# Syllabus

# Savitribai Phule Pune University

# Faculty of Engineering

# Third Year Production Engineering

# (Course 2015)

## (with effect from June 2017 )

# Savitribai Phule Pune University, Pune
# Syllabus for Third Year Production Engineering
# (2015 Course)
### (With effect from Academic Year 2017-18)

### Semester- I

| Course Code | Course | Teaching Scheme (Hrs/week) | | | Examination Scheme | | | | | | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Tutorial | Paper | | TW | OR | PR | Total | TH/TW/TUT | PR/OR |
| | | | | | In-Sem | End-Sem | | | | | | |
| 311081 | Metrology &Quality Assurance | 3 | | | 30 | 70 | | | | 100 | 3 | |
| 311082 | Industrial Engineering and Management | 3 | | | 30 | 70 | | | | 100 | 3 | |
| 311083 | Material Forming | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311084 | Kinematics of Manufacturing Machines | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311085 | Cutting Tool Engineering | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311086 | Production Practice/Employable Skill Development Lab | | 2 | | | | | | 50 | 50 | | 1 |
| 311087 | Metrology & Quality Assurance Lab | | 2 | | | | | | 50 | 50 | | 1 |
| 311088 | Material Forming Lab | | 2 | | | | | 50 | | 50 | | 1 |
| 311089 | Kinematics of Manufacturing Machine Lab | | 2 | | | | 50 | | | 50 | | 1 |
| 311090 | Skill Development/ Cutting Tool Engineering Lab | | 2 | | | | 50 | | | 50 | | 1 |
| | | | | | | | | | | | **18** | **5** |
| | **Total** | **18** | **10** | | **150** | **350** | **100** | **50** | **100** | **750** | **23** | |

**Abbreviations:**

TW: Term Work
TH: Theory
OR: Oral
TUT: Tutorial
PR: Practical

## Semester- II

| Course Code | Course | Teaching Scheme (Hrs/week) | | | Examination Scheme | | | | | | Credit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | Practical | Seminar | Paper | | TW | OR | PR | Total | TH/TW/TUT | PR/OR |
| | | | | | In-Sem | End-Sem | | | | | | |
| 311091 | Production Management | 3 | | | 30 | 70 | | | | 100 | 3 | |
| 311092 | Numerical Techniques & Optimization Methods | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311093 | Machine Tool Engineering | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311094 | Tool Design | 4 | | | 30 | 70 | | | | 100 | 4 | |
| 311095 | Process Planning and Tool Selection | 3 | | | 30 | 70 | | | | 100 | 3 | |
| 311096 | Seminar and Technical Communication Lab | | | 1 | | | | 50 | | 50 | | 1 |
| 311097 | Numerical Techniques & Optimization Methods Lab | | 2 | | | | | | 50 | 50 | | 1 |
| 311098 | Machine Tool Engineering lab | | 2 | | | | 50 | | | 50 | | 1 |
| 311099 | Process Planning andTool Selection Lab | | 2 | | | | 50 | | | 50 | | 1 |
| 311100 | Tool Design Lab | | 2 | | | | | 50 | | 50 | | 1 |
| | | | | | | | | | | | **18** | **5** |
| **Total** | | **18** | **8** | **1** | **150** | **350** | **100** | **100** | **50** | **750** | **23** | |

**Abbreviations:**

TW: Term Work
TH: Theory
OR: Oral
TUT: Tutorial
PR: Practical

# 311081: Metrology and Quality Assurance

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 3 hours / week | Theory: 03 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**

- Basic knowledge of Engineering drawing, Machine drawing, Dimensioning and tolerances, various geometrical features.
- Various manufacturing processes and their capabilities, correlation between operating parameters and process responses.
- Basic knowledge of standard machine tools such as: Lathe, Drilling machine, Milling Machine, etc.
- Basic knowledge of standard machine components such as: Gear, spring, Screw threads etc.

**Course objectives**:

To impart students knowledge of theoretical and practical aspects of measurement standards, measuring instruments and their construction, working and applications. This subject also exposes the students to the principles of measurement, gauges and concepts of quality assurance and their practical use.

**Outcomes:**
After learning this subject, the student will:

- be able to describe and work with various linear and angular measuring devices
- beable to design limit gauges and work with special measuring devices for gear, screw thread and surface finish measurements
- beable to distinguish various comparators and use profile projector
- beable to use various control charts and various quality assurance tools
- get knowledge of various quality standards and their implementations in industries.
- be able to implement TQM and TPM concepts in practice

**Unit I** **(8)**

**Introduction**: Meaning of Metrology, Precision, Accuracy, Errors in Measurement,Calibration.
**Linear Measurement**: Standards, Classification of Standards, Precision and Non Precision Measuring instrument, Slip Gauges. Manufacturing of slip gauges
Angular Measurement: Sine bar, Sine Center, Uses of sine bars, angle gauges, Auto Collimator Angle Dekkor.
**Inspection of Geometric parameters**: Straightness, flatness, Parallelism, Concentricity, Squareness and Circularity. Alignment testing- lathe/milling/ drilling m/c
Comparators: Uses, Types, Advantages and Disadvantages of various Comparators.

**Unit II** **(8)**

**Limits, Fits and Tolerances**: Meaning of Limit, Fits and Tolerance, Cost -Tolerance relationship, concept of Interchangeability, selective assembly, Indian Standard System. Design of limits
**Gauges**: Types, Uses, Taylor's Principle, Design of Limit Gauges, Introduction to auto gauging systems.
**Interferometry**: Introduction, Flatness testing by interferometry, NPL Interferometer.

**Unit III (8)**

**Surface Finish Measurement**: Surface Texture, methods of evaluation of surface roughness, Grades of Roughness, Specifications, Tomlinson's Surface Recorder, Taylor- Hobson Surface Meter and Talysurf for measuring all characteristics of surface texture.

**Screw Thread Metrology:** External Screw Thread terminology, effective diameter measurement methods, Pitch and flank Measurement of External Screw Thread, Application of Tool Maker's Microscope, Use of Profile Projector.
**Gear Metrology**: Spur Gear Parameters, Gear tooth thickness measurement: Gear tooth Vernier caliper, Constant chord method, Span Micrometer, Base tangent method.

**Recent Trends in Engineering Metrology**-Universal measuring machine coordinate measuring machine, laser interferometer.

**Unit IV (8)**

**Introduction to Quality**

Meaning of Quality, Quality of Product, Quality of Service, Cost of Quality, Value of Quality, Role of Quality in Present day environment. Introduction to Statistical Quality Control: Control Charts, X, R, P and C Charts, Sampling inspection, OC Curves and Sampling Plans, Process Capability Index (PCI), Concept, Methods of determining PCI and uses of PCI.

