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**North Maharashtra University,
Jalgaon**

**Syllabus for Third Year Engineering
Degree Course in**

**PRODUCTION
ENGINEERING**

(w.e.f. July, 2000)

NORTH INDIA UNIVERSITY, JALGAON

T.E. (PRODUCTION ENGG.)

First TERM

(N.E.F JULY, 2000)

SR. NO.	CODE	SUBJECT	TEACHING SCHEME (HOURS PER WEEK)			EXAMINATION SCHEME			
			LECTURE	PRACTICAL	DURATION PAPER (hrs)	MAXIMUM THEORY	MARKS TERMWORK	PRACTICAL	ORAL
01.	11	ENGG METALLURGY	04	02	03	100	25	--	25
02.		WORK STUDY, ERGONOMICS & SAFETY	04	02	03	100	25	--	25
03.		PRINCIPLES OF MANAGEMENT	04	02	03	100	--	--	--
04.	11	NUMERICAL ANALYSIS & COMPUTATIONAL METHODS	04	02	03	100	25	--	--
05.		PLANT LAYOUT & MATERIAL HANDLING	04	02	03	100	25	--	--
06.		*WORKSHOP PRACTICE - V		03	--	--	25	25	--
Note :- * Theory related to workshop practice V is to be taught in workshop in practical hours. ** Common to Mechanical & Production Engg.									
TOTAL			20	13	--	500	125	25	50
GRAND TOTAL			33			700			

T.E. (PRODUCTION ENGG.)

Second TERM

(N.E.F Dec, 2000)

SR. NO.	CODE	SUBJECT	TEACHING SCHEME (HOURS PER WEEK)			EXAMINATION SCHEME			
			LECTURE	PRACTICAL	DURATION PAPER (hrs)	MAXIMUM THEORY	MARKS TERMWORK	PRACTICAL	ORAL
01.	13	METROLOGY & QUALITY CONTROL	04	02	03	100	25	--	25
02.		DESIGN ANALYSIS OF MACHINE ELEMENTS	04	04	04	100	25	--	--
03.		MACHINE TOOL DESIGN	04	02	03	100	25	--	25
04.		OPERATION RESEARCH	04	--	03	100	--	--	--
05.		PRODUCTION TECHNOLOGY - II	04	02	03	100	25	--	25
06.	13	PRACTICAL TRAINING / SPECIAL STUDY / MINOR PROJECT	--	--	--	--	25	--	--
Note :- ** Common to Mechanical & Production Engg.									
TOTAL			20	10	--	500	125	--	75
Grand Total			30			700			

Total of Maximum marks of term I & II === 1400

1 term - 1
TERM - 1
ENGINEERING METALLURGY (Paper-1)
T.E. (MECH & PROD)

Teaching Scheme :
Lectures : 4hrs/week
Practicals: 2hrs/week

Examination scheme:
Paper : 100 marks
Termwork : 25 marks
Oral : 25 marks
Paper duration : 3 hrs

UNIT I:

(9 hrs)

1. Metallography:

Microscopy-Specimen preparation, etching, principles of electrolytic polishing, etching reagents and optical metallurgical microscope. Macroscopic-specimen preparation, macroetching, sulfur printing, flow lines observation, examination of fractures and spark test. Application of electron microscope.

2. Steels: Plain Carbon steels:

Iron - Iron Carbide equilibrium diagram. Critical temperatures. Allotropy, Cooling curve and volume changes of pure iron. Microstructures of slowly cooled steels, estimation of carbon from microstructure. Non-equilibrium cooling of steels. Specification of some commonly used steel for engineering application.

(Weightage: 20 marks)

UNIT II:

(9 hrs)

1. Heat Treatment of steels: Principles of heat treatment:

Transformation products of austenite, Time-Temperature-Transformation diagrams. Critical cooling rate. Continuous cooling transformation diagram. Heat treatment of steels.

Quenching media, annealing, normalizing, hardening, other heat treatments such as austempering, patenting, ausforming, martempering, Isoforming, etc. Retention of austenite - Effects of retained austenite. Elimination of retained austenite, tempering, secondary hardening, temper embrittlement, quench cracks, hardenability testing, defects due to heat treatment and remedial measures.

(Weightage: 20 marks)

UNIT - III:-

(9 hrs)

1.A) SURFACE HARDENING TREATMENTS:

Carburising, Heat treatment after Carburising, Nitriding, Carbonitriding, Tufftriding, and sursulf process. Flame Hardening, and Induction hardening, commercial heat treatment practice of gears of different sizes, tools lathe beds, springs etc.

HEAT TREATMENT FURNACES & ATMOSPHERES:-

i. Heat treatment furnaces & their classification. Batch type furnaces continuous furnaces, salt bath furnaces, controlled atmosphere.

(Weightage: 20 marks)

UNIT IV:-

(9 hrs)

1) ENGINEERING ALLOY STEELS:-

Effects of alloying elements. Classification of alloying elements. Examples of alloy steel. Stainless steel. Sensitisation and weld decay of stainless steel. Tool steel and tool materials. Heat treatment of high speed steels. Special purpose steels with applications.

2) CAST IRON:

Classification- Gray cast iron, chilled and alloy cast iron, effect of various parameters on structure and properties of cast iron. Application of cast irons for different components of machine tools, automobile, pumps etc.

(Weightage: 20 marks)

UNIT V:

(9 hrs)

1. Engineering Non-Ferrous Alloys:

Brasses, Bronze (Tin, Aluminum, Beryllium), Copper- Nickel alloys. Aluminum and aluminum alloys. Solders, bearing materials and their application, Precipitation hardening alloys.

