Third Year B. Tech (Production S/w)
Curriculum Structure
(w.e.f. 2017-18)

Semester V

Sr. No.	Course Type	Course Code	Course Name	TeachingScheme			Credits
				L	T	P	
1	SBC		Industrial In-plant Training	0	0	0	10
2	LC		Seminar-I	0	0	0	2
3	SLC		Basics of Kinematics and Dynamics of Machines/ Equivalent MOOC course	0	0	0	3
				0	**0**	**0**	**15**
			Total Academic Engagement and Credits	**Max. 0**			**15**

Semester VI

Sr. No.	Course Type	Course Code	Course Name	TeachingScheme			Credits
				L	T	P	
1	DEC		Department Elective –I	3	0	0	3
2	PCC		Metrology and Quality Control	3	0	0	3
3	PCC		Kinematics and Dynamics of Machines	3	1	0	4
4	PCC		Tool and Die Design	3	0	0	3
5	PCC		Material Forming	3	0	0	3
6	LC		Metrology and Quality Control Laboratory	0	0	2	1
7	LC		Kinematics and Dynamics of Machines Laboratory	0	0	2	1
8	LC		Tool and Die Design Laboratory	0	0	2	1
9	SBC		Modelling and Simulation Laboratory	0	1	2	2
10	BSC		Numerical Methods With C++	0	1	2	2
11	MLC/SLC		Constitution of India	2	0	0	0
12	HSMC		Industrial Engineering and Engineering Economics	3	0	0	3
				20	3	10	26
			Total Academic Engagement and Credits	**Max. 34**			**26**

Department Elective –I

i) **Supply chain and Logistics Management**
ii) **Reliability and Terotechnology**
iii) **Facility Planning and Design**
iv) **Nano Manufacturing**

Minors- Manufacturing Technology (Mechanical)

Semester	Course offered	Teaching scheme			Credits
		L	T	P	
V	Metrology & Quality Control	3	-	-	3
VI	Engineering Economics & Operations Research	3	-	-	3

Minors- Manufacturing Technology (Civil/ENTC/Electrical/Instru/Comp/IT/Meta)

Semester	Course offered	Teaching scheme			Credits
		L	T	P	
V	Production Processes	3	-	-	3
VI	Engineering Economics & Operations Research	3	-	-	3

Honors- Manufacturing Systems Engineering

Semester	Course offered	Teaching scheme			Credits
		L	T	P	
V	Precision Engineering	3	-	-	3
VI	Reliability & Maintenance Engineering	3	-	-	3

Honors- Mechatronics

Semester	Course offered	Teaching scheme			Credits
		L	T	P	
V	Principles of Electronics	3	-	-	3
VI	Mechatronics System Design	3	-	-	3

(LC) Industrial In-plant 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

Course Objectives:

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

Syllabus Contents:

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 andDrawing 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, beat 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, NCICNC 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

9. 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.

10. Study of various Production Planning and Control functions. Process and Operation Planning, Yearly and Monthly Planning, Forecasting, Scheduling, Planning.

11. 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.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Figure out the organizational structure, scale and type of production
2. Understand basic manufacturing technology in terms of scale of production.
3. Understand the functioning of the various departments in the manufacturing environment.
4. Understand the advanced manufacturing and finishing process.
5. Able to handle manufacturing and inspection machines.
6. Understand International Standards on Quality and Reliability
7. Understand various Production Planning and Control functions. Process and Operation Planning
8. Understand material handling methods and equipment.
9. Design manufacturing jigs and fixtures and other accessories
10. Understand different types of tooling system and their role in precision manufacturing.
11. Read and interpret the industrial drawing and process plans

(LC) Seminar - I

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Oral:-- 50 Marks

Term Work:- 50 Marks

Course Objectives:

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

Syllabus Contents:

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 AND INDUSTRIAL MANAGEMENT

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra)

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Certificate Page: -

DEPARTMENT OF PRODUCTION ENGINEERING AND INDUSTRIAL MANAGEMENT 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 .

(Name of Guide)

Date:- dd/mm/yyyy Guide

(Name of HOD)

Place:- Pune-411005. Prof. & Head

Department of Production Engg. & Industrial Management,

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.

(PCC) Basics of Kinematics and Dynamics of Machines

Teaching Scheme
Lectures: Self Study

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam – 60

Course Objectives:

1. Students will learn different type of load, factors affecting the endurance strength of the material.
2. Students will learn the function at least five types of cams and followers with their specific use.
3. Students will be able to recognize and describe the main features of spur gears, helical gears, bevel gears, and worm/wormgear sets.
4. Students will be able to describe the function of clutches, brakes and dynamometers.
5. Students will learn the basic principle of working of journal bearings and various plain surface bearings.

Syllabus Contents:

Unit 1 **(6 hrs)**

Cams and Follower:

Function of cams, classification of cams, Classification of follower, Terms used in radial cams, Motion of follower, Displacement, Velocity, Acceleration and Jerk diagram when follower moves with Uniform velocity, Simple Harmonic Motion, Uniform acceleration and Retardation and Cycloidal motion.

Fluctuating loads:

Stress concentration, Stress concentration factor, Reduction of Stress concentration factor, Numerical on stress concentration, Fluctuating stresses, Fatigue Failure, Endurance limit, Low cycle and High cycle fatigue, Notch sensitivity, Endurance limit approximate estimate by considering various factors.

Unit 2 **(6 hrs)**

Spur Gears:

Mechanical drives, Gear drives, Classification of gears, Selection of type of gears, Terminologies of Spur gear, Law of Gearing, Standard system of gear tooth, Interferance and Undercutting, Backlash, Minimum number of teeth to avoid interference, Effect of pressure angle and centre distance, Path of contact, Arc of contact, Contact Ration, Force Analysis of spur gear with numerical examples, Gear tooth failure, Selection of gear material, Gear lubrication.

Helical Gears:

Terminologies of Helical gears, Virtual Number of Teeth, Tooth properties of Helical Gear, Force Analysis with numerical examples.

Bevel Gears:

Terminologies of Bevel gears, Application of Bevel gears

Worm Gears:

Terminologies of Worm gears, application of worm gear, material for worm and Worm wheel

Unit 3 **(6 hrs)**

Turning Moment Diagram and Flywheel:

Turning Moment Diagram for Single cylinder double acting steam engine, Foure stroke Internal combustion engine, Multi cylinder engine, Fluctuation of Energy, Determination of Maximum fluctuation of energy, Coefficient of Fluctuation of Energy, Fly wheels, Coefficent of fluctuation of speed, flywheel and governors, Material for Flywheel.

Unit 4 **(10 hrs)**

Clutches

Clutches, Classification of Clutches, Torque Transmitting capacity of clutches, Uniform Pressure theory, Unifrom wear theory, Friction Material, Multi disk Clutches, Cone Clutches and Centrifugal Cluthces

Brakes and Dynamometers

Brakes, Classification of Brakes, Block Brake with shoe, Block brake wioth long shoe, Pivoted block brake, Simple Band brake, Differential band brake, Band and block brake, Internal expanding brake, Disk brake, Dynamometer, Classification of Absorption and Transmission dynameters, Bevis Gibson Flash light dynamometer.

