Syllabus

Savitribai Phule Pune University

Faculty of Engineering

Third Year Production Sandwich Engineering

(Course 2015)

(with effect from June 2017)

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

Semester- I

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper							
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	OR	PR	Total	TH/TW/TUT	PR/OR
311121	Industrial In-plant Training for 6 months (2 contact hrs. Per student per week) @	_	_	_	_	_	150 *	100 #	_	250	_	16
311122	Manufacturing Technology (Self Study) $	_	_	_	30	70	_	_	_	100	4	_
311123	Manufacturing Technology Practices	_	_	_	_	_	50	_	_	50	_	1
311124	Seminar @	_	_	_	_	_	50*	50*	_	100	_	2
											4	19
Total					**30**	**70**	**250**	**150**	_	**500**	**23**	

Abbreviations:

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

- Oral based on TW by one internal guide & one external examiner from industry
* - Exams to be conducted in End of Semester after successful completion of Industrial Training and student had procured completion of 6 months Industrial In-plant Training completion certificate from concerned industry.
$ - Students should study this subject during training & contact college guide for guidance.
@- The contact hours are provided for supervision of students under training and for giving guidance regarding the seminar/theory subject to be studied during the training.

Semester- II

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						
311125	Kinematics Design of Machines	4	_	_	30	70	_	_	_	100	4	_
311126	Material forming and Mould Design	4	-	-	30	70	_	_	_	100	4	_
311127	Production and Industrial Management II	3	-	-	30	70	_	_	_	100	3	_
311128	Numerical Techniques and Database Systems	3	_	_	30	70	_	_	_	100	3	_
311129	Production Metallurgy	4	_	_	30	70	_	_	_	100	4	_
311130	Kinematics Design of Machines Practical	_	2	_	_	_	_	50	_	50	_	1
311131	Material forming and Mould design Practical	_	2	_	_	_	_	50	_	50	_	1
311132	Numerical Techniques and Database Systems Practical	_	2	_	_	_	_	50	_	50	_	1
311133	Production Metallurgy Practical	_	2	_	_	_	50	_	_	50	_	1
311134	Production System Design /Employable Skill Developments	_	2	_	_	_	50	_	_	50	_	1
											18	5
Total		**18**	**10**		**150**	**350**	**100**	**150**		**750**	**23**	

Abbreviations:

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

311121 Industrial In-plant Training

Teaching Scheme	Credit Scheme	Examination Scheme:
2 hrs/week/student	Pr/OR: 16	TW: 150 Marks
		Oral: 100 Marks

Duration of Training in industry: 6 Months

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 In-plant 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 and control, quality assurance, assembly, testing, maintenance, stores, purchase, marketing, human resources department, design and drawing department, general administration, packing and dispatching, tool engineering, materials and material handling.

2. Industrial Design and Drawing Practice: Design and Drawing standards, study of Mechanical components and introduction to machine design 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/BIS/TS standards for design, simple assignments based on the above items, selection of materials, material specifications, heat treatment, and properties of materials.

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

4. Study of Various Manufacturing Machine Tools: Lathe, Capstan and Turret Lathe, Planer, Shaper and Milling, Mechanical and Hydraulic Presses, Gear Hobbing, Shaping and Grinding Machines.

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

6. Study of single point cutting tools and multipoint tools, form tools, jig and fixtures, special purpose machine tools and press tools, Tool Material and Tool Selection, Study of Cutting Parameters.

7. Study of Material Handling Methods and Equipment.

8. Introduction to Quality and Quality Policy, Need for quality control, National and

International Standards on Quality and Reliability, Introduction to Total Quality Management (TQM), Kaizen Practice, 5' S, Study of various inspection gauges, selection of gauges, comparators, calibration of gauges, standards room etc. Product Performance Test Procedures.

9. Study of various Production Planning and Control functions. Process and Operations planning, yearly and Monthly Planning, Forecasting, Machine Loading, Exposure to Interdepartmental coordination planning.

10. Study of various Industrial Engineering Functions, Work Study (Motion Study and Time Analysis), Economic considerations, Plant Layout, Safety aspects of working, safety gadgets used on machines and personal safety, Students shall be asked to do simple assignments in various departments where he is undergoing training. Industries shall be instructed to prepare training program before hand, covering as much as possible from above mentioned topics depending upon the type of industry. Students shall be encouraged to give monthly reports and presentation (preferably power point presentation) to the college of his/her work in the industry. Students are also should be encouraged for paper presentation at National/International
Level based upon the applied knowledge gained during the Inplant Training.

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, machine and product specifications.

Examination

Oral Examination shall be conducted after training by appointing one internal examiner and one external examiner from industry.
A Six Months Industrial In-plant Training successful completion certificate is essential for granting the term of student.