Composite Materials: Classification, different types of composite material and it's applications.

(Weightage: 20 marks)

Recommended books :

- 1) B.K.Agrawal: Introduction to engineering Materials. Eight reprint 1998, Tata McGraw Hill Publishing company Limited, New Delhi.
- 2) Kodgire R.D: Material Science and Metallurgy for engineering. Everest publishing House, Pune.
- 3) Clark D.S. and Varney W.R.: physical Metallurgy for Engineers. Affiliated East-West press Pvt.Ltd.
- 4) Sidney H.Avner: Introduction to physical Metallurgy Second Edition, Third Edition Reprint 1998, Tata McGraw Hill Publishing Company Ltd., New delhi.
- 5) Robert E Reed Hill: Physical Metallurgy Principals, East-West Publication.
- 6) Metals Handbook on Heat Treatment, Metallography by ASTM/ASM.

List of experiments:

1) Microspecimen preparation and use of the metallurgical Microscope.

Objectives:

- a) To provide practice in the techniques of microspecimen selection, polishing and Etching.
- b) To provide initial training in the use of the metallurgical microscope.

2) Furnace operation and spark testing:

Objectives:-

- a) To determine the natural (empty furnace) heating and cooling rates of an available laboratory furnace.
- b) To draw Spark diagrams of Medium, High carbon steel, Cast Iron & stainless Steel.

3) Study and drawing of microstructure of mild steel (low carbon steel), medium carbon steel Eutectoid and hypereutectoid steel, in annealed condition.

OBJECTIVES:-

a) To study the constituents present in the microstructure of steel and their effect on properties of steel.

4) To study and drawing of microstructure of Grey modular cast iron, white and malleable cast iron.

5) Sulfur print test on a steel specimen / or flow lines examinations of forged component.

6) Study of change in micro-structure on annealing and normalising of a medium steel.

OBJECTIVES:-

a) To normalise and fully anneal the sample of medium carbon steel and to study the hardness and micro structure of steel.

7) Hardening of steels:- Study of effect of carbon on the hardness of the hardened steel.

OBJECTIVES:-

a) To determine the temperature needed to harden mild steel and high carbon steel to their respective maximum hardness.

b) To study the changes in micro structure of steel as it is heated through the critical range.

c) To determine the effect of carbon on hardness.

8) Tempering of steel:- Effect of temperature on properties:

OBJECTIVES:-

a) To determine the effect of hardening on the structure of steel.

b) To determine the effect of tempering on the structure of steel.

9) Jomney Hardenability test:

OBJECTIVES:-

a) To conduct the jomny hardenability test on two types of steel.

b) To utilize the jomny test results to determine steel and to illustrate its industrial applications.

10) Study and drawing microstructure of carburised steel fusion weld in mild steel.

11) Study and drawing microstructure of alpha brass, Alpha-beta brass, Aluminiumbronze and bearing metal.

Minimum 8 experiments must be performed out of the above list.

NOTE:- Oral will be based on the prescribed term work presented in the form of certified journal.

WORK STUDY, ERGONOMICS AND SAFETY (Paper-2)
T.E. (PROD)

Teaching scheme:
Lectures: 4 hrs/week
Practicals: 2 hrs/week

Examination scheme:
Theory: 100 marks
Term work: 25 marks
Oral: 25 marks
Paper duration: 3hrs

Unit 1:-

(9hrs)

1) Work Study- Introduction, Objectives, Advantages, applications, work study & standard of living, Productivity, Human factors in work study - Trade unions, Top 7 middle management, Labour control, work simplification.

2) Method Study - Objectives, Steps, tools & Techniques, Process Chart symbols, Flow-string diagrams, outline, Two handed, multiple activity, travel charts. Micromotion study, therbligs simo chart, cycle & chronocycle graphs. Principle of motion. Economy, memomotion study.

(Weightage: 20 marks)

Unit 2:-

(8 hrs)

3) Work measurement - Objectives, applications, techniques, stop watch time study, equipments, Elements break down, Performance rating, types, Determination of no. of cycles, Selection of operations

4) Allowances - need, Types - relaxation, interference and others. Standard time calculations, standard data, use of time standards in planning, scheduling, cost estimation etc. types and steps in development of standard data.

(Weightage: 20 marks)

Unit 3:-

(9 hrs)

5) Work Sampling - theory, setting performance standard with working sampling, determination of sample size, comparison of work sampling and time study, Advantages and limitations in work sampling.

6) Predetermined motion time system - Introduction, classification, work factor applications of MTM, Analytical, steps, qualification of estimator, Improving effectiveness of analytical estimating.

(Weightage: 20 marks)

Unit 4:-

(9 hrs)

7) Ergonomics - concepts, definition, objectives, importance and anthropometric data collection & applications, occupational loads

and stresses, Measurement of physical work & it's techniques.

8) Design of information display, design of controls, Relationship between controls and displays, workplace design. Criteria for full body muscular work, work of rest cycles, biomechanical factors, psychomotor task.

(Weightage: 20 marks)

Unit 5:-

(10 hrs)

9) Industrial safety - concept objectives, safety training, communicating safety message, vibration preventions, principle of safe machine design, role of govt. in safety

10) Safety engineering Introduction & elementary concepts, chemical handling, precautions in steam boilers, welding operations, powered machines, maintenance, guarding & mechanical handling, factory Act 1948 (introductory concepts).