**Unit V (8)**

**Quality Assurance tools and techniques**

**Total quality management (T.Q.M):-** Approaches-Deming's Approach,Juran's Approach, , Seven quality tools and new seven quality toolsQ.F.D., Quality Circles, Kaizen, six sigma, T.P.M. Technical Specification (T.S ) TS 16949 Standards.

**Unit VI (8)**

**Quality Standards**

**ISO 9001-2000 Series of Standards**- History and Evolution ofISO 9000Series, 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, benefit of Environmental Management Systems, Environmental, Health and Safety standards.

**Text Books**:

1. K.J.Hume, "Engineering Metrology", Kalyani publi cation ISBN8170290015
2. K.W.B.Sharp, "Practical Engineering Metrology", Pitman Publication
3. F. M. Gryna, R. Chua & J. Defco, "Jurans Quality Planning and Analysis for Enterprise Quality", McGraw Hill series. ISBN0070618488

**ReferenceBooks**:

1. R.K. Jain, "Engineering Metrology", Khanna Publication.
2. I.C.Gupta, "A Text book of Engineering Metrology", Dhanpat Rai and Sons.
3. Kaoru Ishikawa, "Guide to Quality Control", Asian Productivity Organisation, Series,
4. Juran's Quality Handbook

# 311082: Industrial Engineering and Management

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 3 hours / week | Theory: 03 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
knowledge of machines used in manufacturing organizations.

**Course objectives:**
1. To understand and apply management principles in to manufacturing organization.
2. To understand concepts of work study, method study, and time study to improve productivity of any manufacturing organization.

**Outcomes:**
1. Summarize the contribution of peoples to management.
2. Differentiate between two employees on the basis of productivity.
3. Prepare time schedule to complete the task.

**Unit I** **(7)**

**Evolution of Management Practices:** Characteristics, objectives Functions, Principles and Types of Management., Scientific Management-Contribution of F. W. Taylor, Henry Fayol Gantt, Maynard and Indian contributors to the Management thought.

**Organization:** Definition, Principles, Function and Types of organization structure, Different forms of Business—Proprietor, Partnership Firm, Private & Public limited company, Cooperative, Private &Public Trusts.

**Unit II** **(7)**

**Motivation:** Human Needs and Types of Motivation, Theories of Motivations-Maslow's theory, McGregor's Theory of X and Theory of Y, Herzberg's Theory of two factor, David C.McCelland's Theory of Achievement, Expectance/valence Theory of Victor Vroom, Porter & Lawler's Model. Group dynamics: Types, characteristics, objectives of Group Dynamics Leadership: Definition, styles & functions of leadership, qualities for good leadership, role of the leader, Theories of leadership, Managerial grid, professional and business ethics.

**Unit III** **(7)**

**Entrepreneurship development:** Characteristics of successful entrepreneurs, communications skill, problem solving skill and process, Basic element of Business plans, Sources of finance, Selection of Business location, Record keeping system, Analysis financial performance, Break even analysis, Technology and Business, Strategies for Business Growth, Concept related to start-up and Intellectual Property Rights (IPR).

**Unit IV** **(8)**

**Industrial Engineering:** History, Development, Definition, Functions & Applications of Industrial Engineering. Tools and techniques of Industrial Engineering, Introduction to work study and work content.

**Productivity Engineering**

**Productivity:** factor productivity, total productivity; labour Productivity, measurement of Productivity, Productivity improvement techniques. Productivity improvement programme.

**Wages and incentives:** Concept of wages, factors affecting wages, Job evaluation, merit rating.

**Unit V (8)**

**Method Study**

Steps, Tools and Techniques used in the Method Study, outline Process Chart, Flow process Chart, Symbols, Flow Diagrams, Two Handed Chart, String diagram, Multiple Activity Chart, 5W and 1 H,Use of Motion Pictures and its analysis SIMO chart, cyclegraph Chronocylegraph. Developing, Presentation, Installation & Maintenance of new Methods. Principles of motion economy.

**Unit VI (8)**

**Work Measurement**

**Time Study:** Aim & Objectives, Terminology & Tools, Use of stopwatch procedure in making Time Study. Time Study Forms, Performance rating, allowances and its types. Calculation of Standard Time.

**Work Sampling:** Introduction to work sampling. Determinations of Standard time using work Sampling.

Synthetic & Standard data Methods: Concepts, Introduction to PMTS, MTM1, WFS, and Basic Motion Time Study. MTM2 & Other second Generation Methods, MOST and other advanced work measurement techniques.

**Text Books:**

1. M. Telsang, “Industrial Engineering and Production Management”, S. Chand Publication, ISBN 81 219 1773 5.
2. O. P. Khanna, “Work Study”, Dhanpat Rai Publications, New Delhi.
3. Banga & Sharma, “Industrial Organisation & Engg. Economics”, Khanna Publishers, 2001, ISBN 81-7409-078-9
4. Chabra T. N., “Principles & Practices of Management”, Dhanpat lal & compony.
5. Mahajan M., “Industrial Engineering and Production Management” Dhanpat Rai and Sons Publishers, 2005, ISBN-81-7700-047-0

**Reference Books:**

1. H. B. Maynard and others, “Industrial Engineering Handbook”, IVth edition McGraw Hill Publications, ISBN 0-07-041084-4.
2. “Introduction to Work Study”, ILO Universal Pub. Co,B’bay,ISBN 81 85027 06
3. Ralph M. Barnes, “Motion and Time Study: Design and Measurement of Work” J. Wiley & Sons.
4. Koontz Harold and Weihrich Heinz, “Essentials of management”, 7ed, Tata McGraw Hill publishing, 2008, ISBN 0-07-0623030-x.
5. Luthans f., “Organizational Behaviour”, McGraw-Hill Company, 2008, ISBN 81-317-0502
6. Cynthia L. Greene, “Entrepreneurship: Ideas in Action”, Thomson, ISBN-981-243-257-1.

# 311083 : Material Forming

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Material forming** is a manufacturing process in which the shape of metal work piece is changed by plastic deformation of the metal. Theory of plasticity (yield criteria) deals with the mechanism of plastic deformation. Material forming processes classified on the basis of forces applied to the work piece and the working temperature (hot/cold/warm).The subject deals with various forming processes such as forging, wire/rod/tube drawing, rolling, extrusion along with special advanced forming processes.

