Shivaji University, Kolhapur.

STRUCTURE & SYLLABUS FOR B. E. (PRODUCTION ENGINEERING) PROGRAM

Class: S. E. (PRODUCTION ENGINEERING) SEMESTER-III
(TO BE REVISED FROM JULY 2014)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Machine Tools and Processes	3	1	-	4	3	100	25	-	25	150
2	Engineering Mathematics – III	3	-	1*	4	3	100	25	-	-	125
3	Machine Drawing	2	4	-	6	4	100	25	-	25	150
4	Thermal Engineering	3	2	-	5	3	100	25	-	-	125
5	Electrical and Electronics Engineering	3	2	-	5	3	100	25	-	-	125
6	Object Oriented Programming with C++	2	2	-	4	-	-	25	50	-	75
7	Workshop Practice-III	-	2	-	2	-	-	50	-	-	50
	Total	16	13	1	30	-	500	200	50	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work, * Tutorials shall be conducted batch-wise.

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Class: S. E. (PRODUCTION ENGINEERING) SEMESTER-IV

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Foundry Technology	3	2	-	5	3	100	25	-	-	125
2	Advanced Machine Tools and Processes	3	1	-	4	3	100	25	-	-	125
3	Theory of Machines-I	3	2	-	5	4	100	25	-	-	125
4	Analysis of Machine Elements	3	2	-	5	3	100	25	-	25	150
5	Welding Technology	3	2	-	5	3	100	25	-	-	125
6	Computer Aided Solid Modelling	1	2	-	3	-	-	25	25	-	50
7	WS Practice-IV	-	2	-	2	-	-	25	25		50
8	Mini Project*	-	1	-	1	-	-	50	-	-	50
	Total	16	14	-	30	-	500	225	50	25	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work,

* Note: For Mini Project, a group of nine students shall be considered for workload purpose.

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Class: T. E. (PRODUCTION ENGINEERING) SEMESTER-V

(TO BE REVISED FROM JULY 2015)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Metallurgy	3	2	-	5	3	100	25	-	-	125
2	Theory of Machines-II	3	2	-	5	3	100	25	-	-	125
3	Design of Machine Elements	3	2	-	5	3	100	25	-	-	125
4	Metrology	3	2	-	5	3	100	25	25	-	150
5	Metal Forming and Plastic Engineering	3	1	-	4	3	100	25	-	-	125
6	Metal Cutting Theory	3	1	-	4	3	100	25	-	-	125
7	WS Practice -V*	-	2	-	2	-	-	25	-	-	25
	Total	18	12	-	30	-	600	175	25	-	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
*Note: Work load of 2 Hrs. practical per batch to be allotted to the teaching faculty member.

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Class: T. E. (PRODUCTION ENGINEERING) SEMESTER-VI

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Industrial Management	3	1	-	4	3	100	25	-	-	125
2	Industrial Hydraulics and Pneumatics	3	2	-	5	3	100	25	-	25	150
3	Design of Jigs, Fixtures and Dies	4	2	-	6	4	100	25	-	25	150
4	Quality Management	3	2	-	5	3	100	25	-	-	125
5	Machine Tool Design	3	2	-	5	3	100	25	-	-	125
6	CAM Laboratory and CNC Workshop Practice	-	4	-	4	-	-	50	50	-	100
7	Research Seminar #	-	1	-	1	-	-	25	-	-	25
	Total	16	14	-	30	-	500	200	50	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
Note: For Research Seminar, a group of nine students shall be considered for workload purpose.
√ Please refer to the important Instructions for Industrial Training & Project Work at the end of T.E.-Prod. Sem-VI syllabus.

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Class: B. E. (PRODUCTION ENGINEERING) SEMESTER-VII

(TO BE REVISED FROM JULY 2016)

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Operations Research	3	2	-	5	3	100	25	-	-	125
2	Mechatronic Systems	3	2	-	5	3	100	25	25	-	150
3	Production and Operations Management	3	2	-	5	3	100	25	-	-	125
4	Process Engineering	4	2	-	6	4	100	25	-	25	150
5	Elective-I	3	2	-	5	3	100	25	-	-	125
6	Industrial Training*	-	-	-	-	-	-	25	-	25	50
7	Project Work * Phase-I	-	2*	-	2*	-	-	75	-	-	75
	Total	16	12	-	28	-	500	225	25	50	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
*Note: For Industrial Training and Project Work a group of nine students shall be considered for workload purpose.