(Weightage : 20marks)

Term Work:

Term work shall consist of following assignments--

- 1) Introduction to work study & it's applications.
- 2) Assignment on two handed process chart.
- 3) Assignment on multiple activity chart.
- 4) Assignment on simo chart.
- 5) Assignment of allowances & standard time.
- 6) Assignment based on P.M.T.S, M-I-M etc.
- 7) Study of Ergonomic rules for good workplace layout.
- 8) Study of safety precautions in industries & handling of materials.

Note: - Oral will be based on the prescribed termwork presented in the form of certified journals.

Recommended Books:

- 1) Introduction to work study- ILO publication
- 2) Work study & Ergonomics- L.C.Jhamb (Everest publication, Pune)
- 3) Work study - R.M.Durie
- 4) Industrial safety Robert Blake
- 5) Production Management - R.K.Jain (Khanna publishers)
- 6) Work study - D.P.Khanna (Dhanpat Rai publications)
- 7) Motion & time study - M.E.Mundel.

PRINCIPLES OF MANAGEMENT (Paper-3)
T.E. (Prod)

Teaching scheme:
Lectures: 4 hrs/week

Examination scheme:
Theory: 100 marks
Paper duration: 3 hrs

Unit 1

10 hours

Definition of management, Nature of management, Management: Science or art or profession. Development of Management thoughts, Taylor's & scientific management, Principles of scientific management, contributions of Henry Fayol, contributions of Peter Drucker, various schools of mgmt thoughts as Human Behaviour approach, Social systems approach, Mgmt science approach, contingency approach.

(Weightage: 20 marks)

Unit 2:

10 hours

Management process, functions of various management levels. Definition and features of planning, importance of planning, steps in planning, different types of plans, strategic, corporate, & operational planning, Limitations of planning.

-- Nature of objectives, role of objectives, the process of managing of objectives

-- The nature and purpose of strategies and policies, kinds of plannign process.

-- Importance and limitations of Rational Decision making.

(Weightage: 20 marks)

Unit 3

10 hours

Theories of organisation, formal & informal organisation, Departmentation, span of management, tall & flat structures, Line & staff concept, Centralisation & decentralisation, Patterns of organisations, Group dynamics, Power & Authority, Delegation of Authority

-- Nature & scope of staffing, Recruitment, Selection & placement. Training methods & techniques, Performance Appraisal & Job Evaluation.

(Weightage: 20 marks)

Unit 4

9 hours

Fundamentals of Directing, Human factors in managing, behavioural Models i.e. theory X and theory Y. Motivation & motivators, theories of motivation-- Maslow's need hierarchy, Herzberg's theory, ERG theory, various valence-expectancy theory
Job enrichment, Incentives & leadership

Leadership - behaviour & styles
- Communication process, Grapevine, barriers and breakdowns in communication

(Weightage: 20 marks)

Unit 5

9 hours

Concept of managerial control, control system, control as feedback system, control techniques, management information system, International management, the management functions in International Business, Global theory of management

- Overall and preventive control-- principles of preventive control, direct versus preventive control, control of overall performance.

(Weightage: 20 marks)

Books recommended:

1. Personnel management - C.B.Memoria; Himalaya publishing
2. Principles of management - L.M.Prasad; Sultan chand & sons
3. Essentials of management - Harold Knootz, Heint Wehrich
Tata Mc Graw hill
4. Principles of management - Tripathi & reddy
5. Principles of management - Terry franchin
Tata Mc Graw hill
6. Advanced Personnel Management - K.K.Ahuja

NUMERICAL ANALYSIS & COMPUTATIONAL METHODS (Paper-4)
T.E. (Mech & Prod)

Teaching Scheme :
Lectures : 4hrs/week
Practicals: 2hrs/week

Examination scheme:
Paper : 100 marks
Termwork : 25 marks
Paper duration : 3 hrs

(5 hours)

Introduction to language C Programming:-

Study of Numerical methods & feature of the language & its brief teaching for simple INPUT/OUTPUT formatted INPUT/OUTPUT, various IF-statements, loops array, functions & subroutine, introduction algorithm development, flow chart.

UNIT - I:

(8 hrs)

A) SOFTWARE DEVELOPMENT:-

Software development principles.
Concept of mathematical modelling and engineering problem solving. Errors in computation.

B) SOLUTION OF TRANSCENDENTAL EQUATIONS:-

Bracketing methods: Graphical method, Bisection method, false position method.
Successive approximation method, the Newton-Raphson method, rate of convergence.

(weightage - 20 marks)

UNIT - II:-

(8 hrs)

A) NUMERICAL INTEGRATION:-

Trapezoidal rule, Simpson's 1/3rd & 3/8th rule, Gauss Quadrature technique.

B) SOLUTION OF ORDINARY DIFFERENTIAL EQUATION:-

Taylor's series method, Euler's method, Improved and modified Euler's method, Fourth order Runge-Kutta method.

(weightage - 20 marks)

UNIT - III:-

(8 hrs)

A) INTERPOLATION:-

Linear & quadratic interpolation, Lagrange's interpolation, Newton's forward & backward interpolation, Newton's divided difference interpolation, Stirling interpolation.

B) CURVE FITTING (least square criterion):-

Linear & quadratic regression, Logarithmic & exponential curve fitting.

(weightage - 20 marks)

UNIT - IV:-

(8 hrs)

SOLUTION OF LINEAR ALGEBRAIC EQUATIONS:-

Elimination methods: Gauss Elimination method, LU-decomposition method.

