

Revised Syllabus

4-Year Bachelor of Production Engineering Course:

First Year First Semester

Prod/T/111 ENGINEERING MECHANICS

Parts I: **Statics** :A.Fundamentals of Mechanics. B.Important Vector Quantities: Displacement, Force, Moment. C. Free-body Diagram and Equations of Equilibrium: Some important special cases of equilibrium, Concurrent and Parallel forces in a plane and in space.D.Friction.E.Centre of Gravity, Centroid, First and Second Moments of Area, Moments of Inertia. F. Trusses : Method of joints, Method of Sections. G. Principle of Virtual Work.

Parts II : **Dynamics**: Kinematics: Kinematics of rectilinear and curvilinear motion of a particle, Motion of rigid bodies, Instantaneous center of rotation. B.Principle of Kinetics: Motion of a particle, Motion of a system of particles, Force, Mass & Acceleration, D Alembert's principle C. Work, Power and Energy: Kinetic energy of a particle, Work-energy in plane motion, Energy equation and conservation of energy, Acceleration from work-energy D. Impulse and Momentum: Linear Impulse & momentum, Angular Impulse & momentum, Conservation of momentum E. Friction F. Periodic Motion: Free vibrations

ETech/EE/T/112 ELECTRICAL TECHNOLOGY

DC Circuits: Kirchhoff's Laws. Maxwell's Loop Current Methods of Analysis. Star-Delta Conversion. Superposition Theorem. Thevenin's Theorem. Maximum Power Transfer. Magnetic Circuit: MMF, Flux ,Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap.AC 1 -phase: Periodic Waves and Sinusoids. Average and RMS Values, Form Factor, Peak. Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR. Series R-L-C Circuit ,Parallel R-L-C circuit. Resonance.Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence. Star and Delta connections. Power, V A, V AR, Power Factor _or balanced 3-phase circuits.Power Measurement: Wattmeter circuit connection. Power Measurement by two wattmeter methods in 3phase system.DC Machines: Construction and general principle of operation. Generator EMF Equation. Field connection ,shunt series and compound. Generator characteristics.Motor-equation and general operation. starting and speed control, torque -speed curve.1-PhaseTransformer: Construction. EMF equation. Phasor diagram. Equivalent circuits. Losses and Efficiency. Open circuit and Short circuit test.3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip ,torque equation, torquespeed curve.DOL starting and reduced voltage starting.3-Phase Synchronous Machines: Alternator, constructional features, EMF equation, synchronous reactance, power -angle characteristics.Concept of synchronous

motor.

Meters: DC and AC Ammeters and Voltmeters. Megger. Multiplier.

Prod/Math/T/113 MATHEMATICS-I

Rolle's theorem, Mean value theorem, Taylor's theorem, Indeterminate forms, Maxima and minima. Function of several variables: Limit and continuity, Partial derivatives, Differentials, Euler's theorem on homogeneous function, Partial derivatives of composite function, Implicit function, Taylor's theorem, Maxima and minima, Lagrange's method, Riemann Integration.

Determinants (upto order 4): Definition and properties, Solution of a system of linear equations by Cramer's rule.

Matrices: Definition Addition and multiplication of matrices, Transpose and inverse of a matrix, Solution of a system of linear equations by matrix method.

Application of calculus: Tangent and normal, Curvature, convexity and concavity.

Prod/Math/T/114 Mathematics-II

Ordinary Differential Equations: Differential equation of first order exact equation, linear as well as non-linear, Linear differential equation of second and higher orders with constant coefficients. Euler Cauchy equation, Method of variation of parameters.

Integral Transforms: Laplace transforms: Definition and properties, Inverse Laplace transform, Convolution, Application to ordinary differential equations.

Complex Analysis: Functions of a complex variable, Limit, Continuity and differentiability, Cauchy-Riemann Equations, Complex integration, Cauchy's fundamental theorem, Cauchy's integral formula, Taylor's theorem, Laurent's theorem, Singularity Pole Residue theorem, Contour integration.

Series solution of differential equations: Ordinary point and regular singularity of second order linear differential equations, Generating functions and recurrence relation, Orthogonal property of Legendre polynomials.

Ph/T/1B/115 PHYSICS-I

1. Use of vectors in particle mechanics, Unit vectors in spherical and cylindrical polar coordinates, Conservative vector fields and their potential functions - gravitational and electrostatic examples, Gradient of a scalar field, Equipotentials,

- States of equilibrium, Work and Energy, Conservation of energy, Motion in a central field and conservation of angular momentum.
2. Assumption for the kinetic theory of gases, Expression for pressure, Significance of temperature, Deduction of gas laws, Qualitative idea of (i) Maxwell's velocity distribution. (ii) degrees of freedom and equipartition of energy, Specific heat of gases at constant volume and constant pressure.
 3. Statistical description of a system of particles, Phase space, Microstates and macrostates, Boltzmann's formula for the entropy, Canonical partition function, Free energy and other thermodynamic quantities in terms of the partition function, Classical ideal gas, Equipartition theorem and its applications.
 4. Electric potential and intensity, Flux of electric field, Gauss's law and its application to problems with spherical and cylindrical symmetry, Capacitance-parallel plate and spherical condensers, Energy of a capacitor, Energy density of an electric field, Potential and field due to a dipole, Dielectric polarisation, Electric displacement vector, dielectric susceptibility.
 5. Biot-Savart law and Ampere's law in magnetostatics, Calculation of magnetic field in simple situations like (i) straight wire (ii) circular wire (at a point on the symmetry axis) and (iii) Solenoid.
 6. Time-varying fields, Faraday's law of electromagnetic induction, Self and mutual inductance, Resonance and oscillation in electrical circuits.
 7. Nature of light waves, Interference of light waves, Young's experiment, Spatial and temporal coherence, Fresnel bi-prism, Interference in thin film, Newton's rings, Measurement of film thickness and wavelength, Diffraction of light waves, Huygen's construction, Fresnel and Fraunhofer diffraction, Fraunhofer diffraction due to single slit and plane diffraction grating, Approximate rectilinear propagation of light, Zone plate, Polarisation of light waves, Polarisation by reflection, Brewster's law, Double refraction- ordinary extraordinary rays, Polaroid, Optical activity.
 8. Energy levels of the hydrogen atom and the Bohr atom model, X-ray spectra, X-ray diffraction, Bragg's law, Compton effect. De-Broglie waves, Particle diffraction, Uncertainty principle and its application.