311122 Manufacturing Technology (Self Study)

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Theory: 04	In-Sem: 30 Marks End-Sem : 70 Marks

Prerequisites:
Manufacturing Processes, Manufacturing Engineering and Metrology Practices, PIM-I.

Course objectives:
1. To impart students with the knowledge about Non conventional Machining Processes.
2. To make students aware of application of various Measurement systems.
3.To facilitate students to understand the different Plastic Processes and Advanced Manufacturing Processes.

Course Outcomes:
After studying the subjects students will be able to
1. Understand different nonconventional machining processes and their applications in industry.
2. Learn mechanism of different Plastic Processes.
3. Understand the function of various measurement.
4. Understand fundamentals of Mechanical Estimation and Costing.

Unit I: Non Conventional Machining processes

Detail study with respect to principal, processes parameter, 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, merits, limitations and applications of each.

Unit II: Plastic Processing
Introduction, types of plastics, elastomers, material for processing plastics, processing plastics, molding processes, calendaring, thermoforming, casting, laminating and reinforcing, foam plastics, fastening and machining plastics, design considerations. Recycling of plastics.

Unit III: Advanced Manufacturing Processes
Introduction to Micro Electro Mechanical Systems (MEMS), Introduction to fabrication of micro electronic devices - semiconductor and silicon, crystal growing and wafer preparation, film deposition, oxidation, lithography, etching, diffusion and ion implantation, bonding and packaging, yield and reliability, printed circuit boards, Introduction to Nanotechnology, Nanofabrication, Top Down and Bottom Up manufacturing.

Unit IV: Metrology I

Comparators: Definition, Types, Characteristics, Applications, Construction and Working of Different Mechanical, Electrical, Optical, and Pneumatic Comparators.

Measurements by light wave interference: Basic Principle, Optical Flats, Fringe Patterns and Their Interpretation, Testing Of Flat Concave, Convex and Irregular Surfaces, and Checking Of Slip Gauges, Michelson Interferometer, NPL Flatness Interferometer.

Unit V: Metrology II

Angular Measurement: principle and applications of measuring instruments like protractor (optical and bevel), sine bar, angle gauges, spirit level, clinometer, autocollimator, angle dekkor, constant deviation prism, and miscellaneous measurement of angle, Methods of measuring surface finish.

Unit VI: Mechanical Estimating and Costing

Fundamentals of Estimating: Objectives and functions of cost estimating, organization of estimating departments, principle factors in estimating, estimating procedure, time estimation for machining.

Estimation of Weights and materials: Introduction, need for scrap, provision for scrap, minimizing manufacturing time, estimation of volume and weight of material, volume and surface area of solids, densities of metals

Depreciation: Concept, need and classification, methods of depreciation. Replacement Techniques, Time Value of Money.

Reference Books:

1. Kannappan D. and Augustine A. G., "Mechanical Estimating and Costing". TTTI Madras
2. T. R. Banga and S.C. Sharma, "Mechanical Estimating and Costing", Khanna Publisher,
3. HajaraChoudhary, "Workshop Technology", Media Promoters & Publishers Pvt Ltd
4. R. K. Jain, "Engineering Metrology", Khanna Publication.
5. Kalpakjian and Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India ISBN 81-7808-157-1.
6. R K Jain, Production Technology, 11th edition, Khanna Publication.
7. Sharma P.C., "A Text Book of Production Technology- Manufacturing Processes", S. Chand & Co., 2008, ISBN 81-219-111-4-1.
8. Amitabh Ghosh & Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., ISBN 81-85095-85-X

311123 Manufacturing Technology Practices (Self Study)

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Pr/OR: 01	Term Work: 50 Marks

Term Work:

1. Assignment based on Unit No. I
2. Assignment based on Unit No. II
3. Assignment based on Unit No. III
4. Assignment based on Unit No. IV
5. Assignment based on Unit No. V
6. Assignment based on Unit No. VI

311124 Seminar

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Pr/OR: 02	Term Work: 50 Marks Oral: 50 Marks

Seminar shall strictly based on deep study of any topic practically studied during IndustrialInplant Training related to any process, production machines, manufacturing related software.

The seminar topic along with Index of report to be finalized by a college guide within first month of commencement of semester and students must be guided to make this seminar to the level of research article that can be published as review article, technical notes in reputed peer reviewed National/International Journal.

The last part of seminar report should necessarily include the relevant research work reported from peer reviewed research articles published in national and international journals.

The report is expected to be about 15 A4 size pages, including figures and tables, in addition to certificate, synopsis and reference pages. The presentation is expected to be in front of the audience which must include at least two internal examiners one of them being a guide and both being university approved teachers and one external examiner. The marks distribution is equally divided between the report and presentation/oral examination.