Iterative method :- Jacob's Iteration method, Gauss Siedal
Iterative method, Cholesky method.
Convergence analysis, Choice of method.
(weightage - 20 marks)

UNIT - V:- (8 hrs)

FINITE DIFFERENCE METHOD:-

Solution of ordinary differential equation.
Solution of elliptical equations for various boundary condition.
Solution of parabolic equation by explicit, implicit & Crank
Nicolson method.

FINITE ELEMENT METHOD:-

Introduction, comparison with finite difference method, General
approach, Interpolation function, Finite element application on
one dimension (beam element).

(weightage - 20 marks)

****SCOPE OF PROGRAMMING SHOULD BE RESTRICTED TO PRACTICAL CLASS
ONLY.**

ASSIGNMENTS:

The term work should consist of minimum eight assignments
including Analytical/Numerical solution, algorithm, flow chart &
computer programme.

1. A general program like sorting, conditional interest etc.
2. Solution of quadratic equation.
3. Solution of transcendental (exponential or logarithmic)
equation related with engineering application.
4. Calculation of work/heat transferred by using any integration
method.
5. One exercise on Numerical integration related to mechanical
engineering application.
6. Solution of Poisson equation.
7. Solution of one dimensional parabolic equation by Crank-
Nicolson method.
8. Curve fitting for the data related to mechanical engineering
applications.
9. Solution of one/two dimension problem by finite element method
using any compatible software.
10. Interpolation for any tabulated data used in mechanical
engineering.

RECOMMENDED BOOKS:

1. Chapra, Canale: Numerical methods for Engineers-McGraw Hill Co.
2. S.S. Sastry : Introductory methods of Numerical Analysis-
Prentice Hill India.
3. Jain, Jain & Iyengar: Numerical methods for scientist &
engineering Computations-New Age International(P)
-td.
4. J.n. Reddy : Finite element method-McGraw Hill Co.
5. Belegundupatla : Introduction to Finite Elements methods-
Prentice Hall India.
6. V. Rajaraman: Computer Oriented Methods.

PLANT LAYOUT & MATERIAL HANDLING (Paper-5)
T.E. (Prod)

Teaching scheme:
Lectures: 4 hrs/week
Practicals: 2 hrs/week

Examination scheme:
Theory: 100 marks
Term work: 25 marks
paper duration: 3 hrs

UNIT 1

9 hrs

- a) Factory layout: Objectives and principles
- b) Site selection: Raw materials, market, labour, living site, power, fuel, water, taxation, labour laws, climate, transportation, facilities, safety and security +
- c) Types of layouts:- block layout, shop layout, workplace layout, factors affecting layout, Planning and development of layout, evaluation of layout, systematic planning and installation of new layout.

(Weightage: 20 marks)

UNIT 2

9 hrs

- a) Systematic layout techniques- Flow determination, REL charts, space requirement, space relationship diagram, adjustment of diagram, visualisation of layout, evaluation of alternative layouts, computer aided layout planning, Introduction of single and multiple Plant layout
- b) Material handling and Material handling equipments-
Material handling activities, principles of material handling, effect of low facility output, materials handling analysis basis
Material handling problems- Analysis procedure, materials handling system- system analysis and system synthesis.

(Weightage: 20 marks)

UNIT 3

8 hrs

- System design and system implementation. Packaging, decorative and protective packaging. Functions, regulators and supports for storage and movement between workplaces. Shipping End user containers, Receiving and shipping areas storage, safety and materials handling
Air carriage handling
Materials handling training
Materials handling equipment

(Weightage: 20 marks)

Unit 4

9 hrs

- Elements of materials handling system:-
Importance, terminology, principles and features of material handling systems, Analysis of material handling problems

Selection of mechanical handling equipments:-
Selection of the handling system cost data and economic analysis
classification, drives and basis specifications for selection of
mechanical handling equipments

(Weightage: 20 marks)

Unit 5

9 hrs

Study of various types of mechanical handling equipments such as
Industrial trucks, tractors and trailers, cranes, hoist and
monorail, conveyors, slides and chutes, pneumatic and hydraulic
conveying systems, and elevators.

Design of various types of mechanical handling equipments such as
cranes, hoists, conveyors, slides and chutes, Pneumatic &
hydraulic conveying systems.

(Weightage: 20 marks)

* T.W consists of minimum eight Assignment on the above syllabus
(minimum one on each unit)

* Oral based on above T.W.

Reference books:-

- 1) Facilities & Plant engg handbook- Lewis & Marron
Mc Graw Hill publishing
- 2) Plant engineers handbook-- Homi P. Scervai
Multitech publishing Co. Mumbai
- 3) Material handling Equipment - M.P.Alexander
MIR publishers, Moscow
- 4) IQM - Banga & Sharma Khanna publishers

WORKSHOP PRACTICE - V (Paper - 6)
T.E. ~~Exam~~ & Prod)

Teaching Scheme :
Practicals: 3hrs/week

Examination scheme:
Termwork : 25 marks
Practical: 25 marks

Note :- * Theory related to workshop practice - V is to be taught in workshop in practical hours.

1. One mini project on die making for sheet metal working, rubber or plastic by using Jig Boring machine, precision grinding operation like surface grinding, cylindrical grinding, etc. Other machining operations as required should be carried out on general purpose machines.

(12 hours)

2. One job of programming and manufacturing on CNC lathe/trainer.

(1 hr)

3. One job of programming and manufacturing on CNC milling machine/trainer.

(1 hr)

4. One fabrication job of manufacturing a pipe fitting like tee, bend, etc. involving designing of intersections of solids/surfaces, development of surfaces and operations like gas cutting and welding by suitable method.