Prod/T/116 PROJECTION & SPATIAL GRAPHICS

Objects, conditions and methods of projection; Classification of projections; Orthographic projection, Axonometric projections; Isometric, diametric and oblique projections; Sectional view, Auxiliary view, Revolved view. Basic principles of multi view drawing and Monge's projection; Points in quadrants and octants; Projection of lines and traces of a line; True relative positions of two planes, and of a straight line and a plane; Method of revolution; Projections of polyhedrons; Curved lines and surfaces; Contour mapping of curved surfaces; Plane sections of polyhedrons and curved surfaces; Intersection of planes and surfaces, and lines and surfaces; Development of curved surfaces

Ph/S/111 PHYSICS LABORATORY - I

Prod/S/112 GRAPHICS LABORATORY - I

Technical lettering ;classification of line ; dimensioning, construction of scales (linear & diagonal); different types of curves like Cycloid, Epicycloids, Hypocloid, Involute, Archimedean spiral, Orthographic projection; Isometric projection; Sectional view, Auxiliary view, Multi view of point & Line (Both quadrant & octant), True view of line, Slope of line, Type of different lines in space (Parallel , Intersecting & Skew), Perpendicular distance between two lines in space, Dihedral angle, Projection of planes in space, Projection of Polyhedrons & Revolute surface objects, Plane section of Polyhedrons & Revolute surface objects, Development of surfaces, Intersection of different objects.

Prod/S/113 TECHNICAL ARTS

Introduction to different materials in engineering practices with respect to their workability, formability and machinability with hand-tools and power tools: Specification, identification and use of hand-tools and sensitive machines: Datum selection, location layout and marking problems for wood, plastics and metals: Cutting shearing, chipping, sizing and finishing of woods, plastics and metals: Making temporary and permanent joints between materials by processes of mechanical fasteners chemical bonding & riveting. All exercise will be woven around a group of carefully designed product features involving material selection, technology decisions, choice of tooling and fixtures, layout marking and measurements. Processing of plastic products, Injection moulding and Blow moulding.

Prod/EE/S/114 ELECTRICAL TECHNOLOGY LABORATORY

To supplement the course on "**Electrical Technology**".

First Year Second Semester

Hum/T/121 HUMANITIES-B

English - 2 Pds/week - 50 Marks

Sociology - 2 Pds/week - 50 Marks

HUMANITIES

1. Basic writing ,reading and comprehension skills
2. Report, Covering Letter & Curriculum-Vitae writing
3. Selected Short Stories and Poems
4. Soft skill development – Genesis, definitions, importance, Philosophies of human life

SOCIOLOGY

1. Sociology: Nature and scope of Sociology - Sociology and other Social Sciences - Sociological Perspectives and explanation of Social issues
2. Society and Technology: Impact of Technology on the Society - A case study
3. Social Stratification: Systems of Social Stratification - determinants of Social Stratification - Functionalist, Conflict and Elitist perspectives on Social Stratification
4. Work: Meaning and experience of work: Postindustrial society- Post-Fordism and the Flexible Firm
5. Development - Conceptions of and approaches to development - The Roles of State and the Market in the Development
6. Globalization: The concept of globalization - globalization and the nation state - Development and globalization in post colonial times.
7. Industrial Policy and Technological change in India - The nature and Role of the State in India
8. Technology Transfer: The Concept and Types of Technology Transfer-Dynamics of Technology Transfer
9. Technology Assessment: The Concept - Steps involved in Technology Assessment
10. Environment: Sociological Perspectives on Environment - Environmental Tradition and values in ancient India
11. The Development of Management: Scientific Management - Organic Organization - Net Work organization - Post modern Organization - Debureaucratization - Transformation of Management
12. Technological Problems and the Modern Society: Selected Case Studies - Electric Power Crisis, Industrial and/or Environmental Disaster, or Nuclear Accident.

Prod/ T/122 MATERIALS SCIENCE & TECHNOLOGY

1. Nature and properties of materials, packing and crystal structure, crystal imperfections; Phase equilibrium and phase transformation; Physical & Mechanical properties of materials, Destructive & Non-destructive testing ,
2. Metallography; Binary phase equilibrium; Iron carbon equilibrium diagram and characteristics of alloy microstructure;
3. Heat-treatment processes : Annealing, Normalising, Hardening, Case Hardening, Tempering etc.; Furnace applications, Heat-treatment cycles & Evaluation.
4. Non-metallic materials: Visco-elastic materials, Kelvin solid, Plastic and other polymers, Introduction to Powder metallurgy, Ceramic and Composite materials.
5. Nano-materials : concept, properties, and applications. Nano-ceramics & nano-composites

Prod/Math/T/123 Mathematics-III

Vector Calculus: Vector functions, of a scalar variable, Derivative of vector function, Applications to mechanics, Gradient, divergence and curl, Vector integration, Line, Surface and Volume integrals, Green , Gauss and Stokes theorem, Applications.

Fourier series: Periodic function, Trigonometric series with sines and cosines. Euler formula, Fourier series, Dirichlet's conditions, Even and odd functions, Half range sine and cosine series.

Fourier Transforms: Definition and properties, Inverse Fourier transform, Convolution, Application to partial differential equation, Z-transforms, Definition and properties, Applications.

Partial differential equation: Solution of one dimensional wave and diffusion equations and two dimensional Laplace equation by the method of separation of variables, Applications to physical problems.

