

PRODUCTION ENGINEERING

**T.Y. B. Tech.
Effective from A. Y. 2013-14**

INDEX

Item	Page No.
Detailed Syllabus	3
Annexure-I: List of Open Elective/Professional Science courses offered by ALL departments	25

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course
9	BSC	Basic Science Course

Program Education Objectives (PEOs):

1. Advance professionally as a result of his/her ability to solve complex technical problems and to work in multidisciplinary teams on problems whose solutions lead to significant societal benefits.
2. Demonstrate professional engineering competence and compete successfully using principles of manufacturing and time and quality management in the design and manufacture of products and services.
3. Make scholarly contributions to knowledge as demonstrated by publishing papers and/or technical reports, applying for patents, delivering effective conference presentations, and/or contributing to innovative leadership articles.
4. Demonstrate a commitment to the community and the profession through involvement with community and/or professional organizations and/or make contributions towards society's greater good and prosperity.
5. Demonstrate an understanding of the need for life-long learning via progress toward, or successful completion of an advanced degree, professional development and/or industrial training course(s), and/or engineering certification.

Program Outcomes (POs):

On successful completion Graduates will demonstrate:

- a. An ability to apply knowledge of mathematics, science, and engineering.
- b. An ability to apply knowledge of manufacturing, material science, design engineering to solve the real life problems and to increase the productivity.
- c. An ability to design and conduct experiments, as well as to analyze and interpret the data and optimize the process.
- d. An ability to design a system, component, or process to meet desired needs subject to technical, economical and environmental constraints.
- e. An ability to function on multi-disciplinary teams and familiar with organizational behavior and management.
- f. An ability to identify, formulate, and solve manufacturing engineering problems with advance tools and techniques leading to sustainable development of industry and society.
- g. An understanding of professional and ethical responsibility.
- h. An ability to think, listen and communicate effectively verbally and written.
- i. An understanding of the impact of engineering solutions and industrial safety in a global and societal context.
- j. Recognition of the need for, and ability to engage in healthy competition, life-long learning and knowledge of contemporary issues.
- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

CURRICULUM STRUCTURE OF T. Y. B. TECH (Production Sandwich)

Effective from A. Y. 2013-2014

I-Semester:

Sr. No	Course code	Subject Title	Contact hours			Credits
01	Project Work/ PE 09001	Industrial In-plant Training [§] (24-26 weeks) (1 contact hrs. per student per week is allotted to teacher)	-	-	-	16
02	PE 09002	Seminar-I	-	-	-	2
03	PSC/PE 09003	Industrial Engineering and Management § (Self Study)	-	-	-	3
		Total	0	0	0	21

§ The contact hours are provided for supervision of students under training and for giving guidance regarding the theory subject to be studied during training. Assessment will be based on mid-sem presentation and the other at the end of the Industrial In-plant training.

II-Semester:

Sr. No	Course code	Subject Title	Contact hours			Credits
			L	T	P	
01	OEC	Open Elective Refer to Annexure I	3	-	-	3
02	BSC/AS-09004	Engineering Mathematics IV	1	-	2	2
03	PCC/PE-09005	Metrology and Quality Control	3	-	-	3
04	PCC/PE09006	Kinematics and Dynamics of Machines	3	-	-	3
05	PCC/PE09012	Tool and Die Design	3	-	-	3
06	PCC/MT09017	Material Forming	3	-	-	3
07	LC/PE-09009	Metrology and Quality Control Laboratory	-	-	2	1
08	LC/PE09010	Kinematics and Dynamics of Machines Laboratory	-	-	2	1
09	LC/PE 09011	Tool and Die Design Laboratory	-	-	2	1
10	LC/CT09019	Software Laboratory – I	-	-	3	2
11	MLC/ML- 09001	Constitution of India	2	-	-	2
		Total	18	0	11	24

PE - 09001 INDUSTRIAL INPLANT TRAINING

Teaching Scheme

Contact Hours: 2 hrs/week/student
Duration of Training in Industry : 6 months

Examination Scheme

Term Work : 100 Marks
Oral Exam : 100 Marks

General guidelines to the institutions running production - Sandwich degree course and to the students opting for sandwich course. Students are expected to learn following things during the Industrial Inplant Training of 6 months:

He shall be given training in large or medium size manufacturing unit in various departments.

1. Orientation / Rotational Training :

Organizational Structure of the Company, scale and type of production, types of products, functional departments like Manufacturing, Process Planning & Control, Quality Assurance, Assembly, Testing, Maintenance, Stores, Purchase, Marketing, Human Resources Department, Design and Drawing Department, General Administration, Packing and Dispatching. Tool Engineering, Materials & Material Handling etc.

2. Industrial Design and Drawing Practice:

Design and Drawing standards, study of Mechanical components and mechanical components and introduction to machine element design such as gears, gear boxes, chain and belt drives, electric motor selection, couplings, shafts, keys, bearings, brackets, bolted and welded connections. Sub - assembly and assembly design and drawings. Various ISO and BIS standards for design. Simple assignments based on the above items, selection of materials, material specification, heat treatment, and properties of materials.