(2 hrs)

5. Maintenance of CNC and above mentioned machine tools.

(4 hrs)

Note: All jobs specified 1 to 5 should be allocated to batch of 5 to 6 students and different batches should have different designs of jobs.

DEMONSTRATIONS OF FOLLOWING MACHINES AND PROCESSES TO BE CARRIED OUT IN THE WORKSHOP ONLY. (ONE HOUR FOR EACH DEMONSTRATION)

1. Gear Hobbing or Gear Shaping Operation.
2. Operations on Capstan & Turret Lathe and Single Spindle automats.
3. Sheet metal working on Mechanical or Hydraulic Presses.
4. Superfinishing operations like lapping, honning, etc.
5. Plastic moulding operations on injection moulding machines.
6. Die forging on power hammer.
7. Spot welding machine.
8. Different types of grinding wheels, selection criteria, standard marking system of grinding wheel, wheel balancing, truing and dressing operations.
9. Planner.

THEORY: Theory concerned to different machines, their capabilities, applications and limitations, tool holding, work holding devices etc. for above jobs and demonstrations, is to be taught in the workshop only for every batch going to the workshop. Concept of alignment and geometric tolerancing required for job no.1 is to be taught in the class room.

i) Marketable utility items should be selected and it should be manufactured as per IS codes, e.g. Nuts, Bolts, Bushes, pins, gas nozzles, etc.

ii) Setting of turret/capstan for assigned jobs should be done by individual students.

iii) Preparation of CNC programs for job on CNC machine should be done by group of students for their job.

iv) CNC maintenance should be done practically i.e. demonstration regarding various components of both categories; electronics and mechanical.

6. Determination of cutting speeds, feeds, machining time and other parameters required for above job such as cost estimation etc. and should be compared with market rates.

(1 hr)

7. One job on planner should be prepared involving all students batchwise.

(1 hr)

8. The candidates are required to finish the jobs to the following limits;-

i- CNC lathe & milling - $\pm 0.05\text{mm}$

ii- Capstan & Turret lathe - $\pm 0.05\text{mm}$

iii- Planner - $\pm 0.3\text{ mm}$

Notes:- Oral will be based on the prescribed termwork presented in the form of certified journal.

TERM-II

TERM-II
METROLOGY & QUALITY CONTROL (Paper-I)
T.E. (MECH & PROD)

Teaching Scheme :
Lectures : 4hrs/week
Practicals: 2hrs/week

Examination scheme:
Paper : 100 marks
Termwork : 25 marks
Oral : 25 marks
Paper duration : 3 hrs

A) METROLOGY:-

UNIT - I:- (9 hrs)
Definition, measurement, precision, accuracy, sensitivity, classification of method of measurement.
LINEAR MEASUREMENT:- Standards, line standards, end standards, wavelength standards, classification of standards, precision measurement, precision measuring instruments and their characteristics, slip gauges.
STRAIGHTNESS, FLATNESS AND SQUARENESS:- Surface plates, angles plates, V-blocks, measurement of straightness, flatness testing, squareness testing, roundness testing, machine tool metrology.
MEASUREMENT BY LIGHT WAVE INTERFERENCE:- Basic principle, sources of light, optical flats, frige patterns and their interpretation, testing of flat, convex and concave and irregular surface, checking of slip gauges, calibration of optical flat.
(weightage: 20 marks)

UNIT - II:-

(9 hrs)

DESIGN AND MANUFACTURING OF GAUGES:-
Three surface generation, manufacture of slip gauges, principle of alignment, errors.
COMPARATORS:- Characteristics, application, types, construction and working of different mechanical, optical, electrical, pneumatic comparators.
ANGLE MEASUREMENT:- Sine bars, sine centers, uses of sine bars. angle gauges, autocollimeter, angle dekker-constant deviation prism.
MEASUREMENT OF SURFACE FINISH:- Surface texture, definitions, terminology and basic concept, methods of measuring surface finish, assignment of surface roughness as per IS, relationship between surface roughness and manufacturing processes.
(weightage:20 marks)

UNIT - III:-

(9 hrs)

METROLOGY OF SCREW THREADS:- Terminology, errors and their effects, thread gauges, measurement of elements of external and internal threads.
GEAR MEASUREMENT:- Calipers measurements, involute testing, roller measurements, toolmaker's microscope, profile projectors.
STUDY OF MEASURING MACHINES:- Universal measuring machine, co-ordinate measuring machine, possible sources of errors in CMM, electric inspection and measuring machines.

RECENT TRENDS IN ENGG METROLOGY:- Development in optical measurements, precision instruments based on laser, probes, telemetric systems, isometric viewing of surface defects, image shearing microscope for vertical dimensions.

(weightage: 20 marks)

B) QUALITY CONTROL:-

UNIT - IV:-

(9 hrs)

1. Concept of quality & quality control, elements of quality & its growth, purpose, set up, policy and objectives, factors controlling quality of design and conformance, balance between the cost of quality and value of quality.
2. Introduction to topics- zero defects, statistical process control, quality circles, company wide quality management, total quality control, ISO 9000 and equivalent Indian standards.
3. Total quality management, vendor inspection, process capability study, quality audit system, quality assurance, difference between inspection and quality control and quality assurance.

(weightage: 20 marks)

UNIT V:-

(9 hrs)

STATISTICAL QUALITY CONTROL:-

Basic statistics, mean, mode, standard deviation, data collection, histogram, frequency distribution, importance of statistical methods in quality control. Variables and attributes. Measurement inspection, different types of control charts (\bar{X} , R, np, p and C charts) Machine/ process capability analysis.