Prod/Math/T/124 THERMODYNAMICS

Introduction: microscopic and macroscopic viewpoints in thermodynamics, basic concepts of system, control volume, state, extensive and intensive property, equilibrium, processes etc; Zeroth law of thermodynamics: thermal equilibrium, temperature, principle of thermometry; Energy: different forms of energy, definitions, exergy; 1st law of thermodynamics: 1st law of thermodynamics for systems, its application in non-flow and flow processes, internal energy and enthalpy; 2nd law of thermodynamics: heat engine, heat pump, refrigerator, Carnot cycle; Statements of the 2nd law of thermodynamics, reversed heat engine cycle, reversibility and irreversibility, Carnot theorem, absolute thermodynamic temperature scale; Entropy: concept of entropy, entropy principle and its

applications, absolute entropy; Availability: available energy, quality of energy, useful work, thermodynamic functions; Properties of pure substances: thermodynamics properties of pure substances in solid, liquid and vapour phases, p-V-T behaviour, triple point, dryness fraction, Mollier chart; Properties of gases mixture: Laws of thermodynamics for gas mixtures, calculation of enthalpy, entropy, etc of gas mixtures; Refrigeration cycles: vapour compression refrigeration cycle, vapour absorption refrigeration cycle, p-h chart; Psychrometrics: dry and wet bulb temperature, relative and specific humidity, dew point and saturation temperature, psychrometric chart.

Prod/ET/T/125 BASIC ELECTRONICS ENGINEERING

Semiconductors: Elements of transistors & solid state devices. Single phase half-wave and full-wave rectifiers, filters, voltage amplifier, selection of operating point bias, gain of amplifier, equivalent circuits, frequency response, power amplifier, push-pull amplifier; Oscillators: multivibrators, saw tooth generators. Digital electronics: logic gates Boolean Algebra & Flip flop

Prod/CSE/T/121 COMPUTER PROGRAMMING & NUMERICAL ANALYSIS

1. Introduction to Computer System: Computer Organization - CPU, Memory (ROM, RAM), input-output units: Different levels of languages - High level, assembly and machine languages, Assemblers, Compilers, interpreters; Operation system, bits, bytes, words, serial and parallel communication.
2. Programming Logic Algorithms and flow-charts, Programming in a high level language (C/C++ & VB) - Data types, constants and variables; Expressions - numeric & non-numeric, library function, input-output and control statements, loops, arrays, functions, subroutines, file handling; Miscellaneous other features.
3. Numerical Analysis Successive approximations and errors; Differentiation and integration formulae: Simpson's and trapezoidal rules, lines and quadratic interpolations and extrapolations: Solution of algebraic equations - Newton-Raphson method. Simple initial value problems - Runge Kutta method.

Prod/CSE/S/121 COMPUTER PROGRAMMING & NUMERICAL ANALYSIS LABORATORY

Use of digital computers for solving matrix problems of various dimensions: Use of algorithm for matrix inversion, generation of random numbers for simulation studies, Programming for numerical differentiations and integration Programming Applications to be carried out in high level languages (C/C++ & VB).

Fluid laws and equations, study of hydraulic system; (g) Tribology; (h) Balancing & Stability; (i) Vibrations & noise; (j) Experimental stress analysis; (k) Thermal properties of material.

Prod/S/122 GRAPHICS LABORATORY-IIA

Representation of products and its features through graphics, Selection of datum for manufacturing and assembly requirements, auxiliary views, Drawing of standard parts; Line diagrams and symbolic representation of engineering systems and construction of exploded diagram from basic schemes for: a) Mechanical Systems (kinematic diagrams) b) Welding Systems c)Hydraulic Systems, d)Piping Systems. Product representation through computers: 2D and 3D representation, Solid model creation, 3D surface generation.Exchange of graphics data: DXF, IGES, STEP format Specification, Extraction of graphic entities from these data file.

Prod/S/123 BASIC ENGINEERING LABORATORY

Experiments involving calibration for major physical quantities, Verification of laws of basic Physics, Investigations of mechanical and thermal properties of solids; Kinematic synthesis; Laws of Machines. Estimation of physical quantities of mechanical systems, Estimation of errors in Measurements etc.

Prod/ET/S/124 BASIC ELECTRONICS LABORATORY

Experiments pertaining to the theoretical subject "Basic Electronics Engineering" and commensurate with the same.

Second Year First Semester

Prod//T/211 FLUID MECHANICS

- A) Review of fluid properties : density, specific gravity, specific volume, viscosity, surface tension
- B) Classification of fluid,
- C) Hydrostatics: forces on plane surfaces and curved surfaces submerged in fluid, stability of submerged and floating bodies
- D) Kinematics of fluid motion: methods of describing fluid motion, different types of fluid lines; concept of control volume & system; continuity equations (one dimension, two dimension & three dimension); circulation, vorticity & rotational flow; velocity potential; stream function; acceleration of fluid particles.
- E) Dynamics of fluid flow: Euler's equation of motion, Bernoulli's equation, momentum equation, Simple applications
- F) Different flow measuring instruments: venturimeter, orificemeter, Pitot tube etc;
- G) Orifices , Mouthpieces, V-notch weir, Rectangular notches
- H) Viscous & Laminar flow: Navier Stokes equation of motion, Laminar flow through parallel plates, Hagen -Poiseuille equation, hydrodynamic lubrication, power absorbed by bearings
- I) Flow through closed conduits: Darcy – Weisbach equation , friction factor of closed conduits , Moody's Diagram & its use, minor losses in pipe lines, losses due at sudden enlargement, at sudden contraction , at bends , at valves & fittings.
- J) Free surface flow: flow in open channel, Chezy's equation, Manning's equation , hydraulic jump.
- K) Concept of boundary layer, boundary layer thickness, Prandtl's boundary layer equations.
- L) Dimensional Analysis.

Prod/CSE/T/212 THERMAL ENGINEERING

Introduction: modes of heat transfer, heat flux; Conduction: Fourier law of heat conduction, thermal conductivity, steady state one dimensional heat conduction, thermal resistance, critical thickness of insulation, fins, fin efficiency; Convection: Newton's law of cooling, heat transfer coefficient, velocity and thermal boundary layer, free and forced convection over a vertical flat-plate and through a pipe, use of dimensionless parameters in solving heat transfer problems; Radiation: laws of radiation, black body, white body, grey body, opaque body, emissive power, reflectivity, transmissivity, absorptivity, radiation shape factor, radiation intensity, irradiation, radiosity, radiation exchange between bodies through network analysis, radiation shield; Heat exchanger: types of heat exchangers, LMTD, effectiveness, NTU method for heat exchangers for sizing and rating;

Fuel and combustion: fuels, calorific value, HCV and LCV, stoichiometric air-fuel ratio, mixture strength, analysis of combustion products, alternative fuels; Gas power cycles: air standard cycles – Otto, Diesel, Dual, Stirling, Brayton cycle; Internal Combustion Engine: CI and SI engines, two stroke and four stroke engines, working principle of different IC engines, valve timing diagram, performance characteristics of IC engines; Boilers: types of boilers, parts of boiler, energy balance sheet.