Unit 5 **(6 hrs)**

Rolling Contact Bearings

Types of Rolling Contact bearing, Deep groove ball bearing, cylindrical roller bearing, Angular contact bearing, Self aligning bearing, Taper roller bearing, thrust ball bearing, Principal of self aligning bearing, Needle bearing, Bearing failure Cause and Remedies, Lubrication of Rolling contact bearing, Mounting of bearing

Sliding Contact Bearings

Basic Modes of lubrication, Viscosity, Measurement of Viscosity, Viscosity Index, Design parameters for journal bearings, Bearing construction, bearing material, Sintered material bearing, lubricating oils, additives for mineral oil, Selection of lubricants, Greases, Journal bearing failure cause and remedies, comparison of Rolling Contact Bearings and Sliding Contact Bearings

References:

- V. B. Bhandari, “Design of Machine Elements”, Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007
- S. S. Rattan, “Theory of Machines”, Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007
- R.S. Khurmi J. K. Gupta, “Theory of Machines”‖, Eurasia Publishing House (Pvt.) Ltd, 2nd Edition
- Joseph E. Shigley, John J. Uicker, “Theory of Machines and Mechanisms”‖, Oxford

University Press, 3rd Edition
- Robert L. Mott, P.E, “Machine elements in mechanical design”, Pearson Prentice Hall Publication 4th Edition
- M. F. Spotts, “Design of Machine Elements”‖, Dorling Kindersley (India) Pvt. Ltd., 8th Edition

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Describe the at least five types of cams and followers with their specific use.
2. Recognize the factor that affects the magnitude of endurance strength.
3. Recognize and describe the main features of Spur gear, Helical gear, Bevel gear and Worm gear sets.
4. Describe the involute-tooth form and discuss its relationship to the law of gearing.
5. Describe at least five types of clutched, brakes and dynamometers.
6. Identify the types of bearings that are commercially available and select the appropriate type of given application.

Departmental Elective – I

Supply Chain and Logistics Management

Teaching Scheme
Lectures : 3 hrs/week

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

Course Objectives:

1. Understand supply chain flows & supply chain strategies.
2. Understand and design the supply chain network operations.
3. Understand & designing souring & logistics network & analyze factors affecting logistics and souring decisions.

Syllabus Contents:

Unit 1: **(06hrs)**

Introduction to Supply chain management

Definition of Supply chain and supply chain management, Supply chain stages and decision phases, process view of a supply chain. Supply chain flows. Internal supply chains and External supply chains. Information systems and SCM, Inventory management across the SC.

Drivers of supply chain performance. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope, Challenges facing SC managers

Unit 2: **(08hrs)**

Supply Chain Network

Supply Chain Network (SCN) - Role, Factors, design options for distribution network. Models for Facility Location and Capacity Allocation and problem solving, Impact of uncertainty on SCN - Discounted Cash Flow Analysis

Unit 3: **(08hrs)**

Planning & Managing Inventories in a Supply Chain

Role of forecasting in the SC, Time series forecasting methods, Review of inventory concepts. Trade promotions, Managing Cycle Inventory, Cycle time overview, Causes of long cycle times, Methods of reducing cycle time, Safety inventory determination.

Unit 4: **(08hrs)**

Sourcing and Transportation in the supply chain

Role of Sourcing, Supplier - Scoring & Assessment, Selection & Contracts. Design Collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network, Tailored transportation, Routing and scheduling in transportation. International transportation.

Unit 5: **(06hrs)**

Coordination and Technology in the Supply Chain

Coordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT in Supply Chain, The Supply Chain IT Framework, CRM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in Practice. Case discussions.

Unit 6: **(04hrs)**

Performance measurement and Cases in SCM

Performance metrics in SCM, Balanced scorecard approach.

Text Books:

- Sunil Chopra & Peter Meindl; Supply Chain Management -Strategy, Planning & Operation; 11 Edition - 2003. Pearson Education Inc.
- Douglas Lanibert& James Stock: Strategic Logistics Management: Irwin McGraw Hill
- Robert B. Handfield, Ernest L. Nichols, Jr, Introduction to Supply chain management, Prentice Hall

Reference Books:

- Robert B. Handfield, Ernest L. Nichols, Jr.; Supply Chain Redesign-Transforming Supply Chains into Integrated Value Systems 2002, Pearson Education Inc.,ISBN:81-297-0113-8.
- Jeremy F. Shapiro, Duxbury ; Modelling the Supply chain: 2002, Thomson Learning, ISBN: 0-534-37363-
- David Simchi Levi, Philip Kaniinsky& Edith Simchi Levi: Designing and Managing the Supply Chain: McGraw Hill
- B.S. Sahay, Supply Chain Management: Mc. Millen.

Course Outcomes:

1. Understand, analyze the designing, planning and operational decisions of SCM.
2. Identify, clarify managerial action to improve supply chain performance for the desired goals.
3. Understanding of techniques used in the management of critical components of logistics and supply chains e.g., transportation, warehousing, inventory.
4. Explain the likely future development of logistics and supply chain management

Reliability & Terotechnology

Teaching Scheme
Lectures : 3 hrs/week

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

Course Objectives:

1. To familiarize with concept of reliability andmaintainability.
2. To understand how to analyze a system for reliability assessment and life cycle costing.
3. To get familiarize with several maintenance management strategies.
4. To familiarize with condition monitoring in maintainability.

Syllabus Contents:

Unit 1 **(05hrs)**

Reliability

Definition -methods of improving reliability, derivation of Reliability function, configurations of reliability, series parallel & mixed configuration, simple problems

Unit 2 **(08hrs)**

Reliability Calculations

methods of improving reliability, redundancy element, unit stand-by redundancy, reliability models, constant hazard, simple problems, hazard models.

Unit 3 **(08hrs)**

Maintenance Systems

Objective, of maintenance, maintainability and availability concepts, types of availability - mean time to failure-mean time between failures-mean time to repair-mean down time-Reliability allocation

Unit 4 **(08hrs)**

Life Cycle Costing

Techno economic Life; Reliability effort function, simple cost models for Life cycle.

Unit 5 **(08hrs)**

Maintenance Management

Principles types of maintenance breakdown, periodic, preventive and total productive maintenance, maintenance planning and control strategies, maintenance planning, maintenance policies, maintenance organization, maintenance standards-quality service standards-maintenance Strategy, influence of Terotechnology on maintenance management maintenance performance indices, maintenance system documentation.

Failure Analysis: using causes & effects using Ishikawa diagram FMEA, FMECA.

Unit 6 **(08hrs)**

Condition Monitoring

Definitions, advantages, limitations, through ferrography and particle analyser, spectroscopic oil analysis programme (SOAP), contaminant analysis, vibration monitoring, useof monitoring, instruments and applications-magnetic chip detector. Role of computers in condition monitoring. Monitoring, systems- layers & monitors.

Text Books:

- L. S. Srinath Reliability Engineering, -Affiliated East -West press, 2002.

Reference Books:

- K. K. Ahuja, Industrial management and Organizational Behaviour, Khanna Publications. 1999
- H. P. Garg, Industrial Maintenance, S. Chand & company. Ltd, Third Edition 1990.
- Dr. Shankar, Industrial engineering Management Golgotia Publications Pvt. Ltd. 1997
- S.K. Basu&B.Bhadury, Terotechnology: Reliability Engg& maintenance Management, Asian book Private Ltd., Delhi, 1stEdition, 2003.
- A.K. Gupta, Reliability Engineering & Terotechnology

Course Outcomes:

1. Student will be able to understand the importance and application of reliability.
2. Student will be able to use the concepts of reliability in designing and maintenance of products.
3. Student will be able to simulate techno economic life which is very important for industry application.