3. Study of Manufacturing Processes:

Study of Processes such as casting, forging, sheet metal working, plastic moulding, extrusion, rolling and machining operations on various machines. Study of finishing processes like grinding, lapping, honing, burnishing, buffing, etc. chipless manufacturing processes.

4. Study of Various Manufacturing Machine Tools such as lathes, capstan and turret lathes, planer, shaper and milling. Mechanical and Hydraulic Presses, Gear hobbing, shaping and grinding machines.

5. Study of special purpose machines, jig boring machines, NC/CNC machines, work centers and transfer lines and automatic machines.

6. Study of single point cutting tools and multipoint tools, form tools, jig and fixtures, special purpose machine tools and Press tools, Tool material and tool selection, study of cutting parameters.

7. Study of material handling methods and equipment.

8. Introduction to Quality and Quality Policy, need for Quality Control, National and

International Standards on Quality and Reliability. Study of various inspection gauges, selection of gauges, comparators, calibration of gauges, Standards Room, etc. Product

Performance Test Procedures.

9. Study of various Production Planning and Control functions. Process and Operation Planning, Yearly and Monthly Planning, Forecasting, Scheduling, Planning.
10. Study of various Industrial Engineering functions, Work Study, (Motion Study and Time analysis), Ergonomic considerations, Plant Layout, Safety aspects of working, Safety gadgets used on machines and Personal Safety Equipment.

The students shall be asked to do simple assignments in various departments where he is undergoing training.

Industries shall be requested to prepare training program before hand, covering as much as possible from above mentioned topics depending upon the type of industry.

Term Work :

Term Work will consist of a comprehensive report based on his observation, training received and assignments completed during 6 months of training. The report shall also include good drawing figure, process sheets and machine and product specifications.

Students should maintain training project diary and report to internal guide every week. For writing project report, students must follow the format given in the project diary.

Oral Examination

Oral examination will be based on In-plant Training Report (Term Work), which will be conducted jointly by internal examiner from within the institute and external examiner from the industry.

Outcomes:

- Learning the environment of Industry and organization chart.
- Exposed to different departments of plant which gives them to conceptualize design, detail design, manufacturing, quality inspection etc.
- Learning about process of supply chain management, vendor development, product design as well as concept of value engineering in new product design etc.
- Understanding of manufacturing machine tools
- Comprehensive report writing skills based on his/her observations, training received and assignments completed.

PE - 09002 SEMINAR - I

Teaching Scheme

Practical:- 2 hrs/week

Examination Scheme

Term Work: -- 50 Marks

Oral: -- 50 Marks

Seminar shall be based on deep study of any topic related to production engineering; format of the report shall be as follows-

1. Title Page (Refer format given)
2. Certificate (Refer format given)
3. Acknowledgements:- There should not be any mistake in name and initials.
4. Abstract:- A page explaining the Seminar topic in maximum 150 words.
5. Content / Index (Refer format given in the Project Diary)
6. List of Tables/Figures or Nomenclature and Symbols:- List of Tables, Figures, Graphs etc. with respective page numbers.
7. Introduction:- 2-3 pages.
8. Seminar Report:- Description of topic about 12-15 pages.
9. Conclusion
10. References (Refer format given in the Project Diary)

Instructions regarding Seminar Report Printing:-

Page size	:-	A4.
Page Format	:-	Left-1.25", Right-1", Top & Bottom 1" – No Border / Frame.
Font	:-	Arial Regular.
Font Size and Colour	:-	12, Black.
Line Spacing	:-	1.5
Printing / Typing	:-	On one side of the paper only. (No blank sheet be left any where in the report.)
Paragraph	:-	Justified.
Paragraph Indent	:-	Nil.
Page numbers	:-	Right bottom, starting from 'Contents' page.
Printing	:-	Laser.
Binding	:-	Spiral with front and back cover of card paper neatly cut to size.

Number of Copies of the Seminar Report: - **Two.**

Instructions for figures and tables:-

- i. Figures should be drawn on separate sheets or inserted on the page on which the text is typed. The figures are drawn in either permanent black ink or printed on paper. The figures should be numbered.
- ii. Tables shall be typed in text. A separate sheet may be used, if necessary. The table shall be numbered.
- iii. Mathematical portion of the text shall be preferably typed. If this is not possible, it should be written in permanent black ink. Lengthy Mathematical derivations shall

- not be included. Only the important steps and expressions shall be given.
- iv. Discussions and conclusions shall form the last paragraph of the text.

Front page (on Binding and Title Page):-

COLLEGE OF ENGINEERING, PUNE

Title Line (Font size to extend across 5" width)

Title should be in one line, if required use two lines.

Submitted by:-

Class:- _____ Roll No.:- _____

DEPARTMENT OF PRODUCTION ENGINEERING

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

Certificate Page: -

DEPARTMENT OF PRODUCTION ENGINEERING

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

CERTIFICATE

This is to certify that Mr./Miss_____ has completed the Seminar entitled _____ in partial fulfillment of the requirement of the V/VIII semester Production Engineering (Sandwich) Course at the Department of Production Engineering of COLLEGE OF ENGINEERING, PUNE – 411005, during the academic term 200 - 200 .