Prod/T/213 DEFORMATION OF SOLIDS

Definitions of stress and strain : Stress tensor; Differential equations for equilibrium; Linear stress-strain laws and strain energy; Problems of strength and stiffness of circular and non-circular sections subjected to axial load, torsion and bending; Analysis of composites; Transformation of stresses and strains; Mohr's circle; Yield and fracture criteria and theories of failure; Statically indeterminate systems; Virtual work equations; Stability of columns.

Prod/T/214 PRIMARY PRODUCTION PROCESSES

(A) Taxonomy of production and production processes; Product configuration and manufacturing requirements; Casting of ferrous and non-ferrous metals including die casting. Loam moulding, investment casting, centrifugal casting, transfer moulding, etc. (B) Designing of moulds, risers, sprues and gating system; Casting defects, (C) Joining methods: welding brazing and soldering: Welding processes like fusion welding, electric arc welding, resistance welding, GTAW, GMAW, Submerged arc welding(SAW) processes, Friction welding: welding defects. (D) Cold and Hot working of metals, Rolling, Bending, Wire/Tube Drawing, Deep drawing, spinning flow turning, stretch forming; Forging defects etc.

Prod/T/215 ANALYSIS AND SYNTHESIS OF MECHANISMS

1. Mechanisms and machines, Kinematic elements and chain, condition of movability and Grubler criteria, Higher order linkages, Kinematic inversion. Velocity and acceleration analysis of link systems. Various Mechanisms: Slider Crank, Differential, Pentograph quick returns Automatic Steering gear etc. 2. Synthesis of linkages; Kinematic analysis of machine elements Frudenstein's equation, path generation, Cam Synthesis. 3. Belt Drive; Chain Drives, Gear & Gear elements Gear Drive, Gear Train, Cam follower Motion analysis etc.

Prod/T/216 INDUSTRIAL STATISTICS

- (A) Basic laws of probability, conditional probability; Random variable, sample distribution, statistical hypothesis; Statistical tests of significance, correlation, regression analysis; Auto-correlation, analysis of variance.
- (B) Analysis of basic experiment designs; Randomized block design; Latin and orthogonal squares; Factorial designs.
- (C) Markov chains: Poisson's process; Diffusion process.
- (D) Introduction to stochastic problems in engineering.

Prod/CSE/S/211 COMPUTER PROGRAMMING & NUMERICAL ANALYSIS LABORATORY

Use of digital computers for solving matrix problems of various dimensions: Use of algorithm for matrix inversion, generation of random numbers for simulation studies, Programming for numerical differentiations and integration Programming Applications to be carried out in high level languages (C/C++ & VB).

Prod/S/211 ENGINEERING EXPERIMENTATION LABORATORY

Experiments leading to: (a) Energy Balance, (Boiler & Refrigeration system); (b) Performance evaluation of Pumps, Engines, Heat exchanger; (c) Equilibrium of trusses and structures; (d) Deformation characteristics of solids; (e) Kinematic synthesis; (f) Fluid laws and equations, study of hydraulic system; (g) Tribology; (h) Balancing & Stability; (i) Vibrations & noise; (j) Experimental stress analysis; (k) Thermal properties of material.

Prod/S/212 MANUFACTURING SYSTEMS LABORATORY-I

(A) Introduction to major machine tools: Lathe, Shaping machine, Milling machine & Drilling machine. Sketch of important components of the above machine tools, Introduction to major cutting tools for different machining operations and preparing sketches of these tools. (B) Heat Treatment : Annealing, hardening, etc. Surface preparation, Etching and metallographic studies of different material, (C) Plastic moulding, (D) Pattern making , Sand testing : AFS number, Mohr hardness test, Permeability test, (E) Metal forming : bending, blanking, punching, drawing, (F) Welding : Arc welding , Electric resistance welding, MIG and TIG welding etc.

Prod/S/213 GRAPHICS LABORATORY-IIB

Assembly & detail drawing of different products pertaining to Production Engineering

- A) Preparation of Product Assembly details,
- B) Aggregation for assembly,
- C) Computer Aided Assembly Drawing

Second Year Second Semester

Prod/T/221 MICROPROCESSOR CONTROL AND MECHATRONICS

Introduction to Microprocessor: Binary Arithmetic, Flip Flops, Registers, Counters and Memory Elements; RAM, ROM etc: Microprocessor architecture and assembly language programming, Microcontroller, P.L.C. & its applications: Interfacing, memory and peripheral devices. Introduction to Mechatronics: Drives and Actuators; mechanical, hydraulic, pneumatic, electrical, drive circuits: Sensors and Transducers: Measurement of position & displacement, velocity, force, temperature, proximity and range. Concept of feed-back: Open loop and closed loop control systems: linear systems: transfer functions, block diagrams, Servo systems

Prod/T/222 TECHNOLOGY OF MACHINING SYSTEMS

A. Introduction to conventional machine tools:

1. Lathe : different elements, specification; work holding devices; Apron mechanism; different operations in lathe:- turning, facing, grooving, parting, forming, taper cutting, drilling, boring, reaming, screw cutting (odd & even thread) ; machining time calculation
2. Shaping & Planning Machine: different elements of shaping & planning machines; specification. ; shaper drive ; feed mechanism; work holding devices; different machining operations in shaper & planer:-flat surfaces; slot cutting; grooving; T- slot ; dovetail; machining time calculation; difference between planer & shaper;
3. Slotting Machine: brief introduction to slotting machine
4. Drilling Machine: different elements, classification and specification of drilling machine; different machining operations in drilling:-generation of hole; pilot drill; counter-boring, countersinking (straight recess & conical recess); reaming; tapping; machining time calculation; Brief introduction to boring machine
5. Milling Machine: different elements, classification and specification of milling machine ;different types of milling cutters; indexing(simple & differential) ; different machining operations in milling:- generation of flat surfaces with different types of milling cutters; machining time calculation
6. Broaching: brief introduction

7. Grinding Machine: specification of grinding wheel; different types of grinding processes:-surface, cylindrical & internal grinding, tool & cutter grinding; machining time calculation.
8. Super finishing: brief introduction to super finishing, honing & lapping.