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Class: B. E. (PRODUCTION ENGINEERING) SEMESTER-VIII

Sr. No.	Subject	Teaching Scheme Hours/week				Theory Paper Duration Hours	Examination Scheme Marks				Total Marks
		L	Pr	Tut	Total		Theory	TW	Pr	Oral	
1	Costing and Cost Control	3	2	-	5	3	100	25	-	-	125
2	Industrial Engineering	3	2	-	5	3	100	25	-	25	150
3	Finite Element Analysis	4	2	-	6	3	100	25	25	-	150
4	Elective-II	3	2	-	5	3	100	25	-	-	125
5	Elective-III	3	2	-	5	3	100	25	-	-	125
6	Project Work Phase-II #	-	4#	-	4#	-	-	75	-	50	125
	Total	16	14		30	-	500	200	25	75	**800**

L: Lecture, Pr: Practical, Tut: Tutorial, TW: Term Work
Note: For Project Work a group of nine students shall be considered for workload purpose.

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List of Elective Subjects for B. E. (Prod. Engg.) Sem. VII and Sem. VIII

Elective I: (Interdisciplinary Group)

1. Automobile Engineering
2. Energy Engineering
3. Composite Materials and Technology
4. Experimental Stress Analysis
5. Safety Engineering
6. Rapid Prototyping
7. Reliability Engineering

Elective II: (Design and Systems Group)

1. Product Design and Development
2. Advanced Machine Design
3. Advanced Tool & Die Design
4. Material Handling Systems
5. Artificial Intelligence
6. Industrial Robotics
7. Computer Integrated Manufacturing Systems

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Elective III: (Management Group)

1. Marketing Management
2. Statistics for Engineering Research
3. Materials Management
4. Project Management
5. Financial Management
6. Entrepreneurship Development
7. Supply Chain Management

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EQUIVALENCE OF OLD & NEW SYLLABI OF S. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
S. E. (Prod.Engg.) Sem. I	1	Engineering Mathematics-III	S. E. (Prod. Engg.)Sem. I	Engineering Mathematics-III
	2	Machine Drawing	S. E. (Prod. Engg.)Sem. I	Machine Drawing
	3	Thermal Engineering	S. E. (Prod. Engg.)Sem. I	Thermal Engineering
	4	Electrical Technology & Industrial Electronics	S. E. (Prod. Engg.)Sem. I	Electrical & Electronics Engineering
	5	Machine Tools & Processes	S. E. (Prod. Engg.)Sem. I	Machine Tools and Processes
	6	Advanced Programming Laboratory	S. E. (Prod. Engg.)Sem. I	Object Oriented Programming with C++
S. E. (Prod.Engg.) Sem. II	1	Advanced Machine Tools and Processes	S. E. (Prod. Engg.)Sem. II	Advanced Machine Tools and Processes
	2	Foundry Technology	S. E. (Prod. Engg.)Sem. II	Foundry Technology
	3	Analysis of Machine Elements	S. E. (Prod. Engg.)Sem. II	Analysis of Machine Elements
	4	Welding Technology	S. E. (Prod. Engg.)Sem. II	Welding Technology
	5	Theory of Machines - I	S. E. (Prod. Engg.)Sem. II	Theory of Machines-I
	6	Computer Aided Solid Modelling	S. E. (Prod. Engg.)Sem. II	Computer Aided Solid Modelling
	7	Work Shop Practice-IV	S. E. (Prod. Engg.)Sem. II	Work Shop Practice-IV

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EQUIVALENCE OF OLD & NEW SYLLABI OF T. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
T. E. (Prod.Engg.) Sem. I	1	Metallurgy - I	T. E. (Prod. Engg.) Sem. I	Metallurgy
	2	Theory of Machines – II	T. E. (Prod. Engg.) Sem. I	Theory of Machines-II
	3	Design of Machine Elements	T. E. (Prod. Engg.) Sem. I	Design of Machine Elements
	4	Metal Cutting Technology	T. E. (Prod. Engg.) Sem. I	Metal Cutting Theory
	5	Metal Forming & Plastics Technology	T. E. (Prod. Engg.) Sem. I	Metal Forming & Plastics Engineering
	6	Metrology	T. E. (Prod. Engg.) Sem. I	Metrology