311125 Kinematics Design of Machines

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

Pre-requisites:
Mechanics of Materials, Theory of Machines, Design of Machine Elements.

Course objectives:
1. To facilitate students with the knowledge about fluctuating loads and apply knowledge to design components for finite and infinite life under reverse stress condition.
2. To enable students with knowledge about Helical Gears and apply knowledge to design helical gears.
3. To enable students to understand fundamental of kinematics to machines this includes hydrodynamic lubrication bearing, lubricating oils and their selection, mechanism of pressure development etc.
4. To facilitate students to understand and apply knowledge to analyze tolerances, to determine Reliability, factor of safety in engineering design and to optimize design within given constraint using Johnson method of optimum design.
5. To enable students to understand and apply knowledge to design and construction of flywheel, Ergonomic considerations in design and design for manufacturing and assembly etc.
6. To impart students with the knowledge about kinematic synthesis, analysis of mechanisms and kinematic structure of machine tools.

Course Outcomes:
After studying the subjects students will be able to
1. Design components for finite and infinite life under fluctuating load conditions.
2. Apply fundamentals of kinematics of machines this includes analysis of kinematics of helical gears and design of helical gears.
3. Understand design and construction of flywheel, Ergonomic considerations in design, principles in design for manufacturing and assembly.
4. Understand sliding contact bearing and theory of hydrodynamic bearing and parameters in design
5. Understand and apply their knowledge to optimize design and to analyze the tolerances.
6. Carry out kinematic synthesis, analysis of mechanisms and kinematic structure of machine tools.

Unit I: Design for fluctuating loads
Stress Concentration and remedies, S.N .Diagram, Endurance limit, Factors affecting Endurance Strength, Design for Finite and Infinite life under reverse stresses, Cumulative Damage, Sodberg's and Goodman's Diagram, Design of shaft subjected to variable loading.

Unit II: Helical Gears
Introduction, Terms used in helical Gears, Face width of Helical Gears, Normal Module, Virtual no. of teeth, force analysis, Beam and wear strength, types of gear tooth failures, Estimation of dynamic load by velocity factor and Spott's equation. Design of Helical Gears.

Unit III: Sliding Contact Bearings
Introduction, Classification of bearings, Hydrodynamic Lubricated Bearings, Wedge film Journal Bearings, Squeeze film Journal Bearings, Materials used for Sliding Contact Bearings.

Lubricating Oils: Properties, additives for mineral oils, selection of lubricants. Hydrodynamic Lubrication: Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, Two dimensional Reynolds equation, Sommerfield number ,Raimondi & Boyd method, temperature rise, parameters of bearing design, length to diameter ratio, unit bearing pressure, radial clearance & minimum oil film thickness.

Unit IV: Statistical considerations in design and Optimum Design

Statistical Considerations in Design: Analysis of Tolerances, Design and Natural Tolerances, Factor of safety and reliability in engineering design, Probabilistic design using safety margin. Optimum Design: Objectives of Johnson's Method of optimum design, normal specification, redundant and incompatible specification, design for normal specification only.

Unit V:

Flywheel: Introduction, Coefficient of fluctuation of speed, Fluctuation of energy, Maximum fluctuation of energy, Energy stored in flywheel, Stresses in flywheel rim & Arms, Detail Design and construction of flywheel.

Aesthetic and ergonomic considerations in design of products:
Basic types of product forms, Designing for appearance – Shape, features, materials and finishes, proportions symmetry, contrast etc. Morgan’s colour code.Ergonomic considerations - Relation between Man, machine and environmental factors.Design of displays and controls.Practical examples of products or equipments using ergonomic and aesthetic design principles.

Design for manufacture:-

General principles of design for manufacture and assembly (DFM & DMFA). Principles of Design of castings and forgings, Design for machining, Design for powder metallurgy, Design for welding, cost estimation.

Unit VI:

Analysis and Synthesis of mechanisms and kinematics structure of machine tools:
Analysis for four bar mechanism and slider crank mechanism, dimensional synthesis of mechanisms, three position synthesis of slider crank mechanism, Overlay method Machine tool motion and their transmissions, Kinematic balancing equation for motion transmitting elements, Kinematic analysis of machine tool structure: gear hobbling, gear shaping, bevel gear generator.

Text Books:

1. Shigley J. E. and Mischke C. R., "Mechanical Engine ering Design", 1 stedition, McGraw-Hill Publication Co. Ltd., 1989, ISBN 0-07-049462-2.
2. Spotts M. F. and Shoup T. E., "Design of Machine El ements", 8 thedition, Pearson Education Pvt. Ltd., 2008, ISBN 81 -7758- 4219.
3. Bhandari V.B., "Design of Machine Elements", Tata M cGraw-Hill Publishing, 1984, ISBN 0-07-0611416.
4. Kannaiah P., "Machine Design", Scitech publications Pvt. Ltd., 2003, ISBN 81-88429-10.