**Pre-requisites**: Physics, Engineering Metallurgy, Strength of material

**Course objectives**:
1.To analyze the forming processes.
2.To identify, evaluate and overcome forming problems and defects
3.To analyze and identify applications of special forming processes

**Course outcomes**:
1.Students will understand mechanism of plastic deformation.
2.Students will classify and analyze various forming as well as special forming processes
3.Students will identify problems (defects) in forming processes and apply knowledge to overcomethese problems**.**

**Unit I** **(8)**

**Fundamentals of Material Forming**

**Introduction of forming processes**. Concept of plastic deformation Classification of material forming process, True stress-True strain, Strain hardening, flow stress determination, Theory of plasticity, Yield criteria for ductile materials: Von-mises criteria, Tresca criteria. Effect of temperature, strain rate, friction, metallurgical microstructure. Concept of Formability, formability limits and formability diagram.

**Unit II** **(10)**

**Forging**

**Introduction, Classification of forging processes.** Forging equipment- Hammers, presses, Upstter etc., construction, working, capacities and selection of equipment. Basic forging operations such as fullering, edging, drawing, blocking,finishing etc., Types of forging dies, Forgeability tests, design of forging as a product, friction in forging. Cleaning and finishing of forgings, Forging defects and the remedies. Analysis of forging with sliding and sticking friction, New technologies: Liquid metal forging, isothermal forging, No draft forging, P/M forging, Rotary swaging, roll forging, Lubrications in forging.

**Unit III** **(08)**

**Wire, Rod and Tube Drawing**

**Introduction to rod and wire drawing machines -** construction and working. Preparation of stock for wire drawing. Wire drawing dies, material and design. Analysis of wire drawing operation, Variables in wire drawing, Maximum reduction in wire in one pass, forces required in drawing. Multiple drawing, work hardening, lubrication in wire drawing, strip drawing.
**Tube Drawing**: Methods, force calculation, stock preparation. lubrication in tube drawing.

**Unit IV** **(08)**

**Rolling of Metals**

**Scope and importance of rolling.** Types of Rolling Mills **-** Constructionand working. Roll bite,

reduction, elongation and spread. Deformation in rolling and determination forces required. Process variables, redundant deformation. Roll flattening, Roll cambering, Mill spring – its effect on rolling process. Defects in rolling. Automatic gauge control(AGC), Roll pass classification & design. Lubrication in rolling.

**Unit V** **(08)**

**Extrusion**

**Types:** Direct, Indirect, impact, hydrostatic extrusion. Dies for extrusion, stock preparation. Extrusion ratio, Circumscribing circle diameter (CCD), Shape factor. Equipment (with and without friction), Work done in extrusion, Metal flow in extrusion, defects. Role of friction and lubricants. Manufacture of seam-less tubes.

**Unit VI** **(10)**

**Advances in Metal Forming**

**High Energy Rate Forming process (HERF), High Velocity Forming(HVF) -** Principles, comparison with conventional forming processes. Explosive forming, Magnetic pulse forming, Electro hydraulic Forming. Petro-forge forming , Micro forming, Micro coining, micro extrusion, Micro bending, Stretch forming, coining embossing, curling spinning, flow forming advantages, limitations and application of the process, methods of measuring friction in metal forming.

**Text Books**:

1. Dieter, “Mechanical Metallurgy” ISBN0071004068
2. P.N. Rao, “Manufacturing Technology”, Tata-McGraw Hill ISBN0070087695
3. G.W. Rowe, “Principles of Industrial Metal Working Process”, Edward Arnold ISBN8123904282.
4. Juneja B. L., “Fundamentals of metal forming processes”, New Age International Ltd.

**Reference Books**:

1. Dr. R. Narayanswamy, Metal Forming Technology, Ahuja Book Co., ISBN8176190020
2. Surender Kumar, Principles of Metal Working.
3. ASM: Metal Handbook, Volume 14, “Forming”.
4. SME:Tool and Manufacturing Engineers Handbook, Volume 2, “Forming”

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# 311084 : Kinematics of Manufacturing Machines

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
Engineering Mechanics, Mechanics of Materials, Theory of Machines, Design of Machine Elements.

**Course objectives:**
1. To impart students with the knowledge about kinematic synthesis, analysis of mechanisms.
2. To enable students to apply fundamental of kinematics to machines this includes kinematics of gears, gear trains, cams etc.
3. To facilitate students to understand the function of flywheels, the concept of balancing of rotating and reciprocating masses
4. To give awareness to students on the phenomenon of vibration and its effects

**Outcomes:**
After studying the subjects students will be able to
1. Perform kinematic synthesis, analysis of mechanisms.
2. Apply fundamentals of kinematics of machines this includes analysis of kinematics of gears, gear trains, cams etc.
3. Analyze kinematics of flywheels, the balancing of rotating and reciprocating masses
4. Evaluate effect of vibration and remedial actions.

**Unit I** **(8)**
**Synthesis and Analysis of mechanisms**
Computer Aided Analysis and coupler curves for four bar mechanism and slider crank mechanism, dimensional synthesis of mechanisms, three position synthesis of slider crank mechanism, Over lay method, Bloch Synthesis, Least square technique.

**Unit II** **(8)**
**Theory of gears: Spur, bevel, worm gears**
Involute and cycloid profile, path and arc of contact, interference and undercutting. Terminology of Bevel Gears, Worm and worm wheel: design approach of equivalent teeth for bevel gears, geometrical relationships, tooth forces, torque transmitted.

**Unit III** **(8)**
**Gear Trains**
Simple, compoud, epicyclic gear trains, differentials, Computation of velocity ratios and torque transmitted in epicyclic gear trains

**Unit IV** **(8)**
**Cams and flywheels**

**Cams**: Types of cams and followers, terms used in radial cams, analysis of motion of follower, displacement, velocity, acceleration, and jerk diagrams, and determination of cam profile for various types of follower motions: uniform velocity, SHM, uniform acceleration and retardation,

**Flywheels**: Introduction, Turning Moment Diagram ,Fluctuation of speed, Fluctuation of energy, Coefficient of fluctuation of speed, Maximum fluctuation of energy, Energy stored in flywheel, flywheel in engines & punching presses.

**Unit V** **(8)**

**Balancing**

Need for balancing, Static balance, balancing of rotating masses in same and different planes, Dynamic balancing, balancing of reciprocating masses, Balancing of locomotives, Partial balancing of locomotives, swaying couple, hammer blow, variation in tractive effort,

**Unit VI** **(8)**

**Mechanical Vibrations**

Introduction, Degree of freedom, Types of vibrations, Damped vibrations; under damped, critically damped and over damped systems, response curves for single degree of freedom system. Rotating and reciprocating unbalance, base excitations, Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating Unbalance. Materials used in vibration isolation, Longitudinal and Transverse Vibrations, whirling of shaft Vibration measuring instruments.