	7	Work Shop Practice-V	----	No Equivalence, Two additional chances to be given
T. E. (Prod.Engg.) Sem. II	1	Metallurgy – II	----	No Equivalence, Two additional chances to be given
	2	Industrial Management	T. E. (Prod. Engg.)Sem. II	Industrial Management
	3	Industrial Hydraulics & Pneumatics	T. E. (Prod. Engg.) Sem. II	Industrial Hydraulics & Pneumatics
	4	Design of Jigs, Fixtures & Dies	T. E. (Prod. Engg.) Sem. II	Design of Jigs, Fixtures & Dies
	5	Quality Management	T. E. (Prod. Engg.) Sem. II	Quality Management
	6	Machine Tools & Product Design	T. E. (Prod. Engg.) Sem. II	Machine Tool Design
	7	Work Shop Practice-VI	----	No Equivalence, Two additional chances to be given
	8	Seminar	T. E. (Prod. Engg.) Sem. II	Research Seminar

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EQUIVALENCE OF OLD & NEW SYLLABI OF B. E.(Prod. Engg.)

Old Examination	Sr. No.	Subject under Old Syllabus	New Examination	Equivalent Subject under New Syllabus
B. E. (Prod. Engg.) Sem. I	1	Operations Research	B. E. (Prod. Engg.) Sem. I	Operations Research
	2	Mechatronic Systems	B. E. (Prod. Engg.) Sem. I	Mechatronic Systems
	3	Process Engineering	B. E. (Prod. Engg.) Sem. I	Process Engineering
	4	Production & Operations Management	B. E. (Prod. Engg.) Sem. I	Production and Operations Management
	5	Computer Aided Design & Analysis	B. E. (Prod. Engg.) Sem. II	Finite Element Analysis
	6	Advanced CNC Laboratory	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	7	Vacational In-plant Training Report	B. E. (Prod. Engg.) Sem. II	Industrial Training
B. E. (Prod. Engg.) Sem. II	1	Costing and Cost Control	B. E. (Prod. Engg.) Sem.	Costing and Cost Control

			II	
	2	Computer Integrated Manufacturing Systems	B. E. (Prod. Engg.) Sem. II	Elective II -7. Computer Integrated Manufacturing Systems
	3	Advanced Industrial Engineering	B. E. (Prod. Engg.) Sem. II	Industrial Engineering
	4	E I- Marketing Management	B. E. (Prod. Engg.) Sem. II	E III- 1. Marketing Management
	5	E I- Entrepreneurship Development	B. E. (Prod. Engg.) Sem. II	E III-6. Entrepreneurship Development
	6	E I- Materials Management	B. E. (Prod. Engg.) Sem. II	E III- 3. Materials Management
	7	E I- Data Base Management	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	8	E I- Financial Management	B. E. (Prod. Engg.) Sem. II	E III- 5. Financial Management
	9	E I- Environment & Pollution Control	---	No Equivalence, Two additional chances to be given
	10	E I- Organizational Behaviour	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	11	E II- Flexible Manufacturing Systems	B. E. (Prod. Engg.) Sem. II	EII- 7-Computer Integrated Manufacturing Systems
	12	E II-Artificial Intelligence	B. E. (Prod. Engg.) Sem. II	E II- 5. Artificial Intelligence
	13	E II-Industrial Robotics	B. E. (Prod. Engg.) Sem. II	E II-6. Industrial Robotics
	14	E II-Low Cost Automation	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	15	E II-Material Handling Systems	B. E. (Prod. Engg.) Sem. II	E II-4. Material Handling Systems
	16	E II-Advanced Foundry Technology	B. E. (Prod. Engg.) Sem. II	No Equivalence, Two additional chances to be given
	17	E II-Advanced Tool & Die Design	B. E. (Prod. Engg.) Sem. II	E II- 3. Advanced Tool & Die Design

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Shivaji University, Kolhapur.
T.E (Production Engineering) – Part I, Semester V

1. METALLURGY

Teaching Scheme:	**Examination Scheme:**
Lecture 3 hrs/week	Theory Paper (3 Hrs.): 100 Marks
Practical 2 hrs/week	Term work 25 Marks

Course Objective:
To study the structures, compositions, properties, applications of various Ferrous and Non Ferrous materials and to Study various heat treatment processes for different engineering materials and various surface treatments processes.

Course Outcome:
The students shall have the knowledge of structures, compositions, properties, applications of various Ferrous and Non Ferrous materials and various heat treatment processes for different engineering materials and various surface treatments processes.