Date:- dd/mm/yyyy

(Name of Guide)

Guide

Place:- Pune-411005.

(Name of HOD)

Prof. & Head

Department of Production Engg. & Workshop,
College of Engineering, Pune:- 411005.

(Examiner)

Term Work

Term Work shall comprise of Seminar report. Topic of seminar should be pre-approved by guide.

Oral Examination

Seminar Presentation / Oral examination will be assessed by guide and one internal examiner from within the institute.

Outcomes:

- Understanding of seminar topic and its importance
- Excellent presentation & communication skill
- Interest towards research oriented fields with ability to search the literature and brief report preparation.
- Technical writing skill.

PE - 09003 INDUSTRIAL ENGINEERING AND MANAGEMENT**Teaching Scheme**

Self Study

Examination Scheme

End-Sem Exam- 100.

Unit 1**Evolution of Industrial Management:**

Evolution - Importance of Industrial Management – Scientific Management - Meaning definitions - principles - Importance and Criticism.

Organisation : Concept of organisation, characteristics of organisation, elements of organisation, organisational structure, organisation charts, Types of organisation- formal line, military or scalar organisation, functional organization, line & staff organisation, project organisation, matrix organisation, authority and responsibility, span of control, delegation of authority. Industrial ownership: Types of ownership- single ownership, partnership, joint stock company, co- operative societies, public sector, private sector, scientific management- review of different schools of thoughts.

Unit 2**Productivity and Work Study:**

Definition of productivity, individual enterprises, task of management. Productivity of materials, land, building, machine and power. Measurement of productivity, factors affecting the productivity, productivity improvement programmers, wages and incentives (no numerical problem). Definition, objective and scope of work-study. Human factors in work-study. Work study and management, work-study and supervision, work-study and worker.

Unit 3**Method Study:**

Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation - process charts, flow process charts, travel chart and multiple activity charts. Charts to record movement at work place - principles of motion

economy, classification of moments, two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method, brief concept about synthetic motion studies.

Unit 4

Work Measurements:

Definition, objectives and benefit of work measurement. Work measurement techniques.

Work sampling - need, confidence levels, sample size determinations, random observation, conducting study with the simple problems.

Time study - definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination.

Unit 5

Personnel Management:

Concept, Importance, objectives, functions of personnel management. Recruitment and Selection: Recruitment Policy, Sources of recruitment, Selection Procedure, Steps in selection. Employee Training: Need, Aims, Importance, Steps in Training programme, methods of training, training evaluation.

Performance Appraisal: Meaning, Purposes, Methods, Ethics in appraisal.

Wage and Salary Administration: Nature and purpose of wage and salary administration, methods of wage payment, Time, Piece, incentive systems, Halsey, Rowan, and Taylor's differential piece rate plan.

Unit 6

Ergonomics:

Introduction, areas of study under ergonomics, system approach to ergonomics model, man-machine system. Components of man- machine system and their functions - work capabilities of industrial worker, study of development of stress in human body and their consequences.

Text Books

- Edited by George Kanavaty, Introduction to Work Study-ILO, , Fourth Revised Edition, 1992

Reference Book

- Basu S.K., Sahu K.C and Rajiv B, Industrial Organization and Management –. PHI New Delhi, 2012
- M.S. Sanders and E.J. McCormick, "Human Factors in Engineering Design", VI Edition, McGraw Hill
- R.M. Barnes, "Motion and Time Study", Wiley International, 1980
- S. Dalela and Sourabh, "Work Study and Ergonomics". Standard Publishers, Latest Edition

Outcomes:

- Ability to apply various management principles for Work study & Method study.
- Ability to use work measurement techniques and time study.
- Ability to apply various techniques for ergonomic considerations in man machine system

AS – 09004 ENGINEERING MATHEMATICS IV

Teaching Scheme

Lectures : 1 hr/week
Practical : 2hrs/week

Examination Scheme

Term Work-50 marks
Practical/Oral -50 marks

Unit 1

(15 hrs)

COMPUTER ORIENTED NUMERICAL METHODS I:

Interpolation: Langrange's Interpolation, Newton's forward, backward and central difference method, divided difference method, Inverse Interpolation, Curve Fitting: least square criteria- 1st and 2nd Degree.

Solution of linear simultaneous equations: Homogeneous/Non-homogeneous systems, Gauss Elimination, Gauss-Jordan, Gauss-Seidel Methods, LU- Decomposition, Cholesky Method.

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Secant Method, Regula-Falsi Method, Newton-Raphson Method, Successive Approximation Method.

Applications.

Unit 2

(15 hrs)

COMPUTER ORIENTED NUMERICAL METHODS II:

Numerical Differentiation: Forward, Backward and Central Difference Methods.

Numerical integration: Trapezoidal Rule, Simpson 1/3' and 3/8th Rule, Weddle's Rule, Gauss Quadrature - Two and Three Point Formula, Double Integration.