Facility Planning and Design

Teaching Scheme
Lectures : 3 hrs/week

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

Course Objectives:

1. To appraise students of facility planning & location, selection and layout techniques, particularly with available computer aided programmes in market for effective production systems
2. To teach them different analytical methods relating design of location models, warehouse layout models, storage models etc.
3. To brief them about different layouts evaluating methods including modern concepts in managerial decisions.

Syllabus Contents:

Unit 1 **(08hrs)**

Plant Location And Layout

Factors influencing plant location, Theories of plant location and location economies.

Plant Layout

Objectives of plant layout, Principles of plant layout, type: of plant layout, their merits and demerits.

Unit 2 **(08hrs)**

Material Handling

Definition, principles, system design and selection of equipment, unit load concepts, basic layout types Immer, Nadler, Muther, Apple James and Reed's approaches to plant layout, Modular design concept, Production Line balancing.

Unit 3 **(08hrs)**

Computer Aided Layout

CRAFT, COFAD, PLANET, CORELAP, ALDEP, Muther‟s Classification, formation of cells of machines each operating using common Host Computer.

Unit 4 **(08hrs)**

Space Determination And Area Allocation

Factors for consideration in space planning, receiving, storage, production, shipping, other auxiliary) service actions, Establishing total space requirement, area allocation factor to be considered, expansion, flexibility, aisles column and area allocation procedure. Design of layout using Travel chart, plot plan, block plan, Sequence demand straight-line method and non - directional method.

Construction of the Layout

Methods of constructing the layout, evaluation of layout, efficiency indices, presenting layout to management, implementing layout.

Unit 5 **(08hrs)**

Quantitative Approaches to Facilities Planning

Deterministic models - single and multi facility location models, Location allocation problems - quadratic assignment problems, Warehouse layout models, plant location problems. Conveyor models. Storage models.

Unit 6 **(08hrs)**

Probabilistic Models

Conveyor models, waiting line models and simulation models. Evaluation, selection, implementation and maintenance of the facilities plan.

Text Books:

- Thompkins, J A and White, J. A Facilities Planning, John Wiley & Sons.
- Francies, R.L. and White, J. A. Facility layout and Location, John Wiley &Sons .

Reference Books:

- James M Apple, Plant Layout and Material handling 2ndEdition., The Ronald Press Company John, Wiely and Sail
- Muther Richard, Practical plant layout, McGraw hill.
- SundereshHeragu, Facilities Design, PWS Publishing Company, ISBN- 0-534- 95183.
- James M Moore, Plant Layout Design, Mac Millon Co. 1962 LCCCN: 61 - 5204.

Course Outcomes:

1. Learn formulations, models, and analytical procedures for the study of facilities layout planning.
2. Learn fundamental principles of material handling.
3. Be able to design a factory layout incorporating product, process, and personnel requirements.

Nano-Manufacturing

Teaching Scheme
Lectures : 3 hrs/week

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

Course Objectives:

1. Understand the basic concepts of Micro and nano technology and micro nano systems and its applications.
2. To understand the fundamentals of micro and nano fabrication process.
3. To impart the fundamentals of nano polishing methods
4. To get acquainted with micro sensors, actuators, MEMS devices and its various industrial as well as Biomedical Applications.

Syllabus Contents:

Unit 1 (**06 hrs)**

Fundamentalof micro and nano technology, Microand Nanofabrication, concepts of micro and Nanosystems and Microsystems Products, Microsystems and Microelectronics , Application of Microsystems, Standardisation and Commercialization Issues of Micro-Nano Systems

Unit 2 (**08 hrs)**

Micro machining – Ultra Sonic Micro Machining, Abrasive Water Jet Micro Machining – Tool based Micro-machining, Chemical and Electro Chemical Micro Machining – Electric Discharge Micro machining. Electron and Laser Beam Micro Machining, Hybrid Micro machining, Electro Chemical Discharge micro machining, Machining of Micro gear, micro nozzle, micro pins and its applications. Tool based micromachining (TBMM)

Unit 3 (**08 hrs)**

Nano machining and Finishing: Focused Ion Beam Machining –Plasma Beam Machining – electrochemical nanomachining, Abrasive Flow finishing –- Magnetic Float polishing – Elastic Emission Machining – Chemo-Mechanical Polishing, Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing

Unit 4 (**07 hrs)**

Concepts of micro forming and welding, Micro extrusion – Micro and Nano structured surface development by Nano plastic forming, Roller Imprinting, Electrochemical and , Electro-discharge machining etc, Micro bending and micro welding with LASER, Electron beam for micro welding, Metrology for micro machined components.

Unit 5 (**06 hrs)**

Micro sensors, Micro actuation, MEMS with Micro actuators, Micro actuators with mechanical Inertia – Micro fluidics, micro/nano biosensors: Classification of physical sensors, Integrated, Intelligent or Smart sensors, Bio sensing Principles and sensing methods, Biosensors arrays and Implantable devices, Innovative Applications on Present Devices: Nano chips, Nanotubes and Nanowires, Integration of chips and microprocessors.

Unit 6 (**07 hrs)**

Introduction to different Biomedical Applications of Microsystems:

Delivery of Diagnostic and Therapeutic Agents to Vascular Targets, Real-Time Biological Imaging and Detection,
Diagnostic and Therapeutic Applications of Metal Nano shells, Micro devices for Oral Drug Delivery etc. Technology Support, Meeting Social Needs , future scope of micro-nano systems

Text Books:

- Foundations of MEMS, Chang Liu 2006, Prentice Hall
- Jain V.K., ‗Introduction to Micro machining' Narosa Publishing House, 2011
- Bhattacharyya B., "Electrochemical Micromachining for Nanofabrication, MEMS and Nanotechnology", William Andrew publications (Imprint of Elsevier) 2015
- Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN: 8122422578.
- Tai-Ran Hsu, "MEMS and MICROSYSTEMS", John Wiley & Sons, New Jersey, 2008.
- Micro fabrication & Nano manufacturing by Mark J. Jackson

Reference Books:

- Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
- Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer, 2008
- Stephen .D. Senturia, "Microsystems design", Springer, 2000.
- Nanotechnology and Nano electronics – WR Fahrner, Springer International Z. Cui, Nanofabrication, Springer, 2008
- Janocha H., Actuators – Basics and applications, Springer publishers – 2012
- Company Ltd., 2000, 3rdEdition.

Course Outcomes:

1. The course will enable the students to know the basic concepts of and principles of Micro and nano systems
2. The course will impart fundamental knowledge of micro and nano fabrication processes to the students.
3. This course will help students to know about working principles and applications of micro sensors/micro actuators.
4. This course will help students to know the advance applications of micro-nano systems to various critical applications such as biomedical, microfluidics etc.

(PCC) Metrology and Quality Control

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. To educate students on different measurement systems and on common types of errors.
2. To introduce different types of linear and angular measurement processes and instruments.
3. To give knowledge about interferometers, comparators and screw and gear measurements.
4. To familiarize students with surface roughness measurements, Optical instruments and 3D measurements.
5. Familiarize students about industrial practises of statistical process control using variable and attribute control charts and sampling techniques.
6. Impart the knowledge about design of experiments, reliability and quality assurance system used in modern manufacturing.