Unit-1 Introduction to Metals and alloy system (8)

- Introduction of Materials: Classification metals, alloys, ceramics, polymers and composites types, properties and applications
- Crystallography - Unit Cell, study of crystal structures of S.C., B.C.C., F.C.C. and H.C.P, Average number of atoms per unit cell, A.P.F. only.
- Nucleation and growth, coring and dendrite structure
- Concept of phases, constituents (components) and degree of freedom
- Phase rule and lever rules
- Construction of phase diagram using cooling curves
- Equilibrium diagrams for Isomorphous systems, Eutectic system, Eutectoid, Peritectic and explanations of cooling of an alloy from liquid state to room temperature.
- Solid solutions and its types, Intermediate phases: electron compound, interstitial compounds

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Unit 2 Study of ferrous equilibrium diagrams, with respect to compositions, properties and applications for following alloys (7)

Fe-Fe3C Equilibrium diagram-plain carbon steels,

- Effect of carbon on structure and properties,
- Free cutting steels, Alloy steels ,Tool steels, Stainless steels, Heat resisting steels, HSLA steels, Low temperature alloys, Invar, Hadfield steel, Spring steel

Cast Irons - Fe-C Equilibrium Diagram,

- Factors Affecting Structure of C.I.(graphitization), C.E of cast iron,
- Alloy C.I., Ni-Hard, modified Ni- Hard and Ni-Resists,
- Wrought Iron

Unit 3 Study of non-ferrous equilibrium diagrams, compositions, properties, applications and specifications of important alloys (3)

- Copper-based alloys – (Cu-Ni, Cu-Zn, Cu-Sn, Cu-Be)
- Aluminum-based alloys - Al-Cu: Duralumin, Al-Si: modification treatment
- Titanium-based alloys - Ti-Al, Ti-Mn
- Non-ferrous equilibrium diagrams - Pb-Sn : solders, Sn-Sb : Babbit

Unit 4 Introduction and Principles of Heat Treatment Processes of Steels , Heat treatment furnaces, atmospheres, defects and energy economy (8)

- Introduction to heat treatment: Definition of Heat treatment, process, purpose and process variables.
- Transformation of Pearlite into austenite upon heating.
- Transformation of austenite into Pearlite, Bainite and Martensite on cooling.
- TTT and CCT Diagram and significance, Effect of alloying dements on TTT diagram and its significance.
- Heat treatment furnaces, control systems, equipments, furnace atmospheres.
- Heat treatment defects: - causes and remedies.
- Energy economy in heat treatment through change in material, heat treatment practice and processes.

Unit 5 Heat treatment process of steels , cast iron and Non ferrous alloys. (11)

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Heat treatment process of steels –

- Annealing and Normalizing - Classification and application of processes comparison between annealing and normalizing
- Hardening -Hardening process, factors affecting hardening process, hardenability, factors affecting hardenability, determination of hardenability, hardening methods
- Tempering - Purposes of tempering, types of tempering, structural changes during tempering, secondary hardening, temper brittleness.
- Heat treatment process of Cast Irons –Stress relief annealing, normalizing, hardening, surface, hardening and malleablising, annealing.

Surface and case hardening processes:

- Case Hardening
- Carburizing: Pack , liquid and gas carburizing
- Nitriding : Liquid and gas nitriding, plasma nitriding
- Surface Hardening: Flame hardening, induction hardening, electron beam hardening and laser hardening, advantages and limitations
- Case depth measurement - hardness method, chemical method, microstructure method.
- Introduction to heat treatment process carried out on Cu, Al, Mg and Ti metals

and alloys.

- Precipitation Hardening: Basic requirements of alloys that can be precipitation Hardened Precipitation hardenable ferrous and non ferrous alloys and their application.
- Steps in the process of precipitation hardening-Solutionizing, quenching ,aging
- Effects of variables like aging time, temperature, cold working, impurity alloy composition etc. on properties of precipitation hardenable alloys
- Mechanism of Precipitation Hardening- Coherent lattice theory and G.P Zone theory.

Unit 6 Powder Metallurgy. (3)

- Importance of powder metallurgy as a manufacturing technique, advantages and limitations of powder metallurgy
- Methods of powder manufacture, characteristic and testing of metal powders, powder conditioning - heat treatment, blending and mixing.
- Powder compaction - Methods of compaction, compaction pressures, types of compaction, property changes during compaction.
- Sintering - Types of sintering, structure and property changes during sintering, sintering atmospheres and their importance.
- Finishing operations - Sizing, heat treatment, surface treatment, electroplating and impregnation treatments.
- Applications - Self lubricating (porous) bearings, electric contact materials, filters, magnets, sintered friction materials, cutting tools and cermets, flow charts for manufacturing of above components.