Numerical Solution of Ordinary Differential Equation: Taylor Series Method, Euler Method, Modified Euler Method, Predictor-Corrector Methods — Milne's Method, Adam-Bashforth Method, Runge Kutta 2' and 4th order method, Simultaneous Differential Equations and Second Order Differential Equations. Applications.

Assignments/Tutorials

The term work shall consist of record of following exercises using C/C++ language.

- Interpolation
- Curve Fitting
- Linear simultaneous equations
- Numerical Differentiation
- Algebraic and Transcendental equations
- Numerical integration
- Ordinary Differential Equation

Text Books:

- Chapra, S.C. & Canal, R. P., "Numerical Methods for Engineers", 4th Ed., Tata McGraw Hill Publication.
- Balagurusamy, E., "Numerical Methods", Tata McGraw Hill Publication.

References:

- Rajaraman, V., "Computer Oriented Numerical Methods", Prentice Hall of India Ltd.
- Sastry, S. S., "Introductory Methods of Numerical Analysis", Prentice Hall of India Ltd.
- Jain, M.K., Iyengar, S.R.K. and Jain, R.K., "Numerical Methods for Scientific and Engineering Computations", 5th Ed., New Age International Ltd.

- Rajasekaran, S., "Numerical Methods in Science and Engineering – A practical Approach", S. Chand and Co. Ltd.
- Rao, S.S., "Optimization – Theory and Applications", New Age International Ltd.

Outcomes:

- Acquire the knowledge of computer oriented numerical methods, theorems & models
- Use mathematical skills in different application areas of engineering
- Enhance analytical and thinking power.

PE -09005 Metrology and Quality Control

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

Unit 1

(8 hrs)

Introduction:

Meaning of Metrology, Precision, Accuracy, Methods and Errors in Measurement, Calibration.

Linear Measurement:

Standards, Line Standards, End Standard, Wavelength Standard, Classification of Standards, Precision and Non Precision Measuring instruments and their characteristics, Slip Gauges.

Interferometry:

Introduction, Flatness testing by interferometry, NPL Flatness Interferometer.

Study of Measuring Machines, Recent Trends in Engineering Metrology, use of interferometry for length angle and surface roughness measurement

Angle Measurement:

Sine bars, Sine Centers, Uses of sine bars, angle gauges, Auto Collimator Angle Dekkor, Constant deviation prism.

Measurement System Analysis:

Introduction, Influence of temperature, operator skills and the instrument errors etc. on the MSA.

Unit 2

(6 hrs)

Limits, Fits and Tolerances:

Meaning of Limit, Fits and Tolerance, Cost – Tolerance relationship, concept of Interchangeability, Indian Standard System.

Design of limits Gauges:

Types, Uses, Taylor's Principle, Design of Limit Gauges, Three surface Generation.

Inspection of Geometric parameters:

Straightness, Flatness, Parallelism, Concentricity, Squareness, and Circularity.

Comparators:

Uses, Types, Advantages and Disadvantages of various types of Comparators.

Measuring Machines:

Theory of Co-ordinate Metrology, Universal Measuring Machines, Co-ordinate Measuring

Machines (CMM), different configurations of CMM, Principle, Error involved, calibration, Probing system, automated inspection system.

Unit 3

(8 hrs)

Surface Finish Measurement:

Surface Texture, Meaning of RMS and CLA values, Roughness Measuring Instruments, Tactile and Non-tactile measuring instruments, difference between waviness and roughness, Grades of Roughness, Specifications, Assessment of surface roughness as per IS, Relationship between surface roughness and Manufacturing Processes.

Screw Thread Metrology:

External Screw Thread terminology, Floating Carriage Instruments, Pitch and flank Measurement of External Screw Thread, Application of Tool Maker's Microscope, Use of Profile Projector.

Gear Metrology:

Spur Gear Parameters, Gear tooth thickness measurement: Gear tooth vernier caliper, Constant chord method, Span Micrometer.

Unit 4

(8 hrs)

Introduction:

Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Difference between Inspection, Quality Control and Quality Assurance, Role of Quality in Present day environment.

Introduction to Quality Control:

1) Meaning of quality Control 2) 100% Inspection and Selective Inspection 3) Statistics in Selective inspection.

Introduction to Statistical Quality Control:

Interpretation of SPC Charts, benefits for use on shop floor, Control charts- Attribute (P, nP, C, U) and Variable (X bar, R chart and X&R chart), Sampling inspection, OC Curves and Sampling Plan, Process Capability Index (Cp, Cpk), Concept, Methods of determining Cp and Cpk.

Unit 5

(6 hrs)

Quality Assurance Systems:

Total quality management (T.Q.M):

7 tools of Problem Solving, Like Cause and Effect Diagram, Pareto Analysis etc., Q.F.D., Quality Circles, Kaizen, six sigma, 5S System.

ISO 9001-2000 Series of Standards:

History and Evolution of ISO 9000 Series , importance and overview of ISO 9000- 1998 Series standards, structure of ISO 9000-2000 Series standards, clauses of ISO 9000 series standards and their interpretation and implementation, quality system documentation and audit.