Syllabus Contents:

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 interferometery 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, Gauge R and R study.

Unit 2 **(8 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 (6hrs)

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 verniercalliper, Constant chord method, Span Micrometer.

Unit 4 (8hrs)

Introduction: Meaning of Quality, Approaches- Deming's Approach, Juran's Approach, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, and 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 (5hrs)

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 (5hrs)

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 & it's 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 PblicationsPvt. Ltd.18th Edition, 2002
- S.P.Gupta, Statistical Methods, Danpat Rai and Sons, New Delhi, 2007

Reference Books:

- John S. Oahland, Total Quality Management, Elsevier Publications, 3rd Edition 2006.
- P. N. Mukerjee,Total Quality Management, Prenice Hall of India Publications, 2nd Edition 2005.
- AmitavaMitra, Fundamental of Quality Control and improvement, Prenice 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 Pblications Pvt. Ltd.6th Edition, 2004

Course Outcomes:

1. Interpret the manufacturing drawings and perform inspection.
2. Able to use different types of measuring instruments.
3. Select appropriate measurement techniques for geometric features.
4. Carryout data collection and use statistical tools for analysis.
5. Identify and analyze the cause for variation and recommend suitable corrective actions.
6. Design an acceptance sampling plan for inspection and carry out process capability studies.
7. Plot and use of quality control charts.
8. Develop an ability of problem solving and decision making. Suggest measures to improve the quality of product and reduce cost.

(PCC) Kinematics and Dynamics of Machines

Teaching Scheme
Lectures: 3 hrs/week
Tutorial: 1 hr/week

Examination Scheme
T1, T2 – 20 marks each, End-Sem Exam - 60

Course Objectives:

At the end of the course, students will demonstrate the ability to:

1. To identify the appropriate analysis techniques based on the loading pattern to be used for efficient and safe design of the load carrying member.
2. Students will learn about the types of cams and follower and effect of the follower motion on the inertia and jerk of the system.
3. Students will learn about the different features of various kinds of gears, the kinematics of a pair of gears operating together, and the design consideration to avoid failures of gear pairs.
4. Students will be able to describe practical considerations involved in the application of bearings and gives methods for analyzing bearings and for selecting commercially available bearings.
5. Students will be able to learn the mean to analyze and control the vibration and balancing of masses in mechanical system.
6. Students will learn the physics of the operation of a clutch and a brake, considering energy and inertia effects.
7. Student will learn the free, damped and undammed vibration and method balance the unbalanced masses in rotating and reciprocating system.

Syllabus Contents:

Unit1 **(6 hrs)**

Cams and Follower:
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:
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.

Unit2 **(6 hrs)**

Spur Gears:
Law of Gearing, 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.

Unit3 **(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 Rimed Flywheel, Stresses in Arms, Design of Arms, Construction of Flywheel.

Unit4 **(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.

Unit5 **(6 hrs)**

Friction Clutches, Brakes and Dynamometer:

Pivot collar friction, design consideration for plate, cone & centrifugal clutches. Design of various brakes,like band brake, shoe brake, band & block brake, Disc Brakes, thermal considerations.

Unit 6 **(6 hrs)**

Rolling Contact Bearings: Selection of bearing from Manufacturer's Catalogue, Design for variable loads and Speeds, Bearings with Probability of Survival other than 90%.

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

References:

- V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007
- S. S. Rattan, "Theory of Machines", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, 2007
- R.S. Khurmi J. K. Gupta, "Theory of Machines"‖, Eurasia Publishing House (Pvt.) Ltd, 2nd Edition
- 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
- Robert L. Mott, P.E, "Machine elements in mechanical design", Pearson Prentice Hall Publication 4th 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

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Analyze the load-carrying members to be safe under their particular expected loading patterns commonly encountered by machine parts.
2. To select the type of follower motion for particular application.
3. Analyze the stresses on the on different types of gear teeth considering various factors and design the gear pair to be safe under bending and pitting conditions.
4. Select the appropriate type of bearing for a given application, considering static and dynamic loading conditions.
5. Describe journal bearing system and complete the basic design of such bearings.
6. Perform the design and analysis of at least five types of clutches and brakes to specify the required capacity to drive the given system reliably.
7. Analyse damped and un-damped vibrations, force vibration, vibration transmissibility and isolation for single degree of freedom system. Balancing of rotating and reciprocating forces.

(PCC) 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

Course Objectives:

1. To understand the basic concepts, importance and functions of Jigs, Fixtures, press tools and moulding dies.
2. To understand the design aspects ofJigs, Fixtures,press tools and moulding dies.
3. To gain proficiency in the development of required toolings.
4. To understand the analytical/theoretical analysis of Jigs, Fixtures, press tools and moulding dies.

Syllabus Contents:

Unit 1 **(06 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; modular 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 **(08 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 **(06 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 **(08 hrs)**

Design of simple diesfor 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 **(06 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 **(08 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:

- Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000, 3rd Edition.
- VukotaBoljanovic, "Sheet Metal Formin G Processes And Die Design", Industrial Press, New York, 2004.

Reference Books:

- Wilson, Fundamentals of Tool Design, A.S.T.M.E., Prentice Hall of India.
- S. K. Basu, S.N. Mukherjee, R. Mishra, Fundamental of Tool Engineering Design, Oxford & IBH Publishing Co. Pvt. Ltd., 1979.
- J. R. Paquin, R. E. Crowley, Die Design Fundamentals, Industrial Press Inc., 2nd Edition,1987.
- Handbook of Die design Handbook, McGraw Hill, 2006.
- P.C. Sharma; A text Book of Production Engineering, S. Chand and Company Ltd., New Delhi.
- P.N. Rao, Manufacturing Technology, Tata Mcgraw Hill Publishing Co Ltd, 2000.
- M.H.A. Kempster, Introduction to Jigs and Fixture Design, ELBS Edition, 1990.
- R.G.W. Pye, Injection Mould Design, Longmans Publications, 4th Edition,1989.
- A.S. Athalye, Injection Moulding, Multitech Publishers Co. Mumbai
- Metal Hand Book, Vol-II and III.ASME.
- Forging Handbook, ASM, Vol. 5, 9th edition.
- P.H. Joshi, Press Tools Design & Construction, S. Chand & Company Ltd. Delhi, 2nd Edition

(Revised), 2008.

Course Outcomes:

1. The course will enable the students to know the basic concepts of and principles of press tools.
2. The course will able to design different types of jigs & fixtures.
3. This course will help students to development of problem solving ability in regards to forging plastic molding.
4. This course will help students to use the above knowledge to design tools and dies which can later be used to simulate the machining and forming processes to verify the design.

(PCC) Material Forming

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. Gain an understanding and appreciation of the breadth and depth of the field of material forming.
2. Understand the various basicsof formability, working on metals.
3. Learn how to apply different theory criterions to metal forming.

Syllabus Contents:

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 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 the remedies. New technologies: Liquid metal forging, isothermal forging, No draft forging, P/M forging, Rotary swaging, roll forging, Lubrications in forging.

Unit 3

Wire and Tube Drawing **(6 hrs)**

Introduction rod and wire drawing machines - construction and working. Preparation ofstock 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- Rollpass

classification & design. Lubrication in rolling. Sheet Metal Forming, blanking, bending, drawing and deep drawing.