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Term Work:

The term work shall consist of performance of the following experiments:

1. Study of Metallurgical microscope, construction , its working and need for microscopy
2. Metallography – preparation of specimen and study of mounting
3. Study of microstructure of Low, medium and high carbon steel
4. Study of microstructure of cast iron(Gray, White, Malleable and S.G cast iron)
5. Study of microstructure of Non-ferrous alloys(70-30,60-40 brass, bronze and babbits)
6. Study of heat treatment furnaces

Text Books and Reference Books:

1. Vijendra Singh. Engg. Physical Metallurgy, Standard Publishers, Delhi
2. V.D. Kodgire, Material science and metallurgy, Everest Publishers Pune
3. S.H.Avner, Physical Metallurgy, TMH publication.
4. Rollson , Metallurgy for Engg. Technicians, English language Book Society
5. Clerk, Verney, Engineering Metallurgy' -.
6. Higgins R. A., Hodder, Engineering Metallurgy I and II, English language Book Society.
7. T.V. Rajan & C.P. Sharma, Heat Treatments Principles & Practices, PHI.

8. Prabhudev, Heat treatment of Steels, HMT Handbook
9. A.K. Sinha, Powder Metallurgy
10. G.E. Dieter, Mechanical Metallurgy, Tata McGraw-Hill, New Delhi.
11. Engineering Physical Metallurgy - Lakhtin, C.B.S. Publishers & Distributors
12. Heat treatment of Metals – B. Zaharov, C.B.S. Publishers & Distributors India
13. Material science and Metallurgy, C. Daniel Yesudin, D. G. Harris Samuel Scitech
14. Material Science And Engineering , Callister Wiley India Edition
15. Study of heat treatment processes of steels (annealing, normalizing and hardening) and effect of process on metallurgical structure and properties
16. Study of Jominy end - quench test for hardenability
17. Study of heat treatment defects, cause and remedies.
18. Industrial visits (at least one) for observing various heat treatment processes, furnaces, control systems and equt carrying out heat treatment of ferrous & nonferrous metals and alloys.

Shivaji University, Kolhapur.
T.E. (Production Engineering) – Part I, Semester V

2. THEORY OF MACHINES – II

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Teaching Scheme:
Lectures: 3 Hrs/Week
Practical: 2 Hrs/Week/Batch

Examination Scheme:
Theory Paper (3 Hrs):100 Marks
Term work: 25 Marks

Course Objectives :

1) To understand the basics of gear design and motion analysis and selection of gears and gear trains.
2) To demonstrate different types of gear trains and its applications**.**
3) To acquaint with working principles and applications of gyroscope and governors
4) To understand the procedure and effect of static and dynamic balancing of rotary and reciprocating masses.
5) To give awareness to students on the phenomenon of vibrations and its effects.

Course Outcomes:

The student shall be able to -

1) Develop designing skills and enhance thinking and analytical power of students to understand working of machines from design point of view.
2) Understand the need of gear, gear train, governors, gyroscope etc. from project point of view.
3) Understand the concept of basics of vibrations from application point of view.
4) Gain knowledge for solving problems in static and dynamic force analysis using graphical and analytical method.

Unit - 1

Gear: Introduction, law of gearing, involute and cycloidal profiles, gear terminology, length of path of contact, arc of contact, contact ratio, interference of involute gear teeth, helical and double helical gears. (5)

Unit - 2
Gear Trains : Types of gear trains, analysis of gear trains. (4)

Unit -3
Balancing: Static and dynamic balancing, balancing of rotary masses, masses in the same plane, masses in different planes, balancing of reciprocating masses, primary and secondary balancing, balancing of locomotives, balancing of multi-cylinder inline engines, balancing of V-engines. (6)

Unit – 4
Gyroscope: Introduction, Gyroscopic couple, Effect of gyroscopic couple on motion of aero plane, naval ship, two and four wheelers, Gyroscopic stabilization (5)

Unit – 5
5.1 Governors: Functions of governor, types of governors, characteristics of governor, effort and power of governor. (5)
5.2 Flywheel: Crank effort, turning moment on crankshaft, turning moment diagram, fluctuations of energy and speed. (4)

Unit – 6
Vibrations:
6.1 Longitudinal and transverse vibrations: Introduction, types, natural frequency for various loading systems, Dunkerly's empirical formula, critical speed of shaft. (4)
6.2 Torsional vibrations: Introduction, natural frequency for single, two and three rotor system, bifilar, trifler suspension system, torsionally equivalent shafts, free torsional vibrations of a geared system.(5)

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Term Work:
Minimum 8 experiments out of first 10 experiments from the following list.