B. Metal Cutting :

1. Tool material and industrial designation of cutting tool; tool geometry for different cutting tools:- single point, drill , milling cutter; mechanism of chip formation;;tool wear & tool life, Failure of cutting tools materials, Cutting fluids.
2. Setting metal cutting parameters;, cutting forces, measurement of dynamic forces during metal cutting Cutting force measuring Dynamometer,

C. Introduction to semi-automated machine tools.

Prod/T/223 INSPECTION AND PRODUCT CONTROL

(A) Principles of measurement, Concept of Tolerance & Fit, Standards of measurements; Concepts of interchangeability, Taylor's principles; Design of limit gauge; Selective assembly. Off-line & On-line Inspection, (B) Mechanical, pneumatic, electrical, electronic and optical measuring systems for in-process and post-process, product feature inspection; Measurement techniques of different machine elements e.g gears, threads, bearings, cutting tools etc., machine tool metrology; Principles of light wave interferometry and interferometers; Ultrasonic gauging. (C) Automated Inspection, Contact & non-contact measurement techniques, Use of sensors in measurements, Co-ordinate measurement principles, Co-ordinate measuring machines (CMM); Product feature recognition and image processing. Laser beam based measurements & instrumentations, (D) Surface quality features measurement and analysis; (E) Quality and reliability; (F) Basic principles of statistical quality control; General theory of control charts for variable and attributes; Concept of acceptance sampling; Computer applications in inspection and quality control, ISO 9000 requirements.

Prod/T/224 FLUID MACHINES

- A) Introduction: definition of fluid machinery, classification (positive displacement type machine, turbomachine and others); energy transfer in fluid machines – application of linear and angular momentum equations.
- B) Pelton turbine: Different layout of turbine, Design of different components, Force, power & efficiency
- C) Francis turbine: Different types, Main components, Draft tubes, Draft tube theory, Design of different components, Cavitation, Torque, Power & Efficiency.
- D) Kaplan turbine : Introduction , Force, Power, Torque & efficiency
- E) Reciprocating Pump: Working principles, Different reciprocating Pump (Single acting, Double acting, Two / Three throw), air vessel,
- F) Centrifugal Pump: Definition, Working principal & operation, Classification: Working Head, Type of casing , Number of impellers, Flow through impeller,

- etc., Specific Speed, Layout, Head of pump, Power, Theory of Centrifugal pump, Multi staging, Priming, Cavitation ,
- G) Similarity & model study of turbo Machine, Operating characteristics curve,
 - H) Introduction to fluid power, Hydraulic Circuits, Different components of hydraulic circuits, Positive displacement pumps, Actuators, valves: flow, pressure & direction control valves, accumulators, intensifiers, Hydraulic circuits: linear, regenerative, sequence circuits & speed control.

Prod/T/225 MACHINE DYNAMICS

1. Static and dynamic force analysis of constrained kinematic systems: Dynamics of rotary and reciprocating machines; Critical speeds, Precessional motions and gyroscopic stability. Balancing of rotating and reciprocating masses, flywheel, governor mechanism.
2. Simple Harmonic Motion vibration of single degree freedom system: Force & undamped, damped & forced vibration systems, Two degrees of freedom systems, Mode coupling, Vibration Damper.

Prod/T/226 PRODUCTION MANAGEMENT

Management approaches to planning, analysis and control, Functions involved in a production system; Production cycles, Planning functions; Types of industry: Job, batch, continuous, mass and flow productions; Organization and policies in respect of production planning and control; Forecasting techniques; Resources economics and scheduling, Sequencing and plant loading for optimal utilization; Queuing models and line balancing; Materials planning and control; Inventory management: MRP, MRP-II, JIT, Value analysis; Productivity analysis; Mechanics of production control

Prod/S/221 METROLOGY AND PRODUCT CONTROL LABORATORY

(A) Laboratory experiments for the measurement and inspection of various product features using:- i) Mechanical, pneumatic, optical, electrical and electronic instruments, ii) Co-ordinate measuring machine (CMM) iii) Interferometer; iv) Colour image processing system for product feature recognition, edge detection, etc; v) Ultrasonic ecograph; vi) Surface roughness measuring system, and vii) Gear inspection modules. (B) Laboratory experiments and exercises involving hardware and software modular based off-line product gauging and inspection analysis, inspection information recording and processing - signal channel and multi-channel; on-line and off-line computer aided quality control analyses.

Prod/S/222 MICROPROCESSOR CONTROL & MECHATRONICS LABORATORY

Laboratory experiments involving the following are to be done. Use of logic gates & circuits, Microprocessor Programming - for simple control operations. Measurements of Position, Displacement, Velocity, Force, Temperature, Proximity and range. Open loop position control; Closed loop position control using position and velocity feed back; Use of analog and digital servo systems. Experiments on actuators and drives; PLC

Prod/S/223 MANUFACTURING SYSTEMS LABORATORY-II

(A)Introduction to major machine tools : Lathe , Shaping machine and Milling machine and Drill. Sketch of important components of the above machine tools. Introduction to and sketch of major cutting tools for corresponding machine tools. (B)Laboratory exercise involving (i)Lathe : Centering of a cylindrical piece. Simple turning and facing of a of the above cylindrical by holding it between centres.(ii)Shaping machine : Machining of a C I cube.(iii)Milling machine : Slab milling on a flat plate for horizontal milling; endmil operation for vertical milling.(vi) Drill : Generation of hole of different diameters on a flat bar.& tapping

Prod/S/224 VACATIONAL PRACTICAL TRAINING & VIVA-VOCE I - 200 hrs

In-Plant training involving various production processes like: (A) Foundry, forging, welding and fabrication (B) Organisational hierarchy (C) Product handling features (D) Specialized toolings and set-ups. Students will be required to submit a report on the in-plant training and appear for a Viva-Voce on the said training and report, before a board of examiners comprising of all the Teachers of the Department.