Unit 5

Extrusion **(6 hrs)**

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

Advanced metal forming processes **(6 hrs)**

High velocity forming- principles, comparison of high velocity and conventional Forming processes. Explosive forming, Magnetic pulse forming, Electro hydraulic Forming, Microforming, Microcoining, 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 Books:

- 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.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Learn basic concept of different metal forming process and the application of concept to analyze the processes.
2. Learn application of theoretical approach to solve practical problems associated with different material forming processes such as rolling, drawing, forging, and extrusion.

(LC) Metrology and Quality Control Laboratory

Teaching Scheme
Practical:2 Hrs/week

Examination Scheme
Term-work: 50 marks
Oral: 50 Marks

Course Objectives:

1. To introduce practical aspects of metrological instruments to the students
2. To train the students in dimensional and surface metrology
3. To impart Basic knowledge of measurement system analysis
4. To impart the knowledge of control charts and quality control in manufacturing environment

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

Course Outcomes:

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

(LC) Kinematics and Dynamics of Machines Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Objectives:

1. To develop the design skills in the students to carry out the design of simple mechanical system using standard design procedures.
2. Students will be able to do cam mechanism classification, construct cam profile, and generation of gear teeth profile.
3. Student will be able to find resonance frequency and effect of damping in a single degree of freedom vibratory system.

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.

Course Outcomes:

1. The students will be able to carry out design project design of simple mechanical system by using standard material, procedures and design standards.
2. Student will be able to design cam and draw cam profile.
3. The student will be able find the degree of freedom, resonance frequency and effect of damping in a single degree of freedom vibratory system.
4. Students will able to generate gear profile on gear generating apparatus for various rack shifts

(LC) Tool and Die Design Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Objectives:

1. To understand the design methodology of various press tools, Jigs, Fixtures, press tools and dies.
2. To acquire proficiency in the design and development of required tooling's and dies.
3. To understand use of simulation tool for analysis of press tools and dies.

Syllabus Contents:

Assignments:

1. Detail design and drawing of die for Blanking/Punching operation. (use of CAD desirable)
2. Detail design and drawing of Progressive die. (use of CAD desirable)
3. Detail design and drawing of shallow drawing die. (use of CAD desirable)
4. Detail design and drawing of deep drawing die. (use of CAD desirable)
5. Detail design and drawing of forging die. (use of CAD desirable)

Note: For the above assignments analysis of design can be carried out by using simulation software.

The oral will be based on above term work.

Course Outcomes:

1. The course will enable the students to Design & drawing of dies for shearing, forming operation.
2. The course will enable the students to effectively use CAD/Simulation software for die design.

(SBC) Modeling and Simulation Laboratory

Teaching Scheme
Practical: 2 hrs/week
Tutorial: 1 hr/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Objectives:

At the end of course students will be able to

1. Understand statistical Analysis procedures using software.
2. Apply statistical methods for analysis
3. Carry out CPM /PERT analysis using MS Project
4. Model & Simulate manufacturing system
5. Carry out Layout simulation.
6. To provide the students with a foundation in computer aided design.
7. To produce knowledgeable users of CAD systems.

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(15 hrs)

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 model

Assignments(15 hrs)

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

Course Outcomes:

1. 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.
2. Understand basic concepts of solid modeller which can be used to learn any other solid modeler.

(BSC) Numerical Methods With C++

Teaching Scheme
Practical : 2hrs/week
Tutorial : 1 hr/week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 1: 20 marks
Term Work: 30 marks
ESE Pract./Oral: 30 marks

Course Objectives:

At the end of the course, students will demonstrate the ability to:

1. Apply numerical methods to solve various engineering application problems using discrete data obtained through experiments.
2. Write C++ program for the above mentioned methods and run it in laboratory.

Syllabus Contents:

Unit 1 **(4 hrs)**

Numerical integration: Trapezoidal Rule, Simpson 1/3rd and 3/8th Rule, Weddle's Rule, Gauss Quadrature - Two and Three Point Formula, Double Integration, Applications. Curve Fitting: least square criteria- 1st and 2nd Degree, Applications.

Unit 2 **(3 hrs)**

Numerical Solution of Ordinary Differential Equation: Taylor Series Method, Euler Method, Modified Euler Method, RungeKutta 2nd and 4th order method, Simultaneous Differential Equations and Second Order Differential Equations, Applications.

Unit 3 **(3 hrs)**

Interpolation: Langrange's Interpolation, Newton's forward, backward and central difference method, divided difference method, Inverse Interpolation, Applications. Numerical Differentiation: Forward, Backward and Central Difference Methods, Applications.

Unit 4 **(4 hrs)**

Numerical Solution of Algebraic and Transcendental equations: Bisection Method, Secant Method, Regula-Falsi Method, Newton-Raphson Method, Successive Approximation Method, Applications. Solution of linear simultaneous equations: Homogeneous/Non-homogeneous systems, Gauss Elimination, Gauss Jordon, Gauss-Seidel Methods, LU- Decomposition, Cholesky Method, Applications.

Lab Sessions: **(26 hrs)**

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

- Numerical integration
- Curve Fitting
- Ordinary Differential Equation
- Interpolation
- Numerical Differentiation

- Algebraic and Transcendental equations
- Linear simultaneous equations

Text Books:

- Chapra, S.C. & Canal, R. P., Numerical Methods for Engineers, 5th Ed., Tata McGraw Hill Pubication.

Reference Books:

- Balagurusamy, E., Numerical Methods, Tata McGraw Hill Publication.
- 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

Course Outcomes:

Students will be able to-

1. Know and recall core knowledge of the syllabus. (To measure this outcome, questions may be of the type- define, identify, state, match, list, name etc.)
2. Understand basic concepts. (To measure this outcome, questions may be of the type- explain, describe, illustrate, evaluate, give examples, compute etc.)
3. Analyze the problem and apply the appropriate concept. (To measure this outcome, questions will be based on applications of core concepts)
4. Give reasoning. (To measure this outcome, questions may be of the type- true/false with justification, theoretical fill in the blanks, theoretical problems, proving implications or corollaries of theorems, etc.)
5. Write C++ program and run it in the laboratory for the given data.

ML - 09001 Constitution Of India

Teaching Scheme
Lectures: Self Study

Examination Scheme
End-Sem Exam- 100

Course Objectives:

At the end of the course, students will demonstrate the ability to:

1. 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.

Syllabus Contents:

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 **(4hrs)**

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

Unit 4 **(4hrs)**

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

Unit 5 **(4hrs)**

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

Unit 6 **(4hrs)**

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

Text Books:

- Durga Das Basu: —Introduction to the Constitution of India‖ (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
- Engineering Ethics‖ by Charles E.Haries, Michael. S.Pritchard and Michael J.Robins Thompson Asia, 2003-08-05.
- An Introduction to Constitution of India‖ by M.V.Pylee, Vikas Publishing, 2002.

Course Outcomes:

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

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

Industrial Engineering and Engineering Economics

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2 - 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. To understand different organization structures.
2. Understand the concepts of productivity
3. To understand the methods of improving productivity
4. To understand Economics related to Industrial problems.