1) Generation of involute gear tooth profile.
2) Study of differential gear box.
3) Experiment on verification of static and dynamic balancing principle.
4) Experimental verification of gyroscopic principle.
5) Determination of the governor characteristics of Porter and/or Hartnell governor.
6) Experiment on free longitudinal vibrations
7) Experiment on trifler suspension system.
8) Experiment on critical speed of the shaft.
9) Experiment on forced vibration
10) Measurement of vibrations by using vibration-measuring instrument.
11) At least one industrial visit to study applications related to the subject and submission of the relevant report. **(Compulsory)**

Text Books :

1) Theory of Machines and Mechanisms, by P. L. Ballaney, (Khanna Publishers, Delhi)
2) Theory of Machines, by S. S. Ratan, (TMH)
3) Theory of Mechanism and Machines by Ghosh and Mallik (EWP)
4) 04. Theory of machines, by Dr. R.K.Bansal, Laxmi Publication
5) Theory of Machines by R.S. Khurmi S.Chand and co.
6) Theory of Machines, by Thomas Bevan, (CBS Publishers, Delhi)

Reference Books:

1) Theory of Machines and Mechanisms, by John Uiker, Garden Pennock & Late. J. F. Shigley, (Mc Graw Hill Publications)

2) Theory of Machines, by W. Green,
3) Mechanical vibrations G.K. Grover
4) Mechanical Vibration Analysis- P.Srineevasan- Tata McGraw Hill
5) Theory and Practice of mechanical vibrations J.S.Rao K.Gupta – New Age International Publications.
6) "Machines and Mechanisms Applied Kinematic Analysis", David H. Myszka, Pearson Education, Asia.
7) "Design of Machinery", R. L. Norton, McGraw-Hill.
8) Theory of vibrations with applications- W.T.Thompson-Prentice Hall of India
9) Mechanical Vibrations- Schaum's outline series- McGraw Hill

Shivaji University, Kolhapur.
T. E. (Production Engineering) – Part I, Semester V

3. DESIGN OF MACHINE ELEMENTS

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs):100 Marks
Term work: 25 Marks

Course Objective:
To study the different types load considerations and design aspects of various machine members.

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Course Outcome:
The students shall have the knowledge of the different types load considerations and design aspects of various machine members.

Unit-1
Introduction: Concept of machine design, general design considerations, design procedure; factor of safety for different types of loading its significance and selection ;theories of failures, Selection of engineering materials for a component considering functionality, raw material generating process, strength, cost, quantity and aesthetics, use of IS codes. (5)

Unit-2
a). Design for static loading: Knuckle joint, turnbuckle, cotter joint, levers. (3)

b). Design for fluctuating loads: Fatigue phenomena, concept of stress vs. number of cycles diagram and endurance limit, stress concentration and remedies, use of Goodman and Soderberg diagram in design of machine elements like shafts, springs and couplings. (5)

Unit-3.
Design of shafts, keys, splines and couplings: Design of solid and hollow shafts for strength and rigidity against pure torsion, pure bending, combined bending, torsion and axial loads; design of keys and splines; design of rigid and flexible couplings. (6)

Unit-4
a) Design of pressure vessels: Classification and design of thick a thin pressure vessels and cylinders. (2)

b) Design of joints: Design of bolted, riveted, and welded joints subjected under transverse and eccentric loading, materials for bolts, initial tightening loads on bolts, effect of washer and gasket, uniform strength bolts. (3)

Unit-5

a). Design of springs: Types, applications, spring materials, stress deflection equation of helical spring, Whal's stress factor, style of ends, design of springs for valves, clutches, buffers etc., design considerations for leaf spring. (4)

b). Design of power screw: Types, materials used, thread forms and their applications. types of stresses induced, overhauling and self-locking properties, re-circulating ball screw, design of nuts, methods of pitch error compensation for machine tools. (4)

Unit-6

a). Design of gears: a) Spur gears- materials, gear tooth loads, number of teeth, face width, strength of gear teeth, static beam strength (Lewis equation), dynamic tooth load, Wear strength (Buckingham's equation), estimation of module based on beam strength and wear strength, gear design for maximum power. (4)

b) Helical gears- No. of teeth, force analysis, beam and wear strength, effective load and design procedure (2)

c) Construction details of gears i.e. hub, web, arms, rim, gear Lubrication, gear tooth failures and remedies. (1)

Term Work:

Any Six of the following exercises.