Third Year First Semester

Prod/T/311 MACHINE TOOL SYSTEMS

Basic concepts and general requirements of machine tools; Conformable kinematic synthesis for tracing, forming, enveloping and generation; Pseudo-Boolean approach for kinematic order; Fuzzy-cluster grouping for size range evaluation; Determination of power for optimal utilization; Designing discrete step drives for machine tools speeds and feeds; Stepless drives; Hydraulic drives and control; Functional analysis of machine tool spindles, guides and slide ways; Compliance of machine tools; Automation and control features; Selection and acceptance testing of machine tools.

Prod/T/312 MASS PRODUCTION TECHNOLOGY AND AUTOMATION

Types of production systems; Role of interchangeability and standardization; Economics of mass production; Factors of production; Planning for optimal production. Comparative Study of various production processes for making (a) Flat surfaces, (b) Housing, (c) Shafts and spindles, (d) Screw threads, (e) Gears, (f) Assembled products. Holding devices for tools and work pieces; Collets and chucks; jigs and fixtures; Locating and clamping and clamping elements; Locating rules. Alternative processes for polymer products; Moulding, extrusion and machining of thermoplastics and thermosetting plastics; Shearing processes including Blanking, Punching, Piercing etc. Basic principles of automation, Economics of Automation; Extending the capabilities of conventional machines through improved devices; Automatic machines; Hydro copying lathe; copy milling; single spindle Auto screw machine; Swiss type Automats.

Prod/T/313 ENERGY PRODUCTION SYSTEMS

Vapour power cycles: Rankine cycle, reheat cycle, regenerative cycle; Steam turbine power plant cycle: impulse and reaction turbine, velocity and pressure compounding, velocity diagram, components of turbine power plant; Gas turbine power plant cycle: thermal efficiency, power developed, optimum condition for maximum specific work output, modification in performance using reheating, regeneration and inter-cooling method, parallel and series combination; Reciprocating air compressor: p-V diagram, work-done with and without clearance volume, volumetric efficiency, modification by inter-cooler, use of after-cooler; Nozzle and diffuser: working principle, types, sonic velocity, etc;

Renewable and non-renewable energy: principles of direct energy conversion, solar energy conversion systems; bio-energy conversion systems, wind, tidal, geothermal and

ocean thermal energy conversion systems, fuel cell, nuclear energy and nuclear power plants, MHD generators.

Prod/T/314 PLANT LAYOUT & PRODUCT HANDLING

Objective of Facility Design: Types of layout problems, the layout function, organization of layout. Analysis and Design of Material Flow: Systems approach to flow cycle, process charts, flow process charts, Quantitative analysis of material flow; optimal material flow configuration. Space and Area Allocation for Production and Physical Plant Services; Computerized handling of layout algorithms; Algorithms for computerized Layout Planning, Construction and Development type of computerized Layout Planning Techniques i.e. CRAFT, ALDEP, CORELAP etc.;

Product handling; Design of system configurations conforming to various kinds of product features and layout characteristics; Design concepts of common handling and transfer equipment; Different types of conveyors, elevators, fork lifters; Design concept of warehouse facilities commensurate with adopted kind of handling and transfer devices; Automated Handling of materials, Automated Transfer lines, AGVS, Use of Robots in Product handling, Automated packaging devices. Application of pneumatic and hydraulic system in transportation and handling of products. Design of integrated plant layout for product handling systems.

Prod/T/315 DESIGN OF ENGINEERING SYSTEMS - I

Interrelatedness of product design and production processes. Introduction of engineering design processes; Conceptual design, configurational design, detail design; Design Methods; Design to Standards. Design of Simple Systems involving fasteners, pins, cotters, welds, rivets, pressure vessels, etc. Use of general design rules, rational sections for strength, rigidity, weight reduction, choice of materials. Modelling, simulation and optimization in design; Economic considerations; Systems Engineering using the concepts of concurrent engineering/DFM/DFA/QFD/robust design (Taguchi methods)

Prod/T/316 OPERATIONS RESEARCH

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

Prod/S/311 COMPUTER AIDED PRODUCT MODELLING

Laboratory exposure on: Use of graphics package for (A) 3-D Object and Solid Modeling, (B) Assembly of Products in 3-D (C) 3-D to 2-D Drafting

Prod/S/312 MANUFACTURING SYSTEMS LABORATORY – III

Laboratory exercises involving: Milling : slot milling, convex milling , concave milling , straddle milling , spur & helical gear. Spur gear with differential indexing, Drill: generation of counter bore hole & countersink hole;
Machining operations related to Relieving, profiling, contouring–Hydro copying, Finishing processes: Grinding, Lapping, Polishing; Grinding of tools and cutters;
(B) Introduction to Turret and Capstan lathe.

Prod/S/313 PRODUCTION MANAGEMENT LABORATORY

Experiments and computational work involving: i) Production planning and scheduling ii) Processes planning iii) Resources allocation, machine loading and optimization, iv) Plant facility layout models; v) Mechanical, electro-analogue and computer aided analogue space models for optimal plant facility location analysis; vi) Time study & Motion study.

Prod/S/314 PROJECT AND TERM PAPER

An individualized project will be assigned to any of the Teacher of the Department, either for analysis or for manufacture or both, to be completed within the semester and submitted for evaluation along with the Report. Alternatively, students will be required to submit a term paper for evaluation based on an assignment of thematic area of development in Engineering and Technology. Students have to make a presentation along with a report to a examination board consisting of all the Teachers of the Department, for final evaluation.

Third Year Second Semester

Prod/T/321 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/322 ERGONOMICS AND WORK DESIGN

A) Human Factors in Production Systems:

Introduction to ergonomics: Its inter-disciplinary nature and relation to production safety, health and comfort., Case studies of implementation of ergonomic principles in different industries, homes, fields, and sports. Relevance of anthropometry for effective utility of any operational system-with illustrations. Effect of ambient stresses on human performance: Heat, humidity, illumination, sound/ noise/ vibration – Their assessment and management, Kinesiology: Biomechanical study of human motor activity, manual lifting and posture studies, ILO / NIOSH guidelines. Design of hand-tools, displays for communication and controls, and their ergonomic evaluation etc.