Syllabus Contents:

Unit 1 **(7hrs)**

Introduction

Definition and Role of Industrial Engineering, Contribution of Taylor and Gilbreth, Organisation : Concept of organisation, characteristics of organisation, elements of organisation, organisational structure, organisation charts; Introduction to types of organisation- formal line, military organisation, functional organization, line & staff organisation; authority and responsibility, span of control, delegation of authority. Productivity: Definition of productivity, Productivity of materials, land, building, machine and power. Measurement of productivity: factors affecting the productivity.

Unit 2 **(7 hrs)**

Method Study and scope of work-study

Method Study Definition, objective and scope of work-study. Human factors in work-study. 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, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies Numerical), Introduction to Value Engineering and Value Analysis.

Unit 3 **(7 hrs)**

Work Measurements

Work Measurements: Definition, objectives and uses; 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; Introduction to PMTS and MTM. (Numerical), Introduction to MOST.

Unit 4 **(7 hrs)**

Introduction to Engineering Economics, Definition and scope of Engineering Economics,Time value of money : Simple and compound interest, Time value equivalence, Compound interest factors, Cash flow diagrams Calculation, Calculation of time –value equivalences. Present worth comparisons, Comparisons of assets with equal, unequal and infinite lives, comparison of deferred investments, Future worth comparison, payback period comparison.

Unit 5 **(7 hrs)**

Ratio analysis: Classification of ratios, structural group, standards for comparison limitations of Ratio analysis, returns on investment and integral ratio.

Cost volume profit analysis: mechanics of break even chart, profit planning and break-even analysis, margin of safety.

Unit 6 **(7 hrs)**

Standard Costing:- Concept, Development and use of Standard Costing, Budget and Budgetary Control, Variance Analysis.Marginal Costing:- Use of Marginal Costing in Decision Making.

Allocation of Resources: Capital Budgeting: Control of Capital Expenditure, Evaluation Process – Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return.

Cost of Capital: Relevant Cost, Measurement of Cost of Capital, Cost of Debt, Preference Shares, Equity Shares, Internal Financing, Dividends, Cost of Retained Earnings Concept.

Text Books:

- Work Study , ILO
- Prasad N. K., Cost Accounting Book, Syndicate Pvt. Ltd. Kolkata
- Basu S.K., Sahu K.C and Rajiv B, Industrial Organization and Management –. PHI New Delhi, 2012

Reference Books:

- Henry M. Steiner, Engineering economics Principles, Mc Grow hill Publication.
- P. A. Samuelson, Economics, Mc Grow hill International.
- Colin Drury, management and Cost Accounting, English Language Book Society, Chapman & Hall London.

Course Outcomes:

1. The student will be able to apply the knowledge of organization, productivity improvement.
2. The student will be able to apply Method study, WORK Studyand work measurement techniques in industrial problems.
3. The student will be able to learn and apply concepts of Economics.

Minors- Manufacturing Technology (Mechanical Branch)
SEMESTER-V
(PCC) 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

Course Objectives:

1. To educate students on different measurement systems and on common types of errors.
2. To introduce different types of linear and angular measurement processes and instruments.
3. To give knowledge about interferometers, comparators and screw and gear measurements.
4. To familiarize students with surface roughness measurements, Optical instruments and 3D measurements.
5. Familiarize students about industrial practices of statistical process control using variable and attribute control charts and sampling techniques.
6. Impart the knowledge about design of experiments, reliability and quality assurance system used in modern manufacturing.

Syllabus Contents:

Unit 1 **(8hrs)**

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 interferometery 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, Gauge R and R study.

Unit 2 **(8 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 **(6hrs)**

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 calliper, Constant chord method, Span Micrometer.

Unit 4 **(8hrs)**

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 **(5hrs)**

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 **(5hrs)**

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', 'χ2', 'F' Distribution, elementary sampling theory, test of hypothesis & it's 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 PblicationsPvt. Ltd.18th Edition, 2002
- S.P.Gupta, Statistical Methods, Danpat Rai and Sons, New Delhi, 2007

Reference Books:

- John S. Oahland, Total Quality Management, Elsevier Publications, 3rd Edition 2006.
- P. N. Mukerjee,Total Quality Management, Prenice Hall of India Publications, 2nd Edition 2005.
- AmitavaMitra, Fundamental of Quality Control and improvement, Prenice 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 PblicationsPvt. Ltd.6th Edition, 2004

Course Outcomes:

1. Interpret the manufacturing drawings and perform inspection.
2. Able to use different types of measuring instruments.
3. Select appropriate measurement techniques for geometric features.
4. Carryout data collection and use statistical tools for analysis.
5. Identify and analyze the cause for variation and recommend suitable corrective actions.
6. Design an acceptance sampling plan for inspection and carry out process capability studies.
7. Plot and use of quality control charts.
8. Develop an ability of problem solving and decision making. Suggest measures to improve the quality of product and reduce cost.

Minors- Manufacturing Technology (Civil/ENTC/Electrical/Instru/Comp/IT/Meta)

SEMESTER-V
Production Processes

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2- 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. To understand the various basic manufacturing processes and machine tools.
2. To learn how to select a particular manufacturing process for the given component from theavailable conventional as well as non conventional manufacturing processes.

Syllabus Contents:

Unit 1 **(07 hrs)**

Casting Processes, Expendable Mould Casting Processes

Sand Casting, types of pattern materials, pattern making allowances, core prints, moulding sand properties and testing, hand and machine moulding, core, core boxes, melting and pouring, study of furnaces – cupola, fuel fired, electric arc, induction furnaces. Investment casting, shell moulding. Casting techniques of cast iron, steels and nonferrous metals of alloys; solidification; design of casting, gating and riser in Cleaning, finishing and heat treatment of castings, defects in casting, Permanent Mould Casting Processes, Die casting, low-pressure permanent mould casting – hot and cold chamber processes, centrifugal casting, semi-centrifugal casting, centrifuging, continuous casting.

Unit 2 **(06 hrs)**

Turning, Boring, Related Processes

Fundamentals of turning and boring, lathe – construction, accessories, operations. Thread Cutting – single and multistart threading, Different tools, tool materials, tool geometry. Concept of speed, feed, depth of cut. Capstan and Turret Lathe- Construction, Working and Applications. Introduction to boring machines – general arrangement and nature of work done.

Unit 3 **(07 hrs)**

Drilling and Milling Machines

Drilling:
Fundamentals of drilling process, twist drill geometry, tool holders. Types of drilling machines, operations performed on drilling machines. Types of drills. Reaming process, reamers types, geometry.
Milling Machines:
Fundamentals of milling process, cutters - types and geometry. Operations performed on milling machines. Dividing head, methods of indexing. Gear train calculations for helical and cam milling.

Shaper, Planer and Slotting Machines:
Construction, working of quick return mechanism, operations performed.

Unit 4 **(07 hrs)**

Abrasive Machining Processes

Abrasive machining, abrasives - types, size and geometry. Grinding wheels, wheel marking, wheel selection, wheel mountings. Types of grinding machines. Honing, Lapping, Super Finishing, Buffing
Surface treatment processes
Honing, lapping, buffing, polishing, Honing tools, lapping materials. Abrasive, buffing, polishing wheels and burnishing processes.. Electroplating, Electroless plating, plasma coating, phosphating, galvanizing, metal spraying, anodizing, rubbling and tumbling.