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(Note: Standard components shall be selected from relevant I.S. codes and Design Data Hand Books for the exercises given below.)

1) Study of Engineering Materials, their applications and selection as per different standards used in practice.
2) Design, stress analysis and working drawing of components and assembly of Cotter Joint, Knuckle Joint and Turnbuckle.
3) Design of Coupling and Detailed Working drawings with assembly.
4) Design of bolted, riveted and welded joints for transverse and eccentric loading.
5) Design of Gear Drive involving Gears, Shafts, and Keys with working drawings.
6) One assignment using CAD package on any one of the exercises 2, 3, or 5 above.
7) Two computer programs (or use of spreadsheet) on any of the above exercise.

Reference Books:

1) Design of Machine Elements, V. B. Bhandari, (Tata McGraw-Hill Publishing Company Ltd.)
2) Elements of Machine Design, N. C. Pandya and C. S. Shaha, (Charotar Publishing House)
3) Mechanical Engineering design, J. E. Shigley, Mitchell, (McGraw-Hill Publishing Co. Ltd)
4) Machine Tool Design, N. K. Mehta, (Tata McGraw-Hill Publishing Company Ltd.)
5) Design of Machine Elements, Dbrovalsky(MIR Publisher)
6) A Text Book of Machine Design, R. S. Khurmi, (S. Chand)
7) Design of Machine Elements by M. F. Spoots, T.E.Shoup (PHI)
8) Machine Design, R. K. Jain, (Khanna Publishers.)
9) Engg. Design, a Materials & Processing Approach, G. Dieter, (Tata McGraw-HillPublishing Company Ltd.)
10) Computer Aided Analysis and Design of Machine Elements by Dukki Patti, Rao,Bhat , (New Age, Delhi)

11) CMTI Machine Tool Design Handbook (TMH)
12) Design of Machine Elements, An Integrated Approach by Robert and Norton,(Pearson)
13) Machine Design by Black and Adams (McGraw-Hill Publishing Company Ltd)

Shivaji University, Kolhapur.
T. E. (Production Engineering) – Part I, Semester V

4. METROLOGY

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
Practical examination: 25 Marks

Course Learning Objectives: A Student should be -
1) Able explain the principles of measurement and its techniques.
2) Able demonstrate the design, construction and accuracy features of various instruments.
3) Able to acquire hands-on skills of measurement by using different instruments and gauges.

Course Outcomes: A Student should have-
1) Ability to describe measurement aspects.
2) Ability to design a measuring instrument.
3) Ability to maintain and service measuring instruments.
4) Develop the hands on skill in solving problems encountered during inspection.
5) Ability to use all types of measuring instruments.

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Unit-1
Fundamental Principles of Metrology and Basic Measuring Instruments
Definition and scope of metrology, definition of measurement, primary, secondary, tertiary and working standards, line and end standards, advantages of optical standard precautions to minimize errors, measurement system and its characteristics, Vernier calipers, micrometers, height and depth gauges, - types, design considerations, specifications, applications, sources of errors and handling precautions, selection and general care of measuring instruments. Slip gauge box - Grades, materials, wringing, setting to sizes, precautions while use and storage Accessories - Bench centers, surface plates, V-blocks, angle plates. (8)

Unit-2
Comparators and Advance Measuring Instruments
Need for comparators, comparison of principles, mechanical, pneumatic, optical and electrical and electronic instruments, dial indicator, bore gauges and master rings, optical profile projector, tool makers microscope, electrical and electronic comparators, differential pneumatic comparator, and applications of pneumatic gauging. (5)

Unit-3
Gauges and Gauge Design
Concept of limit gauging, Taylor's principle, various types of plug, ring and snap gauges for plain and taper dimensions, gauge design for a given dimension for workshop, inspection and general grade gauges, fixtures and gauges for measurement ofpitch circle diameter, center distance between holes, positioning of holes and surfaces. (IS:919, Part 1, 1993-ISO system for limits, fits and tolerances, is to be used for gauge design) (4)