B) Work Design:

Understanding the importance of work or job analysis pertaining different nature of work and setting the objectives of work design at both micro – and macro –ergonomic level. Work load and task analysis for validation (EVTA process). Human concepts in work place and work space design. Study of work for productivity enhancement of both individual and the enterprise. Procedures of work-study for its effective implementation. Method study for selection of job – Recording flow of materials and movement of workers. Work measurement work sampling and time study. ILO guidelines etc.

Prod/T/323 MATERIAL FORMING

Nature and purpose of materials forming theory: Octahedral stresses and yielding. Yield criteria, determination of working load in homogeneous deformation, stress evaluation using slip lines: Significance of Velocity diagrams (hydrograph), Visco-plasticity: Upper

and lower bound techniques of load estimation for metal; forming. Drawing & extrusion of round bars, flat strips; rolling of flat slabs and strips: Roll-pass design principles, Forming, Deep Drawing, Bending, Miscellaneous forming processes Mould flow plastics. Non-Traditional forming methods. Principle design features of different forming dies, Design of extrusion, drawing and forging dies; die design for plastic components. Use of computers in solving problems in forming of materials.

Prod/T/324 Elective-I (Management Electives)

- A) [LOGISTICS AND SUPPLY CHAIN MANAGEMENT](#)
- B) [BEHAVIOURAL SCIENCE AND HUMAN RESOURCE MANAGEMENT](#)
- C) [RELIABILITY ENGINEERING](#)
- D) [DECISION SUPPORT SYSTEMS](#)
- E) [PRODUCTIVITY ENGINEERING](#)
- F) [TOTAL QUALITY MANAGEMENT](#)
- G) [ENTREPRENEURSHIP DEVELOPMENT](#)
- H) [CONSTRAINTS MANAGEMENT](#)
- I) [PERFORMANCE MANAGEMENT](#)

Prod/T/324A 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/324B 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/324C 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/324D 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/324E 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/324F TOTAL QUALITY MANAGEMENT

Introduction, Definition, concept of total quality, the evaluation of total quality approaches, SQC, six sigma methodology, Taguchi's method of robust design, organizational culture, concepts of customer value, measuring customer value, cost of quality, organizing to improve systems; strategic linkage of operations through employees involvement; management role responsibilities. SPC, contribution of international authorities towards TQM, Benchmarking, various quality standards. Kaizen, various quality tools, Quality Audits, Quality certification. Enhancing the quality of Environment: Green & Clean Manufacturing. Quality Design of products and systems: QFD, JIT etc.

Prod/T/324G 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, Wholesaler 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/324H CONSTRAINTS MANAGEMENT

Definition, Thinking Process, Synchronous manufacturing, Finance and measure, Drum – Buffer –Rope (DBR) Scheduling, managing the TOC schedule, Buffer management, The identification of bottlenecks –V-A-T analysis , Capacity Constraint Resource (CCR), Supporting the decision processes, Making strategic decisions, Learning curve effect & Taguchi robust design on continuous improvement of system, TOC & Lot sizing, Comparisons among the different accounting procedures , MCDM applications in CM, fuzzy set theory in CM, Modifying the current system,CM in supply chain management, CM in health care industries, Critical chain project management , CM in Marketing & sales, Criticism and case studies.

Prod/T/324I PERFORMANCE MANAGEMENT

Overview, SWOT analysis, Tools and Techniques , Basic CCR model, CCR model and production Correspondence, BCC models, Returns to Scales , models with restricted multipliers , Non – discretionary and Categorical Variables , Allocation models , Data

Variation , Supper –efficiency models , Efficient Change over time , Economics of Scope and Capacity utilization , case studies.

Prod/T/325 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/326 DESIGN OF ENGINEERING SYSTEMS-II

Problems of rational design: Fundamental concepts in design of engineering systems. Static and dynamic analysis of engineering systems involving shafts. Linkages, couplers, transmission devices, toothed elements, etc. Tribological analysis of support systems. Computer solution of design problems.

Prod/S/321 ERGONOMICS LABORATORY

Experiments involving: A) Anthropometry B) Kinesiology C) Comfort analysis D) Fatigue, and E) bio-engineering, etc. are to be done.

Prod/S/322 SEMINAR

Each student will be required to give a number of seminar talks, (at least three), along with reports, to a board of examiners, on current topics related to Production Engineering with audiovisual aids, graphs, charts and models as assigned to them on individual basis.

Prod/S/323 DESIGN SESSIONAL

Design problems related to simple engineering systems, involving fasteners, pins, cotters, welds, rivets, pressure vessels, etc. Problems related to static and dynamic analysis of engineering systems involving shafts, linkages, couplers, transmission devices, toothed

elements etc. Tribological analysis of support systems Computer solutions of design problems.

**Prod/S/324 VACATIONAL PRACTICAL TRAINING &
VIVA-VOCE II 200 hrs.**

In-plant training involving study of: a) Complex machining operation b) Plant layout c) Organizational hierarchy d) Degree of automation e) Product handling features. f) Specialized tooling, set-ups Students will be required to submit a report on the in-plant training and appear for a Viva-Voce on the said training and report, before a board of examiners comprising of all the Teachers of the Department.

Fourth Year First Semester

Prod/T/411 MICRO MANUFACTURING PROCESSES & SYSTEMS

Introduction to Micromanufacturing Processes, Micro-products :design and manufacturing methods consideration; 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.

Micro-Molding and Casting, Micro-Injection Molding, Surface Coating (CVD, PVD), Stereolithography, LIGA, etc;

Micro-joining: micro mechanical assembly, various types of micro-welding, micro-welding parameters, accuracy of process, various welding strengths, applications etc;

Micro-forming: micro bulk forming, micro sheet metal forming, electro forming, deep drawing, bending, hot embossing, micro imprinting, etc;

Micro Machining Processes: Introduction, Classification of micromachining processes; Conventional Methods of Micromachining, Micro Mechanical cutting: micro-turning, micro-milling, micro-grinding, abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micro machining, Electron beam micromachining, Focused Ion Beam micromachining, etc;

Surface engineering and micro manufacturing: different types of surface structuring, surface integrity of machined surfaces, measurements techniques in micro range, etc;

Hybrid processes for micro manufacturing.