Unit 5 **(07 hrs)**

Hot and cold working of metals

Principles of rolling, forging, drop, press, upset, roll forging, extrusion, drawing, spinning, effectsof hot working. Cold working processes, Cold rolling, swaging, forging, extrusion- forward,backward and impact roll forming, tube drawing, wire drawing, spinning, shot penning, highenergy rate forming.

Unit 6 **(07 hrs)**

Joining Processes

Welding Processes: Theory, control and applications, Arc Welding – SMAW, GTAW, GMAW, FCAW, Submerged arc welding, etc.
Resistance welding – theory, Spot, Seam, Projection welding processes etc., Gas welding. Friction welding, Ultrasonic welding, Thermit welding, Electron beam and Laser welding. Defects in welding, their cause and remedy, weldability, welding of dissimilar metals. NDT and other methods of testing welded joints. Soldering and Brazing applications. Use of adhesives for joining. Classification of adhesives, types of adhesives and their applications, surface preparation and various joints.

Text Books:

- S.K. HajraChoudhary and S.K. Bose, Elements of workshop Technology, Volume I, II, AsiaPublishing House, 10th Edition 2000.
- P.N. Rao, Manufacturing Technology, Tata McGraw-Hill Publishing Limited, II Edition, 2002.

Reference Books:

- Chapman W.A.J, Workshop Technology, Volume I, II, III, CBS Publishers and distributors. 5th Edition 2002
- Degarmo, Black and Kohser, Materials and processes in Manufacturing, Prentice Hall of India.2nd Edition 1998
- Milton Shaw, Metal Cutting Principles, Oxford University Press, 4th Edition 2001

- O.P. Khanna and M. Lal, Production Technology, Vol. I,II, Dhanpatrai Publication, 5th Edition,1999.
- B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai Publication, 9th Edition, 1999

Course Outcomes:

1. Gain an understanding and appreciation of the breadth and depth of the field of ManufacturingEngineering.
2. Understand the various basic Production Processes and Machine Tools.
3. Learn how to select a particular production process for the given component from theavailable conventional as well as non conventional manufacturing processes.
4. Learn development and application of advanced technologies and components & processes forManufacturing.

SEMESTER –VI

Engineering Economics and Operations Research

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2- 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. To get conceptualize about different financial terminology in business
2. To get to understand to estimate different parameters in business.
3. To get optimum decision under a specified business objections
4. To get acquired for different mathematical approaches for managerial decision
5. To understand budgeting, risk estimation, business strategy etc.

Syllabus Contents:

Unit 1(6 hrs)

Engineering Economy

Introduction, Importance, Time value of money, Net present value, Payback period, Return on investment, Internal rate of return, Equity, Shares, Dividends.

Unit 2(6 hrs)

Accounting tools

Income statement, Project cash flow statement, Cost estimation, LCC estimation, capital cost estimation, Turnover ratio, Lang's factor, operating cost, marginal cost estimation, evaluation of economic alternatives, profit planning and break-even analysis.

Unit 3(8 hrs)

Decision making under deterministic model

Simplex method, linear programming, deterministic inventory model, Assignment technique, Replacement etc.

Unit 4(8 hrs)

Decision making under probabilistic model

Theory of games, Queuing theory and simulation, Stock control under uncertainty.

Unit 5 **(6 hrs)**

Sequencing Models (6 hrs)

Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on machines. Processing of two jobs on machines with each having different processing order

Unit 6(6hrs)

Network Models:

Introduction to PERT / CPM and its importance in project management. (Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, Resource allocation and load smoothening.

Text Books:

- C. B.Gupta -*Fundamentals of Business*, Sultan Chand & Co
- Basu S.K., Sahu K.C and Rajiv B - *Industrial Organization and Management* –. PHI New Delhi, 2012
- Gupta P. K. and Hira D. S. -*Operations Research,* S Chand & Company Ltd.

Reference Books:

- KR Sharma - Fundamentals of Engineering economy, Cognella, , the United States of America,2011
- Henry M. Stenier - Engineering economics Principles, Mc Grow hill Publication.
- P. A. Samualson -Economics, Mc Grow hill International.
- Colin Drury - Management and Cost Accounting, English Language Book Society, Chapman & Hall Landon.
- Sharma J. K. -Mathematical Models in Operations Research, Tata McGraw – Hill
- Publishing Company Limited.
- Engineering economy- web based course- Georgia university, USA

Course Outcomes:

1. Be able to apply concepts of economic analysis to a manufacturing industries.
2. Be able to understand Break Even Analysis, Standard Costing, Marginal Costing.
3. Be able to apply probabilistic risk analysis methods.
4. To apply mathematical approach to take managerial decision.

HONORS

SEMESTER-V
Precision Engineering

Teaching Scheme
Lectures : 3 hrs/week

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

Course Objectives:

1. To familiarize the students in the Science of Precision Engineering.
2. To provide and enhance the technical knowledge in precision manufacturing and error control.
3. To create the awareness among students about new trends in manufacturing and its precise control.

Syllabus Contents:

Unit 1(07 hrs)

Precision engineering

Introduction – Precision, Accuracy & Smoothness – Need – Development of overall machining precision Classes of achievable machining Accuracy-Precision machining-High precision Machining-Ultra precision Machining-application of precision machining- Materials for tools and machine elements – carbides – ceramic, CBN & diamond-Tool and work material compatibility.

Unit 2(07 hrs)

Precision machine element

Introduction – Guide ways – Drive systems – Spindle drive – preferred numbers – Rolling elements – hydrodynamic & hydrostatic bearings –Hybrid fluid bearings- Aero static and aero dynamic bearings-Hybrid gas bearings-materials for bearings.

Unit 3(07 hrs)

Error Control

Error – Sources – Static stiffness – Variation of the cutting force – total compliance – Different machining methods – Thermal effects – heat source – heat dissipation – Stabilization – decreasing thermal effects – forced vibration on accuracy – clamping & setting errors – Control errors due to locations – principle of constant location surfaces.

Unit 4(07 hrs)

Precision Manufacturing

Micro machining processes-diamond machining - micro engraving - Micro replication techniquesforming-casting-injection moulding - micro embossing - Energy assisted processes LBM, EBM, FIB, Micro electro discharge machining-photolithography-LIGA process- Silicon micro machining-Wet and dry etching-thin film deposition.

Unit 5(07 hrs)

MEMS

Introduction – MEMS –characteristics- principle – Design – Application: automobile, defence, health care, Industrial, aerospace etc.,

Unit 6 **(07 hrs)**

Micromachining

Laser Optics, Laser Ablation, Heat Affected Zone and Laser Polymerisation. LIGA, S-LIGA Micro welding: Micro welding in similar and dissimilar materials; welding processes like ultrasonic, EB, LB; applications. Micro casting: Casting processes like vacuum, semi-solid state; applications Processing of Integrated Circuits, Clean rooms, crystal growing and shaping of wafers, Etching, Photo and other lithography techniques, Impurity introduction, Thermal oxidation, CVD, Metallisation etc. IC packaging

Text Books:

- Venkatesh V.C. and Izman S., —Precision Engineering‖, Tata McGraw Hill, 2007.
- Murthy R.L., —Precision Engineering‖, New Age International, 2009

Reference Books:

- Nakazawa H., —Principles of Precision Engineering‖, Oxford University Press, 1994.
- Institute of Physics Publishing, Bristol and Philadelphia, Bristol, BSI 6BE U.K

Course Outcomes:

After studying this course, the students would be able to understand

1. The meaning precision machining and the importance of it.
2. The requirements of machine network elements to achieve precision in the components.
3. The principles of various precision engineering processes and apply them in actual field.
4. Various method of micromachining using LASER and other processes.