**Text Books**

1. S.S.Ratan , “Theory of Machines”, Tata McGraw Hill [ISBN0070591202]
2. R.S.Khurmi, J.K.Gupta, “Theory of Machine”, S Chand Co. Delhi. [ISBN812192524X]
3. P.L.Ballaney, “Theory of Machine”, Khanna Publisher.
4. G.C. Sen & A. Bhattacharya, “Principles of Machine Tools” [ISBN8173811555]

**Reference books**

1. J. E. Shigley and J.J.Uicker Jr., “Theory of Machines and Mechanism”, McGraw Hill [ISBN019515598X]
2. G K Grover’, “Mechanical Vibration”, Nemchand and brothers. [ISBN8185240752]
3. S. Graham Kelly, Schaum's Outline of Mechanical Vibrations, McGraw Hill Professional, 1996, [ISBN: 0070340412]

# 311085 : Cutting Tool Engineering

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
Machine Drawing & Computer Graphics, Machine Tool Operations.

**Courseobjectives:**
1. To demonstrate effect of cutting tool geometry on economics of machining
2. To demonstrate design process of cutting tool
3.To present theory and design aspects of jigs and fixtures

**Outcomes:**
Students will be able to:
1. Understand the different cutting tool geometry and economics of machining
2. Calculate the cutting force components in orthogonal cutting
3. Understand, design and draw the different cutting tools
4. Understand the different principles of locating and clamping
5. Understand, design and draw the Jigs and fixtures and to understand environmental issues, decide manufacturing policies, various responsibilities of engineering professional etc.

**Unit I** **(8)**

**Theory of Metal Cutting**
Geometry of single point tool, Concept of speed, feed, depth of cut, Effect of cutting parameters on tool geometry, Chip formation, Types of Chips, Orthogonal & oblique cutting, Determination of shear plane angle, Cutting force components in orthogonal, Merchant model for orthogonal cutting, Ernst Merchants theory, Chip velocity, Strain in chip, Estimation of cutting forces and cutting power.

**Unit II** **(8)**

**Cutting tool standards, Materials & Cutting force measurement**
Tool angle specification systems, British system, American system, German system,ISO system . Cutting tool materials, Desirable properties of tool material, Coating tools, Coating techniques on tool, Heat treatment of tools.
**Classification of dynamometers** , Study of working principles in Lathe ,Milling ,Drilling, Grinding dynamometers.
**Nonconventional tool geometry**: Koleshov tool, Antichatter tool, Gustin tool, Throwaway inserts.

**Unit III** **(8)**

**Heat generation, tool life & Economic of cutting tools**
Sources of heat generation, Tool wear and its type, Tool wear mechanism, Types of cutting fluids, Selection of cutting fluids.
Tool life equation of Taylor. Factors affecting tool life, Tool failure criteria.Machinability and its rating, Machinability criteria, Economics of machining. Criteria for minimum cost & maximum production.

**Unit IV** **(8)**

**Design of cutting tools**
Chip breakers, Throwaway inserts and methods mounting, Design of single point cutting tool, Design of circular & tangential form tools, drill, reamer, milling cutter and broach. Manufacturing of Cutting tools

**Unit V** **(8)**

**Fundamentals of Jigs and Fixtures**

Six degrees of freedom, Six point location principle 3-2-1, , Types of locators, Redundant location, Types of clamping devices , Types of drill bushes, Types of support pins, Fool proofing, Classifications of jigs and fixtures. Indexing mechanisms.

**Unit VI** **(8)**

**Design of Jigs & Fixtures**

General guidelines & procedures for design of Jigs and fixtures, Economics of Jigs and fixtures, Pneumatics & Hydraulics for jig & fixtures.Concept of modular fixtures & tool presetting fixtures

**Text Books**:

1. Wilson, “Fundamentals of tool design”, A.S.T.M.E .
2. M.H.A. Kempster, “Introduction to Jigs and fixtures design”.ISBN8185617856.
3. 3.Dr.B.J.Runganath’”Metal Cutting and Tool Design”,Vikas Publication,ISBN0706975103
4. G. Kuppuswamy, “Principles of Metal Cutting”,University press, ISBN 81 73710287.
5. Basu, Mukherjee and Mishra, “Fundamentals of Tool Engineering and Design”,
6. Oxford publishing. ISBN812040016X.

**Reference Books**:

1. P C Sharma, “Production Engg”. , Khanna publishers. ISBN8121904218.
2. P.C. Sharma, “Machine tools & Tool Design”. Khanna publishers, ISBN812192362X.
3. Surender Kumar, “Production Engineering Design”,Sataya Publication
4. Dolalson, Lecain and Goold, “Tool design”, Tata McGrawhill.ISBN0070992746.
5. Hoffman, “Introduction to Jigs and fixtures”.Delnar Cengage Leraning Publication
6. “Tool Engineering Handbook”, A.S.T.M.E.
7. R. K. Jain, “Production Technology”, Khanna Publishers.ISBN8174090991
8. Milton Shaw, “Metal cutting principle”CBS Publication.
9. P .H. Joshi, “Jigs & Fixtures”. Wheeler Publication ISBN074601695.

## 311086 : Production Practice/Employable Skill Development Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | Practical: 50 Marks |

**Each candidate shall be required to complete and submit the following term work.**

A composite job involving different machining operations.

**Part A**:-

1. **Lathe**: external and internal threading (Vee, Square or Acme threads), taper turning, grooving, knurling, drilling operations on lathe.
2. **Milling**: helical or bevel gear cutting on a milling machine.
3. **CNC Job**: Demonstration / job on CNC machine. It should consist of step turning, taper turning, and fillet (Radial) & chamfering.

**Part B**: - **Journal consisting of:**

1. Calculation and procedure for above gear cutting on milling machine.
2. Safety aspects used in the machine shop:- Precautions and care to be taken while working on various machine tools e.g. lathe, milling, drilling, grinding etc

3.CNC programming for
a)Lathe job
b)Milling job

**Note: - A practical examination of 12 hours duration shall be conducted.**

## 311087 : Metrology and Quality Assurance Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | Practical: 50 Marks |

**A] Experiments: (Any Eight)**

1. Linear Measurement using precision instruments.
2. Measurement of angle by sine bar / Sine center
3. Alignment Test on Lathe/ Drilling/Milling Machine.
4. Measurement of the Surface roughness
5. Measurement of Optical surface using Interferometer.
6. Measurement of Screw thread parameters using Floating Carriage Micrometer.
7. Measurement of Gear tooth thickness using Gear tooth Vernier caliper or Span micrometer
8. Study and Experiment on Profile Projector.
9. Study and Experiment on any type Comparator.
10. Study of Limit Gauges and auto gauging systems.

