinate and maximum shear strain; Relationship between elastic constants.

Deformation Symmetrical about an Axis:
Thick-walled cylinders; Compound cylinders; Shrink fit, Rotating disk of uniform thickness.

EE 373 MACHINE CONTROL SYSTEMS

Open and closed loop control, feedback simple control system; sequence control, static switching and logic Switching Algebra.

Stability, accuracy, frequency and transient response.

Time Scale Effects
Linear control system, determination of system performance and design with reference to stability, Transient response, steady state accuracy and frequency response’ Laplace transformation method; Root Locus; Nyquist criteria and Bode plots; Conformal plotting.

Series parallel and feedback techniques of system compensation.
Three term pneumatic controller for chemical plants.

Control system types; regulations, Servomechanism.

Electrical, hydraulic and pneumatic amplifier.

Instrumentation:
Analysis of the performance of electro mechanical transducers used in control.

MS 333 ADVANCED CALCULUS & FOURIER ANALYSIS

Partial Differential Equation:
Basic concepts and formation of partial differential equations; Linear homogeneous partial differential equations and relations to ordinary differential equations; Solution of first order linear and special types
of second and higher order differential equations; D’ Alembert’s solution of the wave equation and two dimensional wave equations; Lagrange’s solution; Various standard forms.

**Fourier series:**
Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients; Expansion of function with arbitrary periods. Odd and even functions and their Fourier series; Half range expansions of Fourier series, “DFT and FFT, Fourier Spectrum”.

**Advance calculus:**
Define a stationary point of a function of several variables, define local maximum, and saddle point for a function of two variables the stationary points of a several variables, obtain higher partial derivatives of simple functions of two or more variables, iterated integrals, double and triple integrations with applications (area, centeroid, moment of inertia, surface area, and volume, use multiple integrals in solutions of engineering problems.

**Vector Calculus:**
Vector differential operator, directional derivative, gradient, divergence, curl of a vector field, and laplacian operators with applications. (Solenoid, conservative, etc).
Vector Integrations; Evaluate line integrals along simple paths, apply line integrals to calculate work done, apply Green’s theorem in the plane to simple examples, evaluate surface integrals over simple surface, use the jacobian to transform a problem a new co-ordinate system, apply Gauss’ divergence theorem to simple problems, apply Stokes’ theorem to simple examples.

**HS 303 ENGINEERING ECONOMICS**

**Introduction**
Engineering economy defined; Measures of financial effectiveness; Non-monetary factors and multiple objectives; principles of engineering economy.

**The Economic Environment**
Consumer and producer goods; Measures of economic worth; Price, Supply, & Demand relationship; Production; Factors of production; Laws of return.

**Cost Concepts & Analysis**
Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Breakeven analysis; Unit cost of production; Cost-benefit analysis; Feasibility studies; Value analysis in designing & purchasing.

**Time Value of Money**
Simple interest, Compound Interest, Cash flow diagrams, Interest formulas, Nominal versus effective interest rates, continuous compounding.

**Depreciation and Depletion**
Purpose of depreciation, types of depreciation, economic life, what can be depreciated?

**Comparing Alternatives**
Present economy, Selection among machines, materials, processes, and designs, Payback period method, Present worth method, Uniform annual cost method, Rate of return method, Alternatives having identical live, Alternatives having different lives.
Production Concepts & Mathematical Models
Manufacturing lead time; Production rate; Capacity; Utilization; Availability; Work in process; WIP and TIP ratios.

Linear Programming
Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems.

Capital Financing and Budgeting
Types of ownership; types of stock; Partnership & joint stock companies; Banking & specialized credit institutions.

Industrial Relations
Labour problems; Labour organizations; Prevention & settlement of disputes.

HS 304 BUSINESS COMMUNICATION & ETHICS

Business English:
Writing formal and business letters and memos; Drafting notices and minutes; Theoretical knowledge and comprehension of contracts and agreements; Preparing proposals and conducting and writing research project reports; Participating in seminars and interviews, and writing and presenting conference papers; Solving IELTS type papers.