SEMESTER-VI
Reliability and Maintenance Engineering

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz/T1/T2- 40 Marks, End Sem Exam- 60 marks

Course Objectives:

1. To appraise strategy of concept of reliability & maintainability & their importance.
2. To make them analyse a system for reliability assessment.
3. To get familiarize with several maintenance strategies.
4. To assess reliability, availability & maintainability qualities.
5. To understand analytical approach of maintenance objectives.

Syllabus Contents:

Unit 1 **(06 hrs)**

Fundamental concepts of reliability, maintainability

Definition, Failure pattern, Distribution, Life characterization phases, MTBF, MTTF etc.

Unit 2 **(08 hrs)**

Component and system reliability

Probability distribution of failure, Component reliability estimation, Conditioning probability, Parallel and series combination, Redundancy etc.

Unit 3 **(08 hrs)**

Maintainability and availability

Objectives, factors affecting them, Markov chain analysis, fault tree analysis, FMECA etc, RPN, evaluation of availability.

Unit 4 **(06 hrs)**

Maintenance models and strategy

Preventive and corrective maintenance TPM, CBM, RCM etc

Unit 5 **(06 hrs)**

Analytical methods in maintenance

Optimal inspection frequency, Corrective maintenance planning under CBM- mathematical model, Repair limit model, opportunistic maintenance policy.

Unit 6 **(06 hrs)**

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Software maintenance cost, medical equipment maintenance and repair, spare parts inventory models, Optimal overhaul internal model, human related maintenance activity, robot maintenance

under maximum profit.

Text Books:

- L. S. Srinath - Reliability Engineering, -Affiliated East -West press, 2002.
- S.K. Basu&B.Bhadury- Terotechnology: Reliability Engg& maintenance Management, Asian book Private Ltd., Delhi, 1stEdition, 2003.

Reference Books:

- L Lamberson, KC Kapur - Reliability in engineering design- John Wiley & Sons, 1977.
- K. K. Ahuja - Industrial management and Organizational Behaviour, Khanna Publications.
- 1999
- H. P. Garg - Industrial Maintenance, S. Chand & company. Ltd, Third Edition 1990.
- Dr. Shankar - Industrial engineering Management Golgotia Publications Pvt. Ltd. 1997
- B.S. Dhillon- Maintainability, Maintenance, and Reliability for Engineers, CRC press, taylor and francis group, 2006
- Charles Ebeling- An introduction to reliability and maintainability engineering, Tata macgraw- Hill, 1997.
- Plant engineering handbook
- LC Morrow - Maintenance engineering handbook,McGraw-Hill, 2nd ed, 1966,

Course Outcomes:

1. Student will be able to understand the importance and assessment of reliability and maintainability.
2. Student will be able in a position to analyze reliability in designing and maintenance of product.
3. Student will be aware of several maintenance strategy for wide range of application.

Honors- Mechatronics

Bridge Course (Mechanical/ Electronics)

(PCC) Principles of Electronics

Teaching Scheme
Lectures : 2 hrs/week
Tutorial: 1 hr/.week

Examination Scheme
T1/T2/ Assignments/ Quiz - 40
End-Sem Exam- 60 marks

Course Objectives:

1. To make known electronics technical concepts for development of elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors;
2. To exhibit methods of circuit understanding and analysis.
3. To select appropriate circuit fromvarious electronic circuits.

Syllabus Contents:

Role of various Engineering disciplines in Mechatronics, Mechatronics Design elements, Scope and Applications of Mechatronics, Analog electronic components and devices, Oscillators as signal generators, Power supplies and voltage regulators, Power Electronics-Devices, Industrial electronic circuits, Digital Electronics- Arithmetic circuits, Multiplexers/Demultiplexers, Registers, Counters, Memories, Few examples of transducers, Signal conditioning Circuits using Operational amplifiers, Noise Problems, Grounding and shielding, Data acquisition systems,-Single channel and multichannel, Data loggers, Control Systems Components, Classification of Control Systems, Transfer functions, Time and Frequency response Analysis tools.

Reference Books:

1. Allen Mottershed, “Electronic Devices and Circuits”, Prentice Hall International, Third Edition
2. M. D. Singh and J. G. Joshi, “Mechatronics – Principles and Applications”, Prentice Hall India publication-EEE.

Course Outcomes:

1. To develop and employ circuit models for elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors;
2. Become adept at using various methods of circuit analysis.
3. Be able to use basic techniques for analyzing analogue and digital electronic circuits

(PCC) Mechatronics System Design

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
T1/T2/ Assignments/ Quiz - 40
End-Sem Exam- 60 marks

Course Objectives:

1. To be aware ofintegration of knowledge from different disciplines into Mechatronics
2. To realize existence of Mechatronics in engineering and consumer products those are useful in everyday life.
3. To impart theoretical knowledge andmake students familiar to selectsuitable sensors and actuators while designing electro-mechanical systems.
4. To demonstrate technical requirement while working with Mechatronics Systems.

Syllabus Contents:

- **Rotational drives** - Pneumatic Motors: continuous and limited rotation - Hydraulic Motors: continuous and limited rotation - Brushless DC Motors - Motion convertors, Fixed ratio, invariant motion profile, variators, remotely controlled couplings Hydraulic Circuits and Pneumatic Circuits.
- **Mechanical Systems and Design** - Mechatronics approach - Control program control, adaptive control and distributed systems - Design process - Types of Design - Integrated product design - Mechanisms, load conditions, design and flexibility Structures, load conditions, flexibility and environmental isolation – Man machine interface, industrial design and ergonomics, information transfer from machine from machine to man and man to machine, safety.
- **Real time interfacing** - Introduction Elements of data acquisition and control Overview of I/O process-Installation of I/O card and software - Installation of application software- Over framing.
- **Case studies on Data Acquisition** - Transducer calibration system for Automotive applications Strain Gauge weighing system - Solenoid force - Displacement calibration system - Rotary optical encoder - Inverted pendulum control - Controlling temperature of a hot/cold reservoir -Pick and place robot - Carpark barriers.
- **Case studies on Data Acquisition and Control** - Thermal cycle fatigue of a ceramic plate - pH control system - De-Icing Temperature Control System - Skip control of a CD Player - Autofocus Camera, exposure control.
- **Case studies on design of Mechatronics products** - Motion control using D.C. Motor, A.C. Motor & Solenoids - Car engine management - Barcode reader.

References

- W. Bolton, Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.

- Devdas Shetty, Richard A. Kolk, Mechatronics System Design, PWS Publishing company, 1997
- Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.
- Brian Morris, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995.
- Gopal, Sensors- A comprehensive Survey Vol I & Vol VIII, BCH Publisher.

Course Outcomes:

1. Demonstrate how mechatronics integrates knowledge from different disciplines in order to realize engineering and consumer products that are useful in everyday life.
2. Application of theoretical knowledge: understanding selection of suitable sensors and actuators; designing electro-mechanical systems.
3. Technical work: working with mechanical systems that include digital and analogue electronics as a data acquisition model.