ACCEPTANCE SAMPLING:

Sampling inspection v/s hundred % inspection, basic concept of sampling inspection, operating characteristics curves, conflicting interests of consumer and producer, producer's and consumer's risk, AQL, LTPD, AOQL, single and double sampling plans, standard sampling tables, vendor rating.

(weightage: 20 marks)

Termwork:-

The termwork shall consists of record of any ten out of the following experiments and assignments. Oral will be based on termwork.

1. Determination of linear/angular dimensions of part using precision and non-precision measuring instrument.
2. Angular measurement using a sine bar, autocollimator, angle dekkor.
3. Machine tool alignment tests on any machine tool like Lathe, Drilling, Milling.
4. Measurement of gear parameters (i) gear tooth thickness (ii) constant chord (iii) pitch circle diameter.
5. Surface finish measurement.
6. Measurement of surface flatness using optical flat.
7. Exercise on design of limit gauges using Taylor's principles.
8. Study and measurement of parameters using tool makers microscope.

9. Assignment on unit-iv.
10. Assignment on unit-v.
11. Measurements by using mechanical, electrical and pneumatic comparators.
12. Measurement of screw parameters using floating carriage micrometer.

Recommended Books:-

1. R K Jain; Engg Metrology; Khanna Publishers.
2. Handbook of industrial metrology; ASTM; Prentice Hall Pub.
3. J M Juran; Handbook of quality control, McGraw Hill Pub.
4. M. Mahajan; Statistical Quality Control;
5. K C Jain; TQM & ISO 9000; Khanna Publishers.
6. I C Gupta; A textbook of Engg Metrology; Khanna Publishers.
7. R C Gupta; Engg Precision Metrology; Khanna Publishers.

Note:

Oral will be based on the prescribed termwork presented in the form of certified journal.

DESIGN ANALYSIS OF MACHINE ELEMENTS (Paper-2)
T.E. (Prod)

Teaching Scheme :
Lectures : 4hrs/week
Practicals: 4hrs/week
(2HRS DWG
2HRS COMPUTER)

Examination scheme:
Paper : 100 marks
Termwork : 25 marks
Paper duration : 4 hrs

UNIT - I:- INTRODUCTION TO MACHINE DESIGN (9 HRS)

- a) Mechanical Engineering design process: Traditional design methods. Design consideration: Strength, deformation, Wear, creep, and corrosion. Aesthetic and ergonomic considerations in design.
- b) Standards: ISO 9000, Use of standardisation, use of Design Data books.
- c) Stresses:- Simple stresses - Tension, Compression, bending and torsion, Stress Strain relationship. Combined effect of different stresses.
- d) Design of machine elements subjected to static loading: Knuckle joint, Cotter joint.
- e) Materials: Properties of material such as strength, plasticity.
- f) Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum distortion energy theory and maximum strain theory, max. principal stress theory - their applications and limitations.

(Weightage: 20 marks)

UNIT - II:- (9 HRS)

- a) Shaft, Keys and Couplings: Various design considerations in transmission shafts, splined shafts.
- b) Spindles and axles - strength lateral and torsional rigidity. ASME code for designing shafting. Shafting materials and stresses.
- c) Types of keys-their classification and fitments in keyways. Design considerations in parallel and tapered sunk keys. Couplings: Design considerations, Design of rigid couplings, Ruff & flange type, Design of flexible coupling.
- d) Flywheels: Fundamentals equation of motion, Torque analysis, Stresses in flywheel rim and its sprockets, Design of solid and rimmed flywheel.

* (Weightage: 20 marks)

UNIT - III: (9 HRS)

- a) Springs: Types, applications, materials of springs. Stress - deflection equations of helical springs, Wahl's factor, style of ends. Design of helical compression, tension and torsional springs under static loads. Construction and design considerations in leaf springs. Shot peening.

b) Clutches: Design requirements of friction clutches, selection criteria, Torque transmitting capacity of single plate clutch, multiple clutch, cone clutch and centrifugal clutch. Dry and wet clutches. Material for clutch facings. Energy considerations and temperature rise.

c) Brakes: Design considerations in brakes - Energy equations, thermal considerations, rating of brakes. Design of block brakes with short shoe, long shoe, internal expanding shoe brakes and band brakes. Brake friction materials properties.

UNIT - IV:-

(12 hrs)

SPUR AND HELICAL GEARS

Classification of gear drives and their selection criteria's, revision of theory of gears, standard system of gear tooth.

Spur: Gear tooth load, number of teeth, face width, strength of gear teeth, static beam strength, (Lewis equation), Barth equation, dynamic tooth loads, (Spotts equation), wear strength (Buckingham's equation), estimation of module on beam strength and wear strength, gear design for maximum power, types of gear teeth failures, gear materials and constructional details of gear wheels, methods of gear lubrication.

Helical: Gear tooth load, formative number of teeth in helical gears, face width, strength of gear teeth, static beam strength, Lewis equation, Barth equation, dynamic tooth loads, (Spotts equation), wear strength (Buckingham's equation), estimation of module on beam strength and wear strength, gear design for maximum power, types of gear teeth failures, gear materials and constructional details of gear wheels, methods of gear lubrication.

UNIT - V:-

(10 hrs)

PRESSURE VESSELS:-

Thick & thin cylinders, Failure criteria of vessels. Lamé's equation, Clavarino's & Birnie equations, auto fretting & compound cylinders.