ISO 14000:- environmental management concepts, and requirement of ISO 14001, benefits of environmental management Systems.

Unit 6

(8 hrs)

Statistics:

Role of statistics in industries, Role of statistics as industrial engineering tool correlation & regression (Linear Up to 2 independent variables).

Probability:

Addition & multiplication theorem (review), probability distributions (Binomial, Poisson,

Exponential, Normal), sampling distribution of ' t ', ' χ^2 ', ' F ' Distribution, elementary sampling theory, test of hypothesis & its significance.

Design of experiment:

Meaning, objective, and types of research, approaches, two factorial experiments, Taguchi Method.

Reliability Engineering:- Concept, Definitions of MTTF, MTBF, FEMA.

Text Books

- R. K. Jain, A Text book of Engineering Metrology, Khanna Publications Pvt. Ltd. 18th Edition, 2002
- S.P.Gupta, Statistical Methods, Danpat Rai and Sons, New Delhi, 2007

Reference Book

- John S. Oahland, Total Quality Management, Elsevier Publications, 3rd Edition 2006.
- P. N. Mukerjee, Total Quality Management, Prentice Hall of India Publications, 2nd Edition 2005.
- Amitava Mitra, Fundamental of Quality Control and improvement, Prentice Hall of India Publications, 2nd Edition 2006.
- G.M.S. De Silva, Basic Metrology for ISO 9000 Certification Elsevier Publications, 3rd Edition 2002.
- I.C.Gupta, A Text book of Engineering Metrology, Dhanpat Rai Publications Pvt. Ltd. 6th Edition, 2004

Outcomes:

- Interpret the manufacturing drawings and perform inspection.
- Understand the salient concept and principles required to develop the ability of using different types of measuring instrument.
- Select appropriate measurement techniques for geometric features. Carryout data collection and use statistical tools for analysis.
- Identify and analyze the cause for variation and recommend suitable corrective actions.
- Design an acceptance sampling plan for inspection and carry out process capability studies.
- Plot and use of quality control charts.
- Develop an ability of problem solving and decision making. Suggest measures to improve the quality of product and reduce cost.

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

Unit 1**(8 hrs)****Cams and Follower:**

Types of cams and followers, analysis of motion, determination of cam profile for given follower motion (stress should be for cams and follower used in automats).

Design for fluctuating loads:

Stress Concentration and remedies, S-N Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative damage, Soderberg's and Goodman's Diagram, Design of components like shaft, bolted joints, springs etc. subjected to variable loading.

Unit 2**(8 hrs)****Spur Gears:**

Law of Gearing, Effect of Pressure angle and Centre Distance, Path of Contact, Arc of Contact, Contact Ratio, Interference and Undercutting, Minimum number of teeth to avoid interference, Design of Spur Gears, Selection of Type of Gears, Force Analysis, Gear tooth Failures, Selection of Materials, Beam Strength, Wear Strength, Effective Load Calculation, Dynamic Load, Gear Design for Maximum Power Transmitting Capacity.

Helical Gears:

Virtual Number of Teeth, Force Analysis, Beam Strength, Wear Strength, Effective Load, Helical Gear Design.

Unit 3**(6 hrs)****Bevel Gears:**

Force Analysis, Design Calculations of Bevel Gears, Beam Strength, Wear Strength, Effective Load.

Worm Gears:

Force Analysis, Friction in Worm Gears, Strength Rating of Worm Gears, Wear Rating of Worm Gears, Heat Dissipation.

Flywheel:

Introduction, Design Parameters, Energy Storage Capacity of the Flywheel, Weight of the Flywheel, Engine Flywheels, Flywheels for Punches, Stresses in Flywheel Rims, Design of Rimmed Flywheel, Stresses in Arms, Design of Arms, Construction of Flywheel.

Unit 4**(10 hrs)****Balancing:**

Balancing of rotating masses, balancing of reciprocating masses in multicylinder engines & machines (primary and secondary) direct & reverse crank concept. Crankshaft balancing machines.

Mechanical Vibrations

Introduction to Mechanical Vibrations, Importance of the Study of Vibrations, Elements of a

Vibratory System, Examples of Vibratory Motion, Terms used in Vibratory Motion, Degrees of freedom and Examples of Degrees of freedom, Discrete and Continuous system, Types of Vibrations, Types of Free Vibrations

Free Undamped Vibrations:

Methods to determine the Equation of Motion, Vibration Analysis Procedure, Determination of Natural Frequency of Free Transverse Vibrations:- Derivation and Examples, Determination of Natural Frequency of Free Torsional Vibrations:- Derivation and Examples, Effect of Inertia of the Constraint (Mass of the Constraint) in Longitudinal Vibrations, Equivalent Stiffness of Spring Combinations:- Derivations and Examples, Examples on Determination of Natural Frequency (Equation of motion) of given system by any of the four methods.

Frequency of Free Damped Vibrations:

Types of Dampers, Free Damped Vibrations:- Damping coefficient, Damping Factor or Damping Ratio and Logarithmic Decrement, Under damped, Over damped and Critically Damped systems and Examples on Free Damped Systems.