Reference Books:

1.William C. OrthweinOrtewein, "Machine Component Des ign", West Pub. Co. and Jaico Publication House, ISBN 81-7224-773-7.
2. Robert C. Juvinall and Marshek K. M., "Fundamentals of Machine Component Design", 1999, John Wiley & Sons, ISBN 0-471-24448- 1.
3. "PSG Design data ", M/S DPV printers, Coimbatore, 2000.
4. Black Paul H.and Adams O. Eugene, "Machine Design", 3 rdedition, McGraw-hill Book Company, 1999, ISBN 0–07-085037-2.
5. Hall Allens, Holowenko Alfred R., Laughlin Herman G., "Theory & Problems of Machine Design" , McGraw-Hill Book Company, New Delhi Ed.2002, ISBN : 0-07-048333-7
6. G. C. Sen& A. Bhattacharyya, "Principles of Machin e Tools", New Central BookAgency (P) Ltd. Kolkata. ISBN: 81-7381-155-5
7. R. S .Khurmi& J. K. Gupta, "Theory of Machine", Eurasia Publishing House Pvt. Ltd.
8. S.S. Rattan," Theory of Machine", Tata McGraw Hill Publication. New Delhi, ISBN: 0-07-460320-5

311126 Material Forming and Mould Design

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

Prerequisites:
Basic knowledge of Engineering Metallurgy and strength of materials.

Course objectives:
1. Students will understand and analyze the mechanism of forming
2. Students will learn to overcome the difficulties in the process

Course outcomes:
After studying the subjects students will be able to

1. Students will be able to classify various forming processes
2. Students will learn roll pass design for rolling process
3. Students will learn to design die for forging process
4. Students will learn to design mould for injection moulding

Unit I: Fundamental of Material Forming

Introduction of forming process, Deformation under complex stresses, Maximum shear stress, Principle stresses and principle planes, Theory of plasticity, Mohr's circle diagram, Slip line theory, Upper and lower bound theory, Yield criteria for ductile material – Von Mises criteria, Tresca criteria. Effect of temperature, strain rate, chemical composition and mechanical properties. Friction and lubrication in metal working, concept of flow stress and flow stress determination. Classification of material forming process on forces and material movement, Concept of formability, formability limit and formability diagram, Concept of redundant work and its impact on metal working operations.

Unit II:

Extrusion: - Introduction, Dies for Extrusion, stock penetration, Extrusion ratio, Force requirement, metal flow in extrusion, defects. Role of friction and lubrication, Extrusion plant layout and accessories, Manufacture of seam-less tubes.

Wire Drawing:-Introduction, Rod and Wire drawing machines- construction and working. Preparation for stock for wire drawing, wire drawing dies, material and design. Variables in wire drawing, maximum reduction in one pass, forces required in drawing, multiple drawing, Lubrication in wire drawing. Force calculation in tube drawing.

Unit III:

Rolling of metals:- Scope and importance of rolling, Types of rolling mills -construction and working, Deformation in rolling and determination force required, Process variable, redundant deformation, Roll flattening, Roll bite, Roll Camber and its effect on rolling process, Mill spring, Rolling Mill plant and accessories, Automatic gauge control – concept,need and methods, Roll pass classification.

Advance Metal forming Processes:-High velocity forming- principles, Comparison of high velocity and conventional forming processes. Explosive forming, Magnetic pulse forming, Electro Hydraulic forming.

Unit IV:

Design of Casting: - Metal pouring, Gating system- design of gating system, solidification time, riser design, Principles of gating, risering and their design methods. Progressive and directional solidification, casting design consideration, Chvornov's rule, numericals on casting.

Design of Die casting dies: - Design of simple die for die casting. Detail calculation of cavity, core, shrinkage and other allowances, heat transfer consideration, directional solidification, design of cooling system, feed and flow system and ejection system. Role of computers in casting die design.

Unit V: Forging & Design of Forging Dies:-

Introduction, forgability tests, classification of forging processes, forging equipments, Basic forging operations such as drawing, fullering, edging, blocking etc, Friction in forging, New technologies:- Liquid metal forging, Isothermal forging, No draft forging, P/M forging, Rotary swaging. Design of forging die for multi-impression die: - selection of parting line, drafts, fillet & Corner 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.

Unit VI Design of Injection Moulds:-

Introduction, Mould materials used for construction, consideration of plastic material parameters-shrinkage, density, bulk factor etc. general mould construction – basic terminology, mould cavities and core, bolsters, ancillary items. Ejection system - ejector grid, ejector plate assembly, ejection techniques, sprue pullers. Feed system - types of gates & runners, design of gates & runners. Cooling systems and heat transfer consideration.Use of CAD for mould design.