Prod/T/412 CNC MACHINES AND ROBOTICS

Basic principles of Numerical Control(NC); NC coding system, Computer Numerical Control (CNC) System, Machine Structure, drive system, motion transmission system, 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 drives; Controllers Sensors; End effectors; Performance analysis of industrial robots; Economics of robotics.

Prod/T/413 PLANT AND MAINTENANCE ENGINEERING

Epistemology of Plant and Maintenance Engineering, Need analysis; Metamorphosis aspects for different plants; Common features in terms of infrastructural input requirements ; some typical plant ,and their system configurations. PEEST analysis site

selection; Various models of plant location, Techno-economic life of equipment , Depreciation , LCC, Replacement analysis, Concept of reliability , availability and maintainability (RAM); System reliability ; Reliability improvement ; FET,FMEA,FMECA, Maintenance Planning and Control , Design of maintenance systems; Spare parts managements, Kaizen, Terotechnology, Overview 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/414 ECOLOGY & ENVIROMENT FOR SUISTAINABLE DEVELOPMENT

1. Context of Ecology &Environment for Sustainable Development :
2. Understanding/ of development dynamics in environmental perspectives; Defining SD/(UN definition – Bran land) for economic growth; Models of Developments (UNCED) ; Environmental degradation and its consequences – Resource / Population distribution
3. Basics of Ecology: Biology cake and level of organization in biological spectrum; Principles and concepts pertaining to ecosystem (Trophic structure , Production and Decomposition) ; Energy life – line for Ecosystem (2nd Law – pumping out disorders , Shrodinges Ratio. Quantification of energy environment, concepts of Productivity /food chain /food web /Trophic levels / ECO-Pyramids and energy flow diagrams) ; BGC cycles and modeling for system ecology),
4. Hazards in the Environment and Environmental Hazards: (UN Program of Hazard mitigation); Hazard management .
5. Understanding the Extent of Pollution : Domain and Type Specific : (Air, water , soil/land, missals, noise , Thermal, Toxicity, radiation) civic and industrial source
6. Technological Measures for Prevention of Pollution: (Air , water, soil ,noise , Thermal / radiation)
7. National and International issues & Debates/ Global worming , chin ate change,
8. IPCC 's role , Carbon Trading , Nuclear or Proliferations and treaties
9. Environmental TQM; Legislation and Standardizations :
 - a. Energy and water development policies and planning; ISO: 9000/14000/21000

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

Experiments to demonstrate: A) Principles of automation B) Limit stops and Cam controlled 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 & METAL CUTTING LABORATORY

(A) Experiments to illustrate: a) Kinematic structures of machine tool drives, b) Compliance characteristics c) Hydraulic and pneumatic control systems d) Use of mass production machine tools, e) 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 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), Electrochemical Deburring (ECD), (iv) Electrochemical Discharge machining (ECDM), (v) Laser beam machining (LBM), (vii) Plasma arc machining (PAM), (viii) Wire-Electro-discharge machining (WEDM) and other non-traditional machining processes.

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 concept, 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 quality control; 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; Business functions; Computer-aided forecasting; Office automation.

Prod/T/422 MANUFACTURING SYSTEMS SIMULATION

A review of basic probability and statistics ; physical modeling : Concept of System and environment, Continuous and discrete systems , Linear and non-linear systems , Stochastic activities , Static and Dynamic models , Principles of modeling , Basic Simulation modeling , Role of simulation in model evaluation and studies, advantages of simulation; System Simulation: Techniques of simulation, Monte Carlo method, Experimental nature of simulation , Numerical computation techniques , Computers in simulation studies , Simulation software packages , Random numbers , Generation of Random numbers , Variance reduction techniques, Determination of length of simulation runs; Simulation of Manufacturing System: Simulation of waiting line systems , Job shop with material handling and Flexible manufacturing systems , Simulation software for manufacturing , Case studies .

Prod/T/423 PLANNING & 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, 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-II (Technology Electives)

- A) TRIBOLOGY
- B) TEROTECHNOLOGY
- C) ROBOTIC ENGINEERING
- D) PRODUCT DESIGN
- E) FINITE ELEMENT METHOD & APPLICATIONS
- F) CONCURRENT ENGINEERING & AGILE MANUFACTURING
- G) PRECISION ENGINEERING
- H) TOOL MANUFACTURING

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 tero-technology; 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 ENGINEERING

INTRODUCTION TO ROBOTICS: Basic concepts, Major components, Work-envelope, Classification of Robot Systems, DRIVE AND CONTROL SYSTEMS: Types of drive system - hydraulic, pneumatic and electric, Open loop and closed loop control systems for robot drive, ROBOT END-EFFECTORS: Grippers and Tools, Types of robot grippers - mechanical, magnetic, vacuum, adhesive, ROBOT KINEMATICS: Homogeneous coordinates and homogeneous transformations, Direct and indirect kinematics in robotics, 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, ROBOT VISION SYSTEM: Imaging devices and image acquisition, Image processing and analysis - preprocessing, segmentation, feature extraction and object recognition, Robot vision applications, ROBOT PROGRAMMING: Robot programming methods, Elements and functions of a robot language, 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 modeling 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. Rapid prototyping & reverse engineering, 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, ultra precision Mirror polishing of hard and brittle materials, finish turning, Boring, Grinding and Honing 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/424H TOOL MANUFACTURING

A) **Tool Materials** : Tool steels, Cemented carbides, Ceramic tools, Abrasive materials, Diamonds, CBN;

B) **Tool Familiarisation** : Fundamentals of Cutting Tool Design, Single point Tools, Form Tools, Drills, Milling Cutters: Profile sharpened Milling Cutters, Form relieved Milling Cutters, Inserted blade Cutters, Gear tooth Milling Cutters, Gear Hobs, Gear Shaping Cutters, Abrasive tools and materials: Principal types, Grinding wheels, Diamond wheels;

C) **Tool Production** : Blank manufacturing, Machining locating Datum surfaces, Manufacturing Body of Cutting Tool, Marking of Cutting edge, Sharpening & Lapping, Standard Tool production processes.

Prod/T/425 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 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 semester, on the topic covered/study done/experiments conducted to a examination board consisting of all the Teachers of the Department, for final evaluation.

Prod/S/422 TECHNOLOGICAL ELECTIVE LABORATORIES/PROJECT

Commensurate with **PROD/T/424** course.