Frequency of Under damped Forced Vibrations:

Magnification Factor or Dynamic Magnifier:- Theory and Examples.

Forced Damped Vibrations:

Theory and Examples, Vibration Isolation and Transmissibility:- Theory and Examples.

Unit 5

(6 hrs)

Friction Clutches, Brakes and Dynamometer:

Pivot collar friction, types of friction clutches, design consideration for plate, cone & centrifugal clutches.

Types like band brake, shoe brake, band & block brake, Disc Brakes, absorption & transmission type dynamometers. Design consideration of various brakes, thermal considerations.

Unit 6

(6 hrs)

Rolling Contact Bearings: Types, Static and Dynamic load Capacity, Stribeck's Equation, Concept of equivalent load, Load life Relationship, Selection of bearing from Manufacturer's Catalogue, Design for variable loads and Speeds, Bearings with Probability of Survival other than 90%, Lubrication and Mounting of bearing.

Sliding Contact Bearings:

Hydrostatic Step Bearing, Energy Losses in Hydrostatic Step Bearing, Reynold's Equation, Raimondi and Boyd Method, Bearing Design – Selection of Parameters, Sommerfeld Number, Constructional Details of Bearings, Temperature Rise, Comparison of Sliding Contact and Rolling Contact Bearings.

Turbo Codes:

Bayes theorem, Decision theory, Signal decision example, Turbo codes fundamentals, Introduction to fading multi path channels.

Text Books

- S. S. Rattan, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007
- V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007

Reference Book

- Joseph E. Shigley, John J. Uicker, "Theory of Machines and Mechanisms", Oxford University Press, 3rd Edition
- Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition
- Robert L. Norton, "Design of Machinery", McGraw Hill Higher Education, 3rd Edition
- M. F. Spotts, "Design of Machine Elements", Dorling Kindersley (India) Pvt. Ltd., 8th Edition
- S. S. Rao, "Mechanical Vibrations", Dorling Kindersley (India) Pvt. Ltd., 4th Edition

Outcomes:

- Understand design methodologies for different elements of manufacturing machines and their models.
- Develop designing skills and enhance thinking and analytical power of students to understand working of machines from design point of view.

PE - 09012 TOOL AND DIE DESIGN

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

Unit 1

(6 hrs)

Jigs and Fixtures:

Significance and purpose of jigs and fixtures and their functions in the manufacturing processes.

Classification of jigs and fixtures such as machining, assembly and inspection fixtures; universal jigs and fixtures; readjustable jigs and fixtures.

Design features of main elements of jigs and fixtures such as locating, clamping and guiding elements and their integration.

Indexing, locking and auxiliary elements. Bodies, bases or frames of jigs and fixtures.

Unit 2

(12 hrs)

Basic Types of Press Working Operations and Equipment:

General classification and components of Press Tools.

Dies And Punches:

Elements of Dies and Punch set. Types of dies – simple, compound, combination and progressive dies and punches of various press working operations such as punching, blanking, drawing, bending, forming, coining, Fine Blanking Burr free blanking etc.

Design of Blanking die, Progressive die, Calculations of clearances, center of pressure, different forces, press tonnage, strip layout, sheet utilization ratio, methods of reducing forces.

Unit 3

(7 hrs)

Drawing And Bending dies:

Design of Shallow & Deep drawing die, Calculation of blank size, number of draws, drawing

force, press capacity, ironing & ironing force, Types of Bending dies, various methods used to overcome spring back, Calculation of total bend length and calculation of various forces.

Unit 4

(8 hrs)

Design of simple dies for forging:

Types of Forging, Guidelines for selection of various design factors, parting line , draft, rib-web, Corner & fillet radius, shrinkage & die wear etc., Detailed calculations of stock size, Design of Fullering, edging, types of die inserts.

Unit 5

(6 hrs)

Design of Die casting dies:

Die Casting processes Hot & Cold Chamber, Metals for die casting, Design considerations in die casting. Types of cores, feeders, inserts, die lubrications & rules, heat transfer consideration, directional solidification, cooling system, feed and flow system and ejection system, interlocks & safety devices, die casting defects and remedies.

Unit 6

(6 hrs)

Plastic and Plastic Moulding :

Introduction of compression and transfer moulding process, Study of Injection and blow moulding process; - machine specifications, moulding cycle.

Mould Design – Design of simple two plate injection moulds. Design of simple blow moulds for articles like bottles, cans, etc. Study of types of ejectors, gates, runner's, Study of cooling systems and heat transfer consideration. Calculation of no. of cavities, Mould opening force, ejection force etc.

Text Books

- Donaldson, Lecain and Goold, Tool Design, Tata McGraw Hill, 3rd Edition.
- S. K. Basu, S.N. Mukherjee, R. Mishra, Fundamental of Tool Engineering Design, Oxford & IBH Publishing Co. Pvt. Ltd., 1979.