**B] Reports based on Industrial Visit**

## 311088 : Material Forming Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical:: 2 hours / week | Pr/Or: 01 | Oral: 50 Marks |

**Term work;**
**Term work shall consist of:**
1. Assignment based on each topic of syllabus
2. Industrial visit and report based on visit

## 311089 : Kinematics of Manufacturing Machines Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | Termwork : 50 Marks |

**Term Work**
Term work will be based on following practical/design assignments
1. To write a computer program for analysis and animation of any mechanism and test it.
2. To draw a conjugate profile for any general shape of gear tooth.
3. Determination of holding torque in epicyclic gear train.
4. To draw a cam profile for specific follower motion
5. Study of flywheel.
6. Experiment on balancing of mass.
7. Experiment on free undamped and free damped vibration of single degree of freedom system

## 311090 : Skill Development - Cutting Tool Engineering Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | TW: 50 Marks |

**List of Experiments**:
1. Experiments on chip formation.
2. Verification of Metal cutting Theories.
3. Measurement of cutting forces (anyone) in Turning / Milling / Drilling.
4. Effect of tool geometry, cutting speed, feed, depth of cut on cutting parameters.
5. Design and working drawing of any three of following cutting tools: Single point tools, Form tool, Reamer, Milling cutter, Broaches and Drills.
7. Design and Working drawing of one jig. (Drilling, Reaming, Tapping)
8. Design and Working drawing of one fixture. (Turning, Milling, Broaching)

# 311091 : Production Management

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 3hours / week | Theory: 03 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
Industrial Engineering & Management.

**Courseobjectives:**
1. Introduce concepts of productivity and efficiency of manufacturing organization.
2. Demonstrate concepts of production management such as production planning and control, facility planning, capacity planning, and scheduling
3. Apply the concept of deterministic inventory models

**Outcomes:**
Upon successful completion of this course, students will learn to:
- Demonstrate awareness and an appreciation of the importance and strategies for the Production and operations management to the sustainability of an enterprise.
- Demonstrate a basic understanding of Production Systems and Production Planning and Control.
- Demonstrate an awareness of the importance of facility layouts and implement in their In-Plant training project work.
- Demonstrate an understanding of the principles of just-in-time systems.
- Explain the importance of forecasting and demonstrate the ability to apply some mathematical forecasting techniques.
- Demonstrate an understanding of the concept of operations scheduling.
- Demonstrate an understanding of the problems involved in inventory management.

**Unit I** **(8)**
**Scope of Production Management**
Scope of production/operation management, relationship with other functions, history of operation management, types of production system-operation and organization, Operation strategies: competing on cost, quality, flexibility, speed, productivity, efficiency & effectiveness.

**Unit II** **(7)**
**Production Planning &Control**
Need for production planning & control, preplanning functions, product design & development, product life cycle, new product development process, marketing aspects, product characteristics, production aspects, economic aspects, cross functional product design, concurrent engineering, design for manufacturing, FMECA, QFD.

**Unit III** **(7)**
**Facility Planning**
Facility location, important factors affecting location decision, location theories, basic types of layouts, layout planning & designing, hybrid layouts, dynamic layout, computerized layout planning, design of operation line, line balancing, Maintenance planning, Total Productive Maintenance.

**Unit IV** **(7)**
**Capacity Planning**
Importance of forecasting, long term & short term forecasting techniques, forecasting errors,

method of planning, routing & estimating, capacity planning-strategies, analysis of machine capacity, aggregate capacity planning & manpower planning. Introduction to Supply chain management, Just in time & Lean manufacturing.

**Unit V** **(7)**

**Loading & Scheduling**

Concept of loading & scheduling, master production schedule, basic sequencing & scheduling techniques-Johnson method, critical ratio scheduling, uses of CPM & PERT, RAMPS (Resource Allocation & Manpower Scheduling), dispatching rules, expediting & evaluating the production plans, design of production planning & control system for intermittent & continuous production. Computerized production management system

**Unit VI** **(7)**

**Inventory Theory**

Introduction, Meaning of Inventory Control, Functional classifications of Inventories, advantages of Inventory Control. Costs associated with Inventories, selective control of inventories, Deterministic Inventory Models: economic lot size with instantaneous replenishment with and without shortage costs, economic lot size with finitereplenishment with and without shortage, economic lot size models with quantity discount. Economic manufacturing quantity (EMQ), fixed order quantity and fixed order interval system.

**Text Books**:

1. Paneerselvam R., “Production and Operations Management”, Prentice Hall India 2012, 3rd Edition ISBN9788120345553
2. Chary S. N., “Production and operations management”, Mc Graw Hill Education 5th Edition, ISBN9781259005107
3. Riggs. J. L., “Production system, planning, analysis and control”, John Weily and sons, New York.ISBN0471858889.
4. James Dilworth, “Production and operation management”, McGraw Hill Book Company, New York. ISBN 9780070169876
5. Martand Telsang, “Industrial Engineering and Production Management”, S Chand & Co, New Delhi.ISBN8121917735
6. 6.Prasanna Chandra, “Project Planning Analysis Selection Implementation and Review”.ISBN0074620495.

**Reference Books**:

1. Buffa. E.S., “Modern Production and Operation Management”, Willey, New Delhi. ISBN9971511630.
2. Adam EE & RJ Ebert, “Production and operation management:, Prentice Hall Englewood Cliff, N.J. ISBN8120308387.
3. Garg A. K., “Production and operations management”, Mc Graw Hill Education 1st Edition, ISBN9781259005107
4. Samuel Eilon, “Production planning and control”. Universal Publishing Corporation ISBN8185027099.
5. Joseph Monks, “Operation Management Theory and Problems”, McGraw Hill Book Company, New York.(1991), ISBN007100579X.
6. F. L. Francis, J. A. White, L. F. McGinnis, “Facilities Layout and Location”, Prentice Hall of India Pvt. Ltd., ISBN 81-203-1460-3. 8120314603.
7. Richard Muther, “Systematic Layout Planning, Van Nostrand Reinhold; 2nd edition ISBN978-0933684065

# 311092 : Numerical Techniques and Optimization Methods

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
Engineering Mathematics- I and II, Design of Machine Elements

**Course objectives**:
1. To demonstrate potential of numerical methods for solving complex algebraic & transcendental equation, simultaneous equations, curve fitting, interpolation, optimization, integration & differentiation.
2. To present the applications of computational tools & techniques to the real life case studies in production engineering
3. To develop ability of student to formulate an optimization model and apply appropriate method of optimization to solve production engineering problems
4. Facilitate concept of database design query process optimization & normalization.