TYPES OF PRESSURE VESSELS:- Horizontal, vertical, classification of pressure vessels as per IS:2825-1969 and typical categories of welds. Materials of constructional details. Stresses induced in pressure vessels, Design of pressure vessels as per IS: 2825 code & ASME code, Shell end and end closures. Effect of openings and nozzles in shells and cover area compensation method, gasketed joints, types of vessel supports.

TERMWORk:-

The term work shall consists of ONE design project based on the above syllabus. Each design project consisting of two imperial size sheets- one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified so as to make it a working drawing. A design report giving all necessary details of calculations of the design of components and assembly should be submitted in a separate file.

FIVE design assignments of problems based on the topics of the syllabus out of which at least three shall be solved with the help of computer. (use C / Visual C++ language)

REFERENCE BOOKS:-

1. Mechanical Engg. design by J.E.Shingley and C.R. Mischke - 5th edition, McGraw Hill Publications.
2. Design of machine elements by M.F. Spotts- Prentice hall Publication.
3. Machine design- Hall and Helowenko - Schaum series.
4. Fundamentals of machine design by Phelan- McGraw Hill Publications.
5. Design of machine elements by V.B.Bhandari, Tata McGraw Hill
6. P.S.G design data book.
7. Machine design - Maleev & hartman
8. IS: 2825-1969 code for unfired pressure vessels.
9. Process equipment design by M.V.Joshi, McMillan India Ltd.

MACHINE TOOL DESIGN
(T.E. Prod)

(Paper-3)

Teaching Schedule:
Lectures: 4 hrs/week
Practicals: 2 hrs/week

Examination Schedule:
Theory Paper: 100 marks
Termwork: 25 marks
Oral: 25 marks

UNIT - I.

(10 HRS)

Different considerations and trends in designing machine tools. Introduction to estimation of forces for design analysis for different machining operations such as turning, drilling, milling, grinding, broaching, shaping, etc. and power required for machining operations.

Kinematics of machine tools:-

Design principles of different driving systems, Determination of speed range, selection of cutting speeds, mechanical regulation and stepped drives.

Design of gear boxes; Graphical representation, Structure diagrams, ray diagram, speed charts, gear teeth calculations, deviation diagram.

Stepless regulation; classification of stepless systems, mechanical friction drives and pressure variators, self tightening drives, etc.

(Weightage: 20 marks)

UNIT - II.

(9 HRS)

Design of machine tool beds and columns:- Design features of various types of beds, forces acting on the table of a vertical lathe, column design of milling machine and drilling machine.

Machine tool slideways & guides:- Classification of guides, wear, accuracy and materials, calculation of pressure distribution on guides, frictional behaviour of machine tool guides, Hydrostatic hydrodynamic lubrication of guides.

Design of power screws for machine tools:- Classification, design features and materials, calculation for strength of lead screw, efficiency of lead screw, ball, recirculating power screw assemblies, static load - efficiency of them. Compensation of backlash, vertical roller feed screw.

(weightage: 20 marks)

UNIT - III.

(9 HRS)

Design of machine tool spindles:- Special features, materials and construction, spindle supports, calculation of sleeve bearing, roller bearing, spindle bearing lubrication in machine tools. Frictional conditions of working, static and dynamic rigidity of machine tool structures, joints, slideways, spindles.

Design against vibrations and chatter in machine tools:- Forced vibrations, shock absorbers, chatter, forced and damped vibration, stick-slip vibration, vibration isolated tool holders.
(weightage: 20 marks)

(9 HRS)

UNIT - IV.

Control system and electrical equipments in machine tools:- Design of controlling systems and electrical equipment in machine tools, design of hydraulic control systems. Installation, maintenance and testing of machine tools according to ISI standards.
(weightage: 20 marks)

(8 HRS)

UNIT - V.

Concept of unit head machines and SPM:- Introduction to modern machine tools, Constructions, operations, tooling, advanced and special developments related to CAD, CAM systems. Introduction to retro-fitting NC/CNC system to existing machine tools.

IS: M WORK:-

- 1) Introduction to different types of m/c tool elements. (it should covered in workshop).
- 2) Design of speed box (including structural diagram, ray diagram, ray charts, deviation diagram, gear layout. (1 sheet).
- 3) Study of different m/c tool mechanisms (indexing, reversing, differential, guide return, approx mechanisms).
- 4) Acceptance tests for 3 m/c tool. ORAL will be based on above term work.

REFERENCE BOOKS:-

- 1) M/c tool Design by N.K.Mehta, Tata McGraw Hills.
- 2) M/c tool Engg. by N.K.Mehta, Tata McGraw Hills.
- 3) M/c Tool Design by Sen, Bhattachary, New central.
- 4) M/c tool Design by Basu, Pal.
- 5) PSG hand Book.

OPERATIONAL RESEARCH
T.E. (Prod)

(Paper - 4)

Teaching scheme:
Lectures: 4 hrs/week

Examination scheme:
Theory: 100 marks
Paper duration: 3hrs

UNIT - I:-

(9 hrs)

Introduction to O.R, models in O.R, scope, phases, O.R in decision making.
linear programming: Model formulation, Graphical method, simplex method, concept of duality & its applications, sensitivity analysis.

(Weightage: 20 marks)

UNIT - II:-

(9 hrs)

Queuing theory: Queuing system, Kendall notation, single channel queuing model, multichannel queuing theory, finite capacitor model, cost model, advance queuing model, series queues, two stations service model with zero queue capacity, K-station model with infinite queue- simulation: basic concept, Monte carlo simulations, advantages & limitations.