Reference Book

- Handbook of Die design Handbook, McGraw Hill, 2006.
- M.H.A. Kempster, Introduction to Jigs and Fixture Design, ELBS Edition, 1990.
- A.S. Athalye, Injection Moulding, Multitech Publishers Co. Mumbai
- Metal Hand Book, Vol-II and III.ASME.
- Forging Handbook, ASM, Vol. 5, 9th edition.

Outcomes:

- On completion of this course the student should be able to design different types of jigs & fixtures, dies by understanding the basic concepts and principles of press tools. Course helps in development of problem solving ability in regards to press tools.

MT - 09017 MATERIAL FORMING

Teaching Scheme

Lectures : 3 hrs/week

Examination Scheme

100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

Unit 1

(10 hrs)

Introduction of forming processes.

Strain hardening Concept of flow stress determination, Theory of plasticity, Yield criteria for ductile materials- Von mises criteria, Tresca Criteria, flow stress concept. Effect of temperature, strain rate, metallurgical microstructure, chemical composition and mechanical properties, for Classification of material forming process. Concept of Formability, formability limits s. and formability diagram.

Unit 2

(10 hrs)

Forging

Introduction, classification of forging processes. Forging equipment- Hammers, presses, furnaces etc. construction working capacities and selection of equipment. Basic forging operations such as drawing, fullering edging, blocking etc. wing Forgability tests, design of forging as a product, Slab Method of Analysis friction in forging. Forging defects and r the remedies. New technologies: Liquid metal forging, isothermal forging, No draft forging, P/M forging, Rotary swaging, roll forging, Lubrications in forging.

Unit 3

(6 hrs)

Wire and Tube drawing

Introduction rod and wire drawing machines - construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Patenting heat treatment. Variables in wire drawing, Maximum reduction in wire in one pass, forces required in drawing. Multiple drawing, work hardening, lubrication in wire drawing. Tube drawing: Methods, force calculation, stock penetration. lubrication in tube drawing

Unit 4

(8 hrs)

Rolling of metals

Scope and importance of rolling. Types of Rolling Mills- Construction and working. Roll bite, reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening, Roll camber - its effect on rolling process, mill spring. Defects in rolling. Automatic gauge control- Roll pass classification & design. Lubrication in rolling. Sheet Metal Forming, blanking, bending, drawing and deep drawing.

Unit 5

(6 hrs)

Extrusion

Types: Direct, reverse, impact, hydrostatic extrusion. Dies for extrusion, stock

penetration. Extrusion ratio Force equipment (with and without friction), metal flow in extrusion, defects. Role of friction and lubricants. Manufacture of seam-less tubes.

Unit 6

(6 hrs)

Advanced metal forming processes

High velocity forming- principles, comparison of high velocity and conventional Forming processes. Explosive forming, Magnetic pulse forming, Electro hydraulic Forming, Microforming, Microcoinig, microextrusion, Microbending Stretch forming, coining embossing, curling spinning, flow forming advantages, limitations and application of the process.

Text Books

- Dieter, Mechanical Metallurgy, ISBN0071004068
- P.N. Rao, "Manufacturing Technology", TataMcGrawHill ISBN0070087695

Reference Book

- G.W. Rowe, "Principles of industrial metal working process", Edward Arnold ISBN8123904282.
- Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co.ISBN8176190020
- ASM Metal hand book Vol: 14 Forming and Forging.

Outcomes:

On completion of this course the student should learn basic concept of different metal forming process and the application of concept to analyse the processes.

PE - 09009 METROLOGY LABORATORY

Teaching Scheme

Practical: 2 hrs/week

Examination Scheme

Term-work: 50 Marks

Oral: 50 Marks

Term Work / Experiments

The term work shall consist of the record of the following experiments and assignments.

1. Determination of Linear/Angular dimensions of a part using Precision and Non Precision measuring Instruments.
2. Precision angular measurement using a) Sine Bar, b) Auto Collimator, c) Angle Dekkor.
3. Machine Tool alignment tests on any machine tool like Lathe, Drilling Machine or Milling machine (minimum three tests)
4. Measurement of screw thread parameters using Floating Carriage Micrometer.
5. Measurement of Gear parameters: a) Gear Tooth thickness and depth, b) constant Chord, c) Span Measurement, d) Pitch Circle Diameter.
6. Surface Finish measurement using suitable instrument.
7. Interferometry : Measurement of surface flatness using optical flat.
8. Study and Measurement of parameters using Profile Projector.

9. Exercise on Design of Limit Gauges using Taylor's Principles.
10. Study and Measurement of parameters using Tool Makers Microscope.

Assignments

1. Assignments on t, F and Chi Square distributions
2. Assignments on Correlation and Regression.

Outcomes:

- Understand principle, construction and working of various measuring instruments,
- Selection of proper instruments for measurement
- Calculation of least count of instrument, take reading using the instrument
- Interpret the observations & results.
- Collection and recording of data and analysis of data

PE – 09010 KINEMATICS AND DYNAMICS OF MACHINES LABORATORY

Teaching Scheme

Practical: 2 hrs/week

Examination Scheme

Term-work: 50 Marks

Oral: 50 Marks

List of Experiments

One design project like gearbox using spur gears, clutch, brake etc. Two imperial size drawing sheets one involving assembly drawing with part list and overall dimensions and other sheet involving drawing of individual components giving manufacturing tolerances, geometric tolerances and finish symbols for critical components. A design report with all necessary calculations in a separate file.