**Outcomes:**
After studying the subjects students will be able to
1. Apply numerical methods to production engineering problems
2. Develop mathematical model of physical problem and subsequent solution by appropriate optimization method
3. Design the database using ER model & work with relational algebra & relation calculus and to manage & control concurrent transactions using query process optimization & normalization.

**Unit I (8)**

**Numerical Method - I**

Revision of „C_ syntax/ Matlab. Errors & approximations: types of errors, error propagation. Numerical solution of algebraic and transcendental equations by bisection method, Newton-Raphson Method.
Numerical solution of Linear Simultaneous Equations by Gauss Elimination Method, Gauss-Siedel Method.

**Unit II (7)**

**Numerical methods -II**

Curve Fitting, methods of curve fitting. Least square criterion- 1st and 2nd order Interpolation: Lagrange's formula, Newton forward difference method. Methods of moment for curve fitting.

**Unit III**

**Numerical methods -III**

Ordinary Differential Equations.- Runge-Kutta Method. Partial Differential Equations -Finite difference method
Numerical Integration: The Trapezoidal Rule, Simpson's Rules, Romberg Integration

**Unit IV (7)**

**Numerical methods -IV**

Manufacturing Optimization- Method of Lagrange multipliers, steepest descent method,

Generalized reduced gradient Method. Introduction to GA and SA.

**Unit V** **(8)**

**Design and Analysis of Experiments**:
Important of experiments, Experimental strategies, Basic Principles of Design
Terminology, ANOVA, steps in experimentation, two and three full Factorial experiments, Taguchi Methods, Design using Orthogonal Arrays, S/N ratios, Data Analysis.

**Unit VI** **(7)**

**Database Management and SQL**
Introduction, Organization & component of database management system (DBMS), data models, entity relationship model, advantages & disadvantages in database processing, hierarchical & network databases. Database design- dependencies and normalization (1rst & 2nd order), database storage and querying, aggregate functions. – Group by, having order by, sub-queries and various SQL operators.

Introduction to oracle, SQL, Database creation, database retrieval, use of compound conditions like AND, OR, Joining and updating tables.

**Text Books**:

1. Silberschatz, Korth H F, Sudarshan, “Database System Concepts”, McGraw Hill Intl., 4th Edition, 2002, ISBN 0071005293.
2. A.M. Muzumdar and P. Bhattacharya, “Database management System”, Tata McGraw Hill Publication, New Delhi, ISBN 0074622390.
3. Turban, Rainer & Potter-John, “Introduction to Information Technology”, Wiley & Sons, 2000, ISBN 8126509686.
4. Ivan Bayross, “SQL. PL/SQL – The programming language of oracle” BPB publication, New Delhi, ISBN 81-7656-964-X.

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**Reference Books**:

1. Rajashekhar Sundarraman, “Oracle91 Programming: Primer”, A Pearson Education, 2004, ISBN 8129703629.
2. Dr. Sadhu Singh, “Computer aided Design and Manufacturing”, Khanna Publication, New Delhi.
3. Y. Kanetkar, “Let Us C”, BPB Publications, 4th revised edition 2002, ISBN 8176566217.
4. B.S. Gottfried, “Programming with C”, McGraw Hill Intl., Schaum‟s Outline Series, ISBN 00071006214.
5. S.C. Chapra, R.P. Canale, “Numerical Methods for engineers with programming and software applications”, Tata McGraw Hill Co. Ltd, New Delhi, ISBN 0071158952.

# 311093 : Machine Tool Engineering

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Prerequisites:**
Students should have basic knowledge of conventional manufacturing processes and machine tools like center lathe, theory of machines and mechanisms, machine drawing, and process planning.

**Course objectives:**
(i) To demonstrate evolution in the field of machine tools and their automation, Pros and cons of hard automation.
(ii) To introduce operational issues of NC/CNC/DNC machines and automated material handling systems
(iii) To present process mechanism and analysis of advanced manufacturing processes
(iv) To provide practical knowledge of Control, Maintenance, Reliability & Installation of machine Tool

**Outcomes:**
Students will be able to:
(i) Classify and describe with a neat sketch the construction and working of various automats
(ii) Compare and contrast NC/CNC and conventional machine tools
(iii) Explain the objectives, principles and selection criteria of Material Handling Systems
(iv) Classify and describe various material handling equipments
(v) Classify, compare and explain with neat sketches various non- conventional machining processes.
(vi) Describe special processes used for manufacturing of gears and threads with a neat sketch
(vii)Explain meaning, considerations, types, and significance, as applicable, of installation, control, maintenance and reliability of machine tools.

**Unit I (8)**
**Turret and automat machine** - Automation Concepts, Automatic and Semiautomatic Machine Tools and their, Classification, Turret and Capstan Lathes. Single Spindle and Multi-spindle Automats, setup of automatics and semi automatics. Tooling Layout and operation Sheet, Cam, Tool Layout for Single spindle automat., Concepts of Transfer Machines/ Lines.

**Unit II (8)**
**NC/CNC/DNC Machines**
NC/CNC Machining: Introduction to NC,CNC,DNC Machines, Tape format and basic G and M codes, Comparison between NC and Conventional Machine Tools, Basic Principles of NC Machines, its Advantages, Tooling Requirements, Introduction to Turning and Machining Center, PLC based machine tools

**Unit III (8)**
**Material Handling Systems**
Material Handling: Objectives, engineering & economic considerations, principles of material handling, selection & classification of material handling equipments, numerical based on economic consideration, Relation between plant layout and material handling.
Automatic Storage and Retrieval System (ASRS), Automated Guided Vehicles (AGV), Interfacing of Advanced Material Handling Equipment with Manufacturing Equipment,

**Unit IV (8)**

**Non-conventional machining process**

Detail study with respect to working principle , process parameter, theoretical analysis, experimental results & comparative assessment of Abrasive jet machining, Ultrasonic machining, Chemical machining, Electrochemical machining, Electro discharge machining, Electron beam machining, laser beam machining, Plasma arc machining, Ion Beam machining, wire cut EDM, Numerical based on above processes

**Unit V (8)**

**Special manufacturing Processes**

Different methods of Gear manufacture – Gear hobbing and gear shaping machines - specifications – gear generation – different methods, gear finishing and shaving,
Grinding and lapping of hobs and shaping cutters – gear honing gear broaching.
Thread manufacturing – Review of thread chasing, die Threading& tapps, thread rolling, thread whirling, milling, thread grinding, & thread whirling

**Unit VI (8)**

**Control, Maintenance, Reliability & Installation of machine Tool**

Machine Tool Operator's Control Systems: Need of Standardization, Classification, Controls in Conventional and NC/CNC Machines, Adaptive Control.
Machine Tool Installation and Maintenance, installations and maintenance of machine tool ,Introduction to reliability of machine tool, availability and maintainability