(Weightage: 20 marks)

UNIT - III:-

(9 hrs)

-Dynamic programming: introduction, basic concept & applications, characteristics of D.P, Dynamic programming approach.
-Special techniques of L.P such as transportation model, assignment model, travelling salesman, transshipment problem.

(Weightage: 20 marks)

UNIT - IV:-

(9 hrs)

- Replacement model:- Deterministics & Probabilistics considerations. Replacement of old equipment by the most efficient by the sudden failure items, failure trees, Examples of failure trees.

- Investment theory:- Introduction, cash flow, percent value of single cash flow, annuity, sinking fund, capital recovery, payback period method, return method, net present value method.

(Weightage: 20 marks)

UNIT - VI-

(9 hrs)

- Decision theory:- Decision trees, classes of decision models, utility, decision under certainty, uncertainty & risk.
- Games theory:- Theory concept, characteristics, maximum & minimax principles, saddle point, dominance basic concept & terminology of two persons zero sum games, MXZ & ZYN games, subgames method, graphical method.

(Weightage: 20 marks)

BOOKS RECOMMENDED:-

1. Quantitative techniques. Vol. I & II by L.C.Jhamb
Everest publications.
2. Operational Research. by Handu Taha; (PHI Pvt. Ltd, Delhi)
3. PERT & CPM principles & applications by L.S.Srinath.
4. Operational Research by Heera & gupta (S.chand & Co.)
5. Introduction to O.R. by Hallies & Librman
6. Operational Research by Prof. A.K. Chitale & Negi (Jain publication)
7. Operational reasearch by J.K.Sharma (Mcmillan India ltd)

PRODUCTION TECHNOLOGY - II (Paper - 5)
T.E. (Prod.)

Teaching Scheme :
Lectures : 4hrs/week
Practicals: 2 hrs/week

Examination scheme:
Paper : 100 marks
Termwork : 25 marks
Oral : 25 marks
Paper Duration: 3 hrs

UNIT - I. PROCESS PLANNING. (10 HRS)

1. Definition & concepts of standard terms like product, assemblies, sub-assemblies, assembly flow chart, etc. Aim, scope & organisational aspects of process planning.
2. Process capability & dimensional analysis, principles of process planning and process sheet design for the complete manufacture of the machined part.
3. Computer aided process planning.

(Weightage: 20 marks)

UNIT - II. AUTOMATS. (10 HRS)

Cam controlled automats - general structure - types of cam mechanisms - and kinematics of single and multispindle automats. Automats with lead screw drive - hydraulic and pneumatic drive and control of automats. Elements of automats - bar - stock feeding mechanisms - magazine feeding devices - hopper feedings - vibratory feeding - chucking devices - tool slides - mechanisms of intermittent motion.

(Weightage: 20 marks)

UNIT - III. NC/CNC MACHINING SYSTEMS. (9HRS)

1. Concepts of NC, CNC, DNC machine tools, machining centre - construction, operations and tooling. Application of microprocessor system for NC/CNC machine tools, TURNING, MILLING AND DRILLING.
2. Adaptive control, Part programming.
3. Retrofitting NC/CNC system to existing machine tools

(Weightage: 20 marks)

UNIT - IV. MODERN MACHINE TOOLS. (9 HRS)

1. Transfer machines - Basic, design considerations, building block principle, types of transfer machines, product design processes, cutting speeds, feeds and tools, equipment - transfer links.
2. FMS, concepts, classification of FMS, types of flexibility, advantage and applications of FMS, Transfer lines and head changing FMS.
3. Robots - Brief Introduction, classification, degrees of freedom, advantages & limitations.

(Weightage: 20 marks)

UNIT - V. SPECIAL PURPOSE MACHINE TOOLS. (10 hrs)

1. Grinding - Cylindrical, surface, centreless. Grinding wheels, I.I specifications, Gear Hopping, Gear Shaving methods, Jig Boring machine.
 2. Tracer controlled machine tools - mechanical copying machines, Hydraulic tracing devices, Electric tracing systems, Automatic Tracing.
 3. Hyperbaric welding, computerisation of welding technology, Laser in production technology. (Weightage: 20 marks)
- Termwork: *

Minimum 8 assignments based on above syllabus.

Oral

Oral will be based upon the termwork only.

Recommended books:-

1. NC of machine tools.
by S.J Martin
E.L.R.S
2. Principles of manufacturing Material & Processes.
by J.S. Campbell
* Tata McGraw Hill Ltd.
3. Production Technology
by HMT
* Tata McGraw Hill Ltd
4. A text book of production engineering
by P.C.Sharma
* S.Chand.

Term-II (Paper-6)

Practical Training/ Special Study/Minor Project

(Common with TE (Electronics, Industrial Electronics, Electronic and Telecommunication Engineering & Computer Engg., Electrical Engg., Instrumentation, Mech., & Production Engg.)

Examination scheme :
Termwork : 25 marks

Every student need to complete following requirements for termwork of Practical Training/Special Study/ Minor Project.

Practical training in any industry for a period of minimum two weeks and submit training report certified by personnel manager or works manager or any other higher authority of that industry.

OR

Special study on a recent topic from reported literature and submit a report on it.

OR

One mini theoretical or fabrication project and submit a report on it.

OR

Attend a course of Entrepreneurship Development course conducted by college and submit a report on it.

NOTE:-

1. Practical training is to be undergone in Summer Vacation after S.E. and / or in Winter Vacation after first term of T.E.
2. Report should be typed on A4 size paper and three copies paper bounded are to be prepared, one copy is for the candidate, one for the library and one for the teacher concerned.