A journal consisting of following experiments and exercises.

To draw a cam profile for a given automat motion.

Experiments on free undamped vibration for single degree of freedom system.

Experiment on free damped vibration for single degree of freedom system.

Experiment on forced damped vibration for single degree of freedom system.

To draw a gear profile on gear generating apparatus for various rack shifts.

The oral will be based on above term work.

Outcomes:

- Understand the process of designing for the project like gear box etc.
- Design of cam and drawing of cam profile
- Understand the concept of free undamped & damped vibrations.
- gear profile on gear generating apparatus for various rack shift

PE – 09011 TOOL AND DIE DESIGN LABORATORY

Teaching Scheme

Practical: 2 hrs/week

Examination Scheme

Term-work: 50 Marks

Oral: 50 Marks

Assignments

1. Detail design and drawing of die for drawing operation or shearing operation. (use of CAD desirable)
2. Detail design and drawing of die for forging operation. (use of CAD desirable)
3. Detail design and working drawing of plastic moulds for plastic components for manual and automatic machines (use of CAD desirable).

The oral will be based on above term work.

Outcomes:

- Design & drawing of dies for drawing or shearing operation.
- Design & drawing of dies for forging operation.
- Design and working drawing of plastic moulds for plastic components for manual and automatic machines.

CT - 09019 SOFTWARE LABORATORY – I

Teaching Scheme

Practical: 2 hrs/week

Examination Scheme

Term-work: 50 Marks

Oral: 50 Marks

The laboratory work will be done in two parts:

Part I

Introduction to Statistical techniques using Microsoft Excel

The term work will consist of following assignments:

- 1) Classification of raw data. Calculation of Mean, Mode, Median, standard deviation, variance
- 2) Fitting data to various distributions. Chi-square test
- 3) Correlation and regression analysis
- 4) Interpretation of results related to the above assignments

PART II

Term Work / Experiments

The term work shall consist of the record of the following experiments and assignments.

1. Study of basic commands from solid modeler
2. Study of advanced commands from solid modeler
3. Study of various CAD translators
4. Study of various applications of solid modeler

Assignments

1. Solid modeling of simple job
2. Mini project under which a group of 4 students will develop assembly of engine component using given solid modeler.

Outcomes:

- After completion of the course the student will be able to apply the knowledge of statistics in various industrial and day-to-day applications and will be able to understand the use of appropriate statistical tools in various data processing.
- Understand basic concepts of solid modeler which can be used to learn any other solid modeler.

ML - 09001 Constitution Of India

Teaching Scheme

Lectures : 2 hrs/week

Examination Scheme

20 marks: Continuous evaluation-
Assignments /Quiz
End - Sem Exam – 30 Marks

Unit 1

(5 hrs)

Preamble to the constitution of India. Fundamental rights under Part – III – details of Exercise of rights, Limitations & Important cases.

Unit 2

(5 hrs)

Relevance of Directive principles of State Policy under Part – IV. Fundamental duties & their significance.

Unit 3**(4 hrs)**

Union Executive – President, Prime Minister, Parliament & the Supreme Court of India.

Unit 4**(4 hrs)**

State executive – Governors, Chief Minister, State Legislator and High Courts.

Unit 5**(4 hrs)**

Constitutional Provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions.

Unit 6**(4 hrs)**

Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.

Text Books:

1. Durga Das Basu: "Introduction to the Constitution of India" (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
2. "Engineering Ethics" by Charles E.Haries, Michael. S.Pritchard and Michael J.Robins Thompson Asia, 2003-08-05.

Reference Books:

1. "An Introduction to Constitution of India" by M.V.Pylee, Vikas Publishing, 2002.

Outcomes:

At the end of this course students will be aware about the Constitution:

- Appreciate the complexity of implementation of any law.
- Appreciate the roles and functions of various high officials.
- Know about Fundamental rights of citizens of India.
- Understand the Electoral process.
- Understand the provisions made for special groups and categories in the constitution

Annexure I

List of Open Elective/Professional Science courses offered by ALL Departments

Sr. No	Department	Course
1	Civil	Finite Elements in Engineering
2	Mechanical	1. Unconventional Machining Processes 2. Modern Control Systems 3. Power Plant Engineering
3	Electrical	1. Industrial Drives 2. Control System Engineering
4	Electronics and Telecommunication	Electronic Communication Systems
5	Metallurgy and Material Science	Composite Materials
6	Instrumentation and Control	Industrial Automation
7	Production	1. Introduction to ERP 2. Operations Efficiency
8	Computer Engineering	Information Systems
9	Information Technology	Information Systems
10	Applied Science	1. Humanities Course 2. Constitution of India
11	Innovation Centre	Liberal Learning Course