Text Books

1. Dieter George E., "Mechanical Metallurgy", McGraw Hill, ISBN 0-07-100406-8.
2. P. H. Joshi, "Press Tool Design & Construction", 1st edition, Wheeler Publication, ISBN 81-85814-46-5.
3. P. N. Rao, "Manufacturing Technology: Foundry, Forming & Welding", Tata McGraw Hill Publication, ISBN 0-07-451863-1.
4. Donaldson Cyril, Lecain Gilt and Goold V. C., "Tool Design", 3rd edition, Tata McGraw Hill Publication, ISBN 0-07-099274-6.
5. B. Ravi Metal Casting, "Computer Aided Design & Analysis", Prentice Hall of India, ISBN 81-203-2726-8.
6. A. Kumar, Fundamental of Tool Design, DanpatRai& Sons.
7. R. Sharam, S.N. Parsad, N.P. Saxena, Forging die design and practice by; S. Chand and Company. New Delhi.

Reference Books:

1. J N Harris, "Mechanical Working of Metals", Pergmon Press
2. Avitzer, "Fundamental of Metal Working", McGraw Hill Publication
3. Dr. R. Narayanswamy, "Metal Forming Technology", Ahuja Book Company

4. ASME, “Metal Hand Book”, Vol II and Vol III.
5. Slotten, “The Die Casting Hand Book”.
6. Surendra Kumar, “Technology of Forming Processes”, Prentice Hall of India.
7. R.G. W. Pye, “Injection Mould Design - An introduction & design manual for the thermoplastics industry”, EWP.

311127 Production and Industrial Management II

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

Pre-requisites: Production and Industrial Management- I, Manufacturing Processes, Manufacturing Engineering and Metrology Practices.

Course objectives:

1. Student will demonstrate the ability to drive the design of manufacturable products, design effective and efficient new production processes and improve the performance of existing operations.
2. Students also develop expertise in Quality and Inspection, statistics which help them to solve application level problems related to core Mechanical Engineering and interdisciplinary areas.

Course Outcomes:

1. The students get employed in jobs, related to Production Planning section, Industrial Engineering Department, Shop floor, Assembly lines, in all sectors like IT, Banking, Manufacturing, Share Market, Higher Education, Sports, where they can implement their statistical knowledge.
2. This subject also helps a student to be a self-employable by getting knowledge of management techniques.
3. Statistical Knowledge enhances chances to get a certification from worldwide famous organisation like ASQ. i.e. American Society for Quality.
4. Student will demonstrate Commitment to quality, timeliness, and continuous improvement in production rate in manufacturing sector.
5. Students also show the ability to formulate, conduct, analyze and interpret experiments and apply experimental results to improve processes in industry.
6. This subject also helps students to implement the concepts they learned, during Industrial In-Plant Training.

Unit I: Process Engineering

Basic Manufacturing processes, supporting operations, study of the functions of the part in the assembly and corresponding finishing operations, study of tooling standard and special tooling, Special of tooling - Conventional tooling methods for commonly machined surfaces, tooling ideas for typical features on job, multi-tooling set up, new tools and tooling methods economics of tooling, make or buy decision, Tolerance chart, Geometric control, Dimensional Tolerances analysis.

Unit II:

(A) Process Planning

Introduction- Production Engineering, Role of Product Engineering department, process engineering functions, coordination of process engineering department with other department, process planning organization, Phases of process planning.

(B) Sequencing and Inventory Model

Sequencing model: Scheduling and sequencing, assumptions in sequencing model, processing 'n' job on 'm' machines, processing of two jobs on machines with each having different processing order.
Inventory control: Discount model Safety stock, ABC analysis, EOQ concept.

Unit III: Quality Control

Definition of Quality, Quality Characteristics, Introduction to Quality Control, Study of control chart -control chart for variables, control chart for attributes. Acceptance Sampling - Sampling inspection v/s 100 percent inspection, Basic concepts, operating characteristics curves, conflicting interests of consumer and producers, producer's andconsumer's risks, AQL, LTPD, AOQL, Single and Double Sampling Plans, Standard Sampling tables. Theory of Work Sampling.**(8)**

Unit IV: World Class Manufacturing-I

Deming's and Juran's Approach, Deming's PDCA, PDSA cycle, 7 QC Tools, 5'S, TPM, Kaizen, Quality Circle, Concurrent Engineering, JIT, Kanban, Quality Function Deployment, House of Quality, Six Sigma, Poka Yoke.

Unit V: World Class Manufacturing-II
ISO, QS and CMM Standards, Introduction to Reliability, FMEA, FTA.
Introduction to, taguchi method, Design of Experiments & Hypothesis Testing.

Unit VI:
(A) Elementary Economics
Basic economics concepts- Law of demand and supply, Law of diminishing marginal utility, Forms and functions of money. Money market and Capital Market.