Engineering Ethics:
Definition of code of ethics; Review of code of ethics of national and international engineering bodies. Relationship between ethics and human rights and their importance in human settlements and societies.

IM 402 COMPUTER AIDED MANUFACTURING (CAM)

Conventional Numerical Control:
Introduction, principles of Numerical Control, Hardware for Numerical Control, NC positioning systems, NC motion control systems, applications of numerical control, economics and justification.

NC Part Programming:
Manual part programming, computer assisted part programming, Lathe CAM Designer, Mill CAM, NC programming with interactive graphics.

Computer Controls in NC:
Problems with conventional NC, NC controller of technology, computer numerical control, direct numerical control, adaptive control machining systems, trends and new developments in NC.

Group Technology and Process Planning:
Part families, methods for developing part families; parts classification and coding, Hierarchical code, Attribute code, Hybrid code, introduction to various available classification and coding systems, Selecting a coding system, production flow analysis, benefits of group technology, machining cells. The role of
process planning in CAD / CAM integration, Approaches to process planning: Manual approach, Variant approach, Generative approach; introduction to various process planning systems.

**Programmable Logic Controllers (PLC’s):**
Functions of controllers, control devices, Programmable Logic Controllers: relay device components, switch, relay, counters, timers, relay logic, Programmable Controller Architecture: processor, memory, input/output, power supply, peripherals, Programming a Programmable Logic Controller: ladder diagram, ladder logic, timers and counters, programming examples.

**Design for Manufacturing (DFM):**
The meaning of DFM, schemes for DFM, axiomatic design, DFM guidelines, design for assembly, Taguchi method for Robust design, manufacturing process design rules, failure mode and effects analysis, summary of DFM tools.

**IM 405 FINITE ELEMENT ANALYSIS**

**Introduction:**
The early use of Finite Elements, matrix forces method, matrix stiffness method, interim period, variational principles and Finite Elements, recent developments.

**Variational Formulation and Approximation:**

**Finite Element Analysis of One-dimensional Problems:**
Basic Steps in FEA; Modeling, Discretization, Connectivity of Elements, Imposition of Boundary Conditions, Solutions & Post Processing; Applications to Heat Transfer, Fluid Mechanics, & solid Mechanics Problems.

**Finite Element Error Analysis:**
Approximation Errors, Various Measures of Errors, Convergence of Solutions, Accuracy of Solutions.

**Numerical Integration & Computer Implementation:**
Isoparametric Formulations, Numerical Integration, Natural Coordinates, Computer Implementation (Pre-processor, Processor, and Post-processor)

**Interpolating Functions, Numerical Integration & Modeling Considerations:**
Interpolating Techniques; Triangular, Rectangular, & Serendipity Elements; Coordinate Transformation; Integration on a Master Element; Modeling, Mesh Generation, Load Representation.

**Plane Elasticity:**
Assumptions of Plane Elasticity; Basic Equations, Weak Formulations; Principle of Virtual Displacement in Matrix Form; Finite Element Model, Matrix & Weak Form Model; Evaluation of Integrals.

**IM 408 AUTOMATION & ROBOTICS**

**Production Operations & Automation Strategies:**
Automation defined; Types of automation; Reasons for automation; Arguments for & against automation.
Manufacturing industries; Types of production; Functions in manufacturing; Organization & information processing in manufacturing; Plant layout; Production concepts & mathematical models; CIM, FMS/FMC, Automation strategies.

**Automotive Type Automation**
Automated flow lines; Methods of work-part transport; Transfer mechanism; Buffer storage; Control functions; Automation for machining operations; Design & fabrication considerations.

**Analysis of Automated Flow Lines & Line Balancing:**

**Automatic Control Systems and Components:**
Basic elements of automatic control system, Levels of automation, Analysis of regulated and servo control systems, Sensors, Actuators, Data conversion, Mechanical components of automation.

**Robotics Technology & Applications**
Robot anatomy, Robot Configurations, Accuracy & Repeatability, Robot specifications, End effectors, Kinematics and Dynamics of a 2-link Manipulator, Characteristics of Robot applications, Robot cell design, Types of Robot applications.