**Text Books:**

1. HMT, “Production Technology”
2. Chapman; “Workshop Technology”, Edward Arnold Publishers, ISBN 0 7131 3287 6
3. P. N. Rao, “Manufacturing Technology”, Tata McGraw Hill, ISBN 0 07 451863 1.
4. K.K AHUJA - “Production and Operations Management " , Prentice Hall of India, 1995.
5. Allegri Theodore, “Material Handling Principles and practice” (CBS Publisher Delhi)

**Reference Books:**

1. P C Sharma; “Production Technology” (Manufacturing Processes), S Chand & Co., ISBN 81 219 114.
2. Kalpakjian S, “Manufacturing Engineering and Technology”, Pearson Education.
3. Pabla Adithan, “CNC Machines”, New age Internati onal Pub,ISBN 81 7808 157 1
4. Kundra B S, P N Rao,M Tiwari; “Numerical Control and Computer Aided Manufacturing “TATA McGraw Hill Pub. ISBN 0 07 4517 40 6.
5. Mikell P. Groover; “Automation, Production Systems and Computer Integrated Manufacturing” ,Prentice Hall of India Ltd, Delhi, ISBN 81 203 0618 X
6. G C Sen. and A.Bhattacharya ,“Principles Of Machine Tools”, New Central Book Agency Pvt Ltd, Calcutta, ISBN 81 7381 155 5.
7. Pandey, Shan; “Modern Machining Processes”.
8. Ghosh Amitabh,A. Malik; “Manufacturing Science”, East-West Press Pvt. LTD,ISBN 8185095 85 X.
9. P.N.Rao, “CAD/CAM/CIM Principles”, Tata McGraw Hill Publication,

# 311094 : Tool Design

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 4 hours / week | Theory: 04 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Tool design** is specialized area of Production Engineering which deals with planning, design, construction of press tool, forging dies and injection molds at minimum overall cost.

**Prerequisites:** Engineering Graphics, Machine drawing, Material forming

**Course objectives:**

1. Todemonstratemechanism and analysis of press working, forging, die casting and plastic processing.
2. To present design process of Press tools, forging dies and Injection molds.

**Outcomes:** Students will be able to-

1.Students will understand various press working operations, plastic processing processes

2. Students will be able to apply knowledge for designing of Press tools, forging dies and Injection molds.

3.Students will be able to draw and construct the assembly of Press tools, forging dies and Injection molds.

**Unit I (8)**

**Introduction of Press working**

Press working terminology, Basic operations, types of presses- mechanical, hydraulic, pneumatic and their mechanisms, elements of die sets, types of die sets, types of dies: simple, compound, progressive, combination and inverted dies, types of punches, Methods of reduction of shear force, types of strip layouts, types of strippers, types of pilots, types of stoppers, selection of dowel pins and screws. Design of Blanking die.

**Unit II (8)**

**Design of Progressive, compound and combination dies**

Strip layout, percent utilization, Calculation of force, Press capacity, clearances, die and punch size, center of pressure, methods of piloting, Design and drawing of progressive, compound and combination die.

**Unit III (8)**

**Design of Drawing and Bending Dies**

Design of shallow and deep drawing die, Calculation of blank size by area and graphical method and standard formula, percentage reduction in each stage , number of draws, drawing force, blank holding force, press capacity, ironing force.

Types of Bending dies, Developed length calculation, bending force, spring back & methods used to overcome it in a press brake.

**Die castings dies**: Die casting machines-Hot & cold chamber, metals for die casting, die locking methods, interlocks & safety devices, specific details of die constructions, casting ejection, cores, slides, loose die pieces, types of cores, directional solidification, types of feeders, die venting, water cooling, classification of dies- single, combination, multi-impression. General details of die

design, inserted impressions, die casting defects & their remedies, die lubrication- types & methods

**Unit IV** **(8)**

**Design of Forging Dies**

Design of forging die for multi-impression die-: selection of parting line, drafts, fillet & comer radii, ribs and webs, stock size calculation, flash and gutter, design of fullering, edging, blocking, finishing impressions, trimming dies, Die block dimensions, die inserts. Rules for upset forging, design of upset die.

**Unit V** **(8)**

**Plastics processing**

Compression, transfer, injection, extrusion, blow & rotational moldings Thermoforming. General construction of injection moulds- Interger mold , insert mold , bolster , guide pillar, register ring, types of nozzles splits, side cores & side cavities, molding internal undercuts. Types of ejectors. Types of runners & gates.

**Unit VI** **(8)**

**Design of Injection mould**

Determination of number of cavities, design of feed system- design of sprue, sprue puller, runners & gates, types of cooling system, design of cooling channels, heat transfer considerations, , determination of mould opening force & ejection force, design of ejector system, use of CAD for mould design.

**Text Books:**

1. Donaldson, Lecain and Goold, “Tool Design”, Tata McGraw Hill, ISBN 0 07 0992746.
2. J R Paquin, “Die design Fundamentals”, Industrial Press Inc., ISBN 0 8311 1172 0.
3. Doehler H.H, .”Die Casting”, Mc Graw Hill
4. P.N. Rao, “Manufacturing Technology, Foundry, Forming and Welding ”, Tata McGraw Hill, ISBN 0 07 451863 1.

5.R.G. W. Pye, “Injection Mould Design(Design manual for plastic industry)”, EWP

**Reference Books:**

1. P.H. Joshi, “Press Tools Design & Construction”, Wheeler Pub., ISBN 81 85814465.
2. P. C. Sharma, “Production Engineering”, S. Chand, ISBN 81 219 0421 8.
3. Dr. Surender Kumar, “Production Engg. Design” (Tool Design), Satya Prakashan
4. A.S. Athalye, “Plastics Materials handbook”, Multitech Pub. Co., ISBN 81 7671 007

# 311095 : Process Planning and Tool Selection

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 3 hours / week | Theory: 03 | In-Sem: 30 Marks<br>End-Sem : 70 Marks |

**Pre-requisites:**
Basic knowledge of CAD, Machine Drawing and Computer Graphics, Manufacturing Process, Cutting Tool Engineering, Production Practice, Industrial Engineering and Management

**Course objectives:**
1. To provide details of the aspects Process engineering, Product design and role of product designer
2. To demonstrate application of geometric dimensioning and tolerance analysis.
3. To analyze and differentiate between Work-piece control and selection of operations.
4. To analyze factors affecting Selection of Equipment & Tooling.
5. To demonstrate process Selection, capacity Planning and approaches for CAPP

**Outcomes:**
Students will be able to
1. Carry out Part print analysis of industrial component drawing
2. Design of Process sheet on GPM for batch production
3. Design of Process sheet for mass production
4. Compute time estimation for assembly using flow-charting techniques
5. Analyze and differentiate between Computer aided process planning

**Unit I** **(8)**

**Process Engineering**:

Product design and role of product designer

Analysis of part print: Method of reading and interpreting the part print, identification of nature of work to be performed, Identification of functional surfaces, grouping of related surfaces to be machined, Identification of basic process for processing and sequence of operation from part print.