(B)Materials Management: Objective, functions of materials management, material planning analysis (MRP I and MRP II), organization of materials, Industrial Purchasing Producer.

(C)Marketing Management: Marketing Function, Marketing Planning, Market Survey and Market Research, Marketing and Selling Concept.**(8)**

Text Books:

1. Zaidi, "SPC, Concepts, Methodologies & Tools", Prentice Hall of India.
2. Panneerselvam, "Engineering Economics", Prentice Hall of India
3. Mukherjee &Kachwala, "Operations Management & Productivity Tech", PH of India.
4. M. Mahajan, "Industrial Engineering & Production Management", Dhanpat Rai&Company.
5. P. Rama Murthy, "Production & Operation Management", New Age International (P) Ltd.

Reference Books:

1. Francis R. L. and White S. A., "Facility Layout & Location: An analytical Approach", Prentice Hall of India.
2. Datta A. K., "Material Management: Procedure, Text & Cases", Prentice Hall of India.
3. Mahapatra P. B., Computer Aided Production Management, Prentice Hall of India, ISBN 81-203-1742-4.

311128 Numerical Techniques and Database Systems

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

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

Course objectives:
1.To facilitate students to understand use of numerical & iterative methods for solving complex algebraic & transcendental equation, simultaneous equations, curve fitting, interpolation, optimization, integration & differentiation.

2.To give students the knowledge of selecting & applying appropriate solution methodology to solve production engineering problems involving complex mathematical formulations.

3.To make students aware of problem formulation and optimization in the field of Production Engineering to solve complex problems.

4.To make students aware to design the database using ER model & work with relational algebra & relation calculus and to manage & control concurrent transactions using query process optimization & normalization.

Course Outcomes:
After studying the subjects students will be able to
1. Understand the use of numerical & iterative methods for solving complex algebraic & transcendental equation, simultaneous equations, curve fitting, interpolation, optimization, integration & differentiation.
2. Select & apply appropriate solution methodology to solve production engineering problems involving complex mathematical formulations.
3. Carry out formulation and optimization in the field of Production Engineering to solve complex problems.
4. 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: Numerical methods-I
Revision of 'C' syntax. Errors & approximations: types of errors, error propagation.
Numerical solution of algebraic Equations Numerical solution of Linear Simultaneous Equations by Gauss Elimination Method, Gauss-Siedel Method.**(8)**

Unit II: Numerical methods –II
Curve Fitting: Least square criterion- 1rst and 2nd order
Interpolation: Lagrange's formula, Newton forward difference method.
Numerical Integration, Trapezoidal Rule Simpson 1/3 Rule and Simpson 3/8 Rule**(8)**

Unit III: Numerical methods –III

Numerical solution of transcendental equations by bisection method,
Newton-Raphson Method.Ordinary Differential Equations.-Runge-Kutta Methods
Partial Differential Equations -Finite difference method**(8)**

Unit IV: **Introduction to Databases Management System**
Introduction, Organization & component of database management system(DBMS), data Models, entity relationship model, advantages & disadvantages in database processing, Hierarchical & network databases.

Introduction to oracle, SQL, Database creation, database retrieval, use of compound Conditions like AND, OR, Joining and updating tables.**(8)**

Unit V: SQL & Emerging Data base Technologies

Database storage and querying, aggregate functions. – Group by, having order by, sub-queries and various SQL operators. Emerging Data base Technologies, Internet Database, DigitialLibrary,Mobile Database, Multimedia Data Base & Spatial Data Base**(8)**

Unit VI: Information technology for competitive Advantages

Introduction to information technology, Inter-organizational and global information Systems, Electronic Data Interchange (EDI) and Electronic Fund Transfer(EFT).
Functional and Enterprise system- Production & operation systems, human resource Management systems, marketing and sales systems, human resource management Systems, marketing and sales systems. Intelligent systems in Business- Artificial intelligence and intelligent systems, expert Systems, intelligent agents. Electronic Commerce (E-Commerce)-foundations, business-to-consumer and business-to business applications, ERP concept (**8)**

Text Books:
1. Silberschatz, Korth H F, Sudarshan, “Database System Concepts”, McGraw Hill Intl., 4th Edition, 2002, ISBN 0 07 100529 3.
2. A.M. Muzumdar and P. Bhattacharya, “Database management System”, Tata McGraw Hill Publication, New Delhi,ISBN 0 07 462 239 0.
3. Turban, Rainer & Potter-John, “Introduction to Information Technology”, Wiley &Sons, 2000,ISBN 81 265 0968 6.