Process engineering and its functions, Co-ordination of process Engineering with other departments., Organization chart, general manufacturing processes, concept of design for manufacturing, communication in engineering Industry, glossary of terms used in process planning.

**Unit- II** **(8)**

**Geometric dimensioning and tolerance analysis**

**Dimensional Analysis:**

Types of dimensions, concept of baseline dimensions, datum selection, dimensional chain and linkage analysis, concept of straightness, flatness, roundness, concentricity and other geometrical forms. Surface quality and surface finish/surface integrity and its effect on product properties.

**Tolerance Analysis:**

Producing accuracies and attainable accuracies- process capability relation with statistical accuracies, prime accuracies, tolerance chart, tolerance grades and its calculations, tolerance stack, tolerance analysis for assembly.

**Unit-III (8)**

**Work-piece control and selection of operations:**

Causes of work-piece variations, variables influencing work-piece control, equilibrium theories, mechanical, geometrical and dimensional control, Concept of location – fundamentals of locating, datum features, errors in location and clamping, establishing process areas, guidelines for identifying holding areas, supporting areas and critical areas.

Study of basic process operations, principal processes and auxiliary processes, Identification of major, critical, qualifying, re-qualifying and supporting operations. Selection of single or combined operations, Identification of finishing operations, Establishing manufacturing sequence.

**Unit- IV (11)**

**Equipment & Tooling Selection:**

Factors to be considered in equipment/machine selection, determining machine up and down time. Types of tooling, Factors affecting selection of tooling, use of multi-tooling set-up. Process Sheet Design: Study of the part-print , logical design of process plan, stock preparation, blank size selection with material estimates, Selection of datum surfaces, identification of machining surfaces, dimension and tolerance analysis, selection of machining methods with time estimates and standard time for each operation, Preparation of process picture sheet and operation route sheet for complete manufacturing part.

**Unit-V (8)**

**Process Selection and Capacity Planning**

Component of process selection, Factor affecting on process selection decisions, Deigning the process (Process flow analysis ,Process Re-engineering, Product –Process Mix, Operations Strategy, Capacity utilization, Capacity Planning, Importance of capacity decisions, Defining and measuring capacity, Dimensions of capacity, Determining capacity requirements, Developing capacity alternatives, Factors determining effective capacity, Introduction to theory of constraints ,OEE and its calculation,

**Unit- VI (5)**

**Computer aided process planning**

Advantages over manual process planning, approaches for CAPP: Generative Process Planning, Knowledge-based Process Planning, Feature Recognition in Computer Aided Process Planning, recent trends

**Text Books:**

1. Eary D. F., Johnson G. E., “Process Engineering for manufacture” Prentice Hall of India Pvt. Ltd.
2. Narayana K. L., Kannaiah P., Vankata Reddy K., “Production Drawing”, New age international Publishers.
3. Groover Mikell P., Automation, Production Systems, and Computer-Integrated Manufacturing, Third Edition, PHI Learning Private Limited.

**Reference Books:**

1. Scallan P., “Process Planning- Design/Manufacture Interface”, John Wiley & Sons, 1995.

## 311096 : Seminar and Technical Communication

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Seminar:1 hours / week | Pr/Or: 01 | Oral: 50 Marks |

1. The objective of Seminar is to test the student on his/her ability for self-study and his/her ability to communicate - Written and oral.

2. Seminar will be in the form of a report submitted by the student:
   a) On topic of his/her choice based on literature survey/ a case study wherever applicable/possible, and approved by the staff- in- charge.
   b) A report with 20-25 pages of A-4 size paper, 1.5 spaced typed material, and appropriately bound.
   c) Title font/figures/graphs shall be black and white.

3. The Oral examination will be based on the report submitted and (orally) presented.

## 311097 : Numerical Techniques and Optimization Method Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | Practical: 50 Marks |

Practical:

1. Review of C/Matlab programming
   C/Matlab program for any three from practical No. 2 to 6:
2. Solution of Algebraic/ Transcendental Equation
3. Solution of Linear simultaneous equations
4. Solution of Curve Fitting
5. Solution of Numerical Interpolation
6. Solution of ordinary differential equation
7. Numerical integration using Matlab.
8. Case study on manufacturing optimization
9. Creation and Addition/Deletion Modification of existing Database using SQL.
10. Creation of Database Application for Purchase/Manufacturing/Logistics and its report generation using Oracle/VB/VC++/Microsoft Access.

## 311098 : Machine Tool Engineering Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical: 2 hours / week | Pr/Or: 01 | Term work : 50 Marks |

**Term Work:**
**Term work shall consist of:**
1. Assignments based on each topic of the syllabus.
2. A industrial visit to any gear manufacturing/thread manufacturing/automation industry and report based on it.
3. A simple program on CNC Turn / CNC Mill / CNC Drill.

## 311099 : Process Planning and Tool Selection Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Lectures: 2 hours / week | Pr/Or: 01 | Term work : 50 Marks |

**Term Work:**
**Term work shall consist of assignments based on following topics:**

1. Part print analysis of one industrial component drawing.
2. Process sheet design of one component on GPM for Batch Production.
3. Process sheet design of one component for mass production.
4. Time estimation for assembly using flow-charting techniques.
5. One case study on two level full factorial experimental design using DOE technique.
6. One case study on Taguchi Analysis using Orthogonal Arrays.

Process sheet design shall include detailed analysis of part print, planning the best sequence of machining operations, selection of proper equipment and tooling, Selection of datum surfaces, stock preparation and blank size selection, machining time calculations, time estimates and standards, design of jigs & fixtures, design of special tooling such as form tool if required, suggest appropriate inspection methodology, preparation of process picture sheets and operation route sheet etc.

## 311100 : Tool Design Lab

| Teaching Scheme | Credit Scheme | Examination Scheme |
|---|---|---|
| Practical:2 hours / week | Pr/Or: 01 | Oral : 50 Marks |

Term Work (Any four of the following)
1. Design and drawing of Progressive die.
2. Design and drawing of die.
3. Design and drawing of Forging die.
4. Design & Drawing of Blanking die.
5. Design and drawing of single cavity injection mould. (All drawings on A2 size drawing sheet)