Reference Books:

1. Rajashekhar Sundarraman, “Oracle91 Programming:Primer”,A Pearson Education, 2004,ISBN 81 297 0362 9.
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 81 7656 621 7.
4. B.S. Gottfried, “Programming with C”, McGraw Hill Intl., Schaum’s Outline Series, ISBN 0 007 100621 4.
5. S.C. Chapra, R.P. Canale, “Numerical Methods for engineers with programming and software applications”, Tata McGraw Hill Co.Ltd, NewDelhi,ISBN 0 07 115895 2.
6.Balagurusamy E. “Numerical Methods”, Tata McGraw Hill Publication, New Delhi,
7.Data base System: Concepts, Design and Application: Singh S.K. Pearson Edition.
8. Online Documentation of Visual Fox pro, MS Access.

311129 Production Metallurgy

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

Prerequisites:

1. Basic knowledge of Steel and changes in properties of Steel with temperature
2. Various heat treatment cycle and Isothermal Treatment.
3. Basic knowledge of Surface hardening such as: Carburizing, Nitriding, Carbonitriding etc.
4. Basic knowledge of alloy steel, Cast Iron and Non-Ferrous alloys etc.
5. Basic knowledge of Composite materials, Biomaterials, Sports materials and Nanomaterials

Course objectives:

1. Analyze phase diagrams and solidification structure at different temp and composition
2. Analyze the effects of alloying element on properties of materials
3. Evaluate the heat treatment cycle and correlate the phase structure with the properties of steel and non-ferrous metals
4. Analyze the phase structure and manufacturing process of cast iron to evaluate the properties and engineering applications of cast iron product
5. Evaluate the properties of different non-ferrous metals and alloys for material selection and various critical engineering application
6. Evaluate the advanced materials for application in sports, biomaterials

Course Outcomes:

After learning this subject, the student will:

1. be able to understand phase diagram and changes in properties wit temperature
2. be able to describe various heat treatment cycle for different application
3. be able to distinguish various surface hardening treatment for application
4. be able to understand alloy steel and cast iron properties, composition and application
5. get knowledge of various non-ferrous alloys, properties, composition and application
6. Able to understand modern engineering materials and practical application in industry

Unit I: Steels

Steels: iron-iron carbide equilibrium diagram, Critical temperatures, Allotropy, cooling curve and volume changes of pure iron. Microstructure, non-equilibrium cooling of steel, widmanstatten structure, structure property relationship. Classification and applications of steels, specifications of some commonly used steels like BIS, EN, AISI, SAE. Introduction to Metallography, micro and macro examination, metallurgical microscope, etching.**(8)**

Unit II: Heat treatment of Steels

Introduction to heat treatment furnaces and Furnace atmospheres, Transformation products of austenite, Time-temperature- transformation diagrams, Critical cooling rate, Continuous

cooling transformation diagrams.Heat treatment of steels Quenching media, Annealing, Normalizing, Hardening, Retention of austenite. Effects of retained austenite, Elimination of retained austenite, Tempering, Secondary hardening, Temper embrittlement, Quench cracks and Hardenability testing.Defects occurring due to heat treatment & remedial measure.**(8)**

Unit III: Surface Hardening & Isothermal Treatments
Carburising, heat treatment after carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs. Isothermal heat treatments such as austempering, patenting, isoforming, martempering, ausforming.**(8)**

Unit IV: Alloy Steels & Cast Iron
Alloy Steels - Effects of alloying elements, classification of alloying elements. Stainless Steels, Sensitization of stainless steel, weld decay of stainless steel. Tool steels and tool materials, Heat treatment of high-speed steel. Special purpose steels with applications.

Cast irons- Classification, Gray cast iron, White cast iron, Malleable cast iron, Ductile Iron, Chilled and alloy cast irons. Effects of various parameters on structures and properties of cast irons, Heat treatments of cast iron. Applications of cast irons for different components of machine tool, automobiles, pumps etc.**(8)**

Unit V: Non-Ferrous Alloys
Copper alloys - Brasses, Bronzes-: Tin, Aluminium, Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. Solders, Bearing materials and their applications, Precipitation hardening alloys. High Temperature materials such as Nimonics, Super alloys, Ti-alloys etc.**(8)**

Unit VI: Modern Engineering Materials
Composites- Types, Characterization, Production techniques& applications. Metal – Matrix composites, Particulate & Fiber composites. Biomaterials, Nano materials, Sports materials. **(8)**

Text-books:
1. Kodgire V. D., "Material science and metallurgy for Engineers", Everest Publishing House, Pune, ISBN 81 86314 00 8.
2. K. G. Bundinski , M. K. Bundinski , “Engineering Materials” Prentice Hall of India Pvt. Ltd., New- Delhi.
3. Higgins "Engineering Metallurgy", Part I Applied Physical Metallurgy, English Language book Society / Edward Arnold.
4. Smith W. F., “Principles of Material Science and Engineering", McGraw- Hill Inc. Book Co., ISBN 0 07 122920 5.

Reference Books:
1. Rollason E. C., "Metallurgy for Engineering", ELBS Publishing.
2. Clark D.S.and Vamey W. R. "Physical Metallurgy for Engineers", East-West Press Pvt. Ltd., New Delhi.
3. Avner, ″An introduction to physical metallurgy", TMH publication.
4. Donald R. Askeland & Pradeep Phule. ,” The science and engineering of materials”, Thomson Asia Pvt.Ltd, ISBN 981 243 855 6.

311130 Kinematic Design of Machines Practical

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

Term Work:

1. Assignments on unit no I
2. Assignments on unit no II
3. Assignments on unit no IV
4. Assignments on unit no V
5. Assignments on unit no VI
6. Design Project: - One design project on gear box design, consisting detail design report & Two Full Imperial size sheets one is showing the manufacturing drawing of assembly of Gear box and second showing details for the same. Study of Kinematics of Machine Tool Gear Box.Oral is based on above Term work

311131 Material Forming and Mould Design Practical

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

Term Work: Oral is based on term work.

1. Assignment based on Unit No. I
2. Assignment based on Unit No. II
3. Assignment based on Unit No. III
4. Assignment based on Unit No. IV
5. Study of Roll pass Design for structural shapes. (At least two)
6. A Report on Factory Visit comprising of Product range, Processes, Plant layout, Auxiliary equipment, Process parameter etc.
7. Detail design and drawing of die for forging operation. (Use of CAD desirable)
8. Detail design and working drawing of plastic moulds for plastic components for manual and automatic machines. (Use of CAD desirable)

311132 Numerical Techniques and Database Systems Practical

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

Term Work: (Oral is based on term work)

1. Assignment on Unit No-1 Numerical Solution Using C Language/ MATLAB
2. Assignment on Unit No-2 Numerical Solution Using C Language/ MATLAB
3. Assignment on Unit No-2 Numerical Solution Using C Language/ MATLAB

Assignment on Database Management system & SQL (Part-1)

4. A database related language such as Oracle/VB/V FoxPro should be covered.
5. Creation of database using SQL.
6. Addition/Deletion Modification of existing Database using VB/FoxPro.
7. Assignment on Emerging Trends in Data Base along with Case Study
8. Assignment on Information technology for competitive Advantages
9. Assignment on study of MRP and ERP systems.

311133 Production Metallurgy Practical

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

List of Experiments (Any eight)

1. Study and drawing of microstructures of mild steel, medium carbon steel, eutectoid steel and hypereutectoid steel.
2. Study and drawing of microstructures of white, malleable, grey and nodular cast iron.
3. Study and drawing of microstructures of alpha brass, alpha-beta brass, aluminum bronze, tin bronze and bearing metal.
4. Study and drawing of microstructures of hardened steel, tempered steel.
5. Hardening of steel- study of effect of carbon on hardness of hardened steel.
6. Tempering of steels - study of effect of temperature on hardness of tempered steel.
7. Study of change in microstructure on annealing and normalizing of tempered steel.
8. Sulphur print test on a steel specimen & flow lines examination of a forged component.
9. Jominy Hardenability test on a steel sample.
10. Testing of Composite materials (Like Hardness, Impact, Tension etc.)

311134 Production System Design / Employable Skill Developments

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

Term Work

Term work consists of writing the journal based on following points. Minimum one assignment on each point.

1) Use of Excel sheet for routine data analysis requirement such as Average, Min, Max, Additions, Subtractions, Range, If, Count, Count If etc.
2) Time Management Skill – Tools to plan your work – To-Do List, Scheduling your day, getting organized, maximizing the available time.
3) Study and design of special cutting tools, like flat, form tools and circular form tool, multipoint cutting tools like milling cutter, drills, reamers and broach.
4) Study of process planning and design of process sheet for machine components under job and mass production. (The process sheet will contain material specifications and estimate, sequence of operations along with in process dimensions, gauging, special tools, jigs and fixtures required as well as time estimate for each operations.)
5) Study of process plant like sugar, paper, cement, chemical, ceramic, etc. (any one visit to any such plant and studying the conversion process in detail and drawing the plant layout in the report.)
6) Facility and Plant layout design preferably using any Software.
7) Calculations for Capacity planning, Productivity, OEE, etc., for any above process plant or any manufacturing shop.
8) Preparation of Control Chart of various types.
9) Needs, scope for self-employment with special reference to self-employment scheme and sources of assistant in central and state government organization like MIDC, SISI, NSIC, SIDO, CSIR, Financial Institutions and banks.
10) Project formation, feasibility, viability, profitable study, Investment Procedure, Loan Procurement, Agencies and banking process for loan clearance.