Unit-4

Measurement of Angles and Geometric Features

Bevel protractor, clinometer, sine bar, angle dekor, angle slip gauges, measurement of taper, angle and radius with the help of simple inspection set-ups using standard pins and balls Measurement of straightness, flatness, parallelism, squareness, circularity, roundness, concentricity, symmetry, distance between axes and other geometrical features Straightedge, level beam comparator, autocollimator. (5)

Unit-5

Gear, Thread and Surface Finish Measurement

a) Measurement of Screw Threads

Basic terminology, measurement of major, minor and effective diameter, Screw thread micrometer, floating carriage diameter measuring machine, two wire and three wire method, measurement of pitch and pitch error, thread pitch gauges, limit gauges for thread measurements

b) Measurement of gears

Basic terminology, measurement of pitch, lead, run out, back lash and tooth thickness, constant chord and base tangent method, Gear tooth Vernier caliper, David Brown tangent comparator, errors in gear geometry, measurement of composite error, Parkinson gear tester

c) Measurement of surface properties

Waviness and roughness, causes of variation in surface quality, different parameters for assessment of surface roughness, methods of calculation, instruments for surface roughness measurement. (10)

Unit-6

Advances in Industrial Metrology

Types, applications, Principle of digital measurement instruments and examples, Instrument-computer interface, Co-ordinate Measuring Machines (CMM), construction, working principle and applications, Objectives, Non Contact inspection methods, equipment; contact type inspection, Inspection robots. (4)

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Term Work:

The term work shall consist of the following.

A) All the experiments listed below-

1. Measurement of linear dimensions using vernier, micrometer and bore gauge
2. Measurement of angle by using bevel protractor and sine bar
3. Dimensional measurement by using pneumatic comparator
4. Measurement of effective diameter of a screw thread by using floating carriage diameter measuring machine
5. Measurement of gear tooth thickness by using Chordal thickness and Base tangent method.
6. Measurement of roundness and concentricity by using dial indicator b) Measurement of radius by using inspection setup like rollers and pins
7. Measurement of roughness of machined surface
8. Assessment of profile of a component by using profile projector.

B) One assignment on Gauge design problem

C) One industrial visit to study inspection practices and submission of the report

Practical Examination: Each student shall perform individually, one assigned experiment from the above list and submit the result, followed by an oral examination.

Reference Books:

1. Engineering Metrology, -K. J. Hume, McDonald London

2. Engineering Metrology, -D. M. Anthony, Oxford University Press (I)
3. The Quality Technician's Handbook,- Garry Griffith, Prentice Hall
4. Engineering Metrology,- I. C. Gupta, DhanpatRai Publications
5. Principles of Machine Tool Design, -Sen, Gupta, New Central Book Agency
6. Basic Machine Technology, -C. Thomas Olivo, Bobbs-Merrill Educational Publishing
7. Machine Tool Practices,-Kibbe, Neely, Meyer, White, Prentice Hall
9. Engineering Metrology, -R. K. Jain, Khanna Publishers, Delhi
8. Testing of Machine Tools, -Dr. George Schlesinger, Pergamon Press
9. Basic Rules on using Measuring Tools, -Mitutoyo Metrology Institute
10. A Manual of Measurement System Analysis, Ford, General Motors, Chrysler Corporation
11. Metrology Laboratory Manual, -R. Bahl, M. Adithan, Technical Teacher's Training Institute, Chandigarh
12. A Text Book of Metrology, -M. Mahajan, DhanpatRai and Co.

Shivaji University, Kolhapur.
T. E. (Production Engineering) – Part I, Semester V

5. METAL FORMING & PLASTIC ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs. / Week Theory
Practical: 1 Hrs. / Week/ Batch

Examination Scheme:
Paper (3 Hrs): 100 Marks
Term work: 25 Marks

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Course Objectives:
1: Gain the fundamental knowledge about metal forming and plastic tech processes
2: Understand the analysis of flow of material and it's properties during the processes
3: Selection the process of metal forming as per the applications such as wire drawing, extrusion, rolling forging etc.
4:To introduce the students to the theory and practices of metal forming and plastics processing.

Course Outcome :
The students shall have the knowledge of fundamentals of metal forming and plastics technology

Unit-1
Theory of Plasticity
Flow curve, Concepts of true stress and true strain, plane stress condition ,stress tensor, yield criteria and their comparison., plastic stress-strain relationships. (6)

Unit-2
Introduction to Workability and rolling
Introduction to Workability
Overview at the workability, Strain tensor, strain hardening. Strain rate, Friction and Lubrication in metal forming (3)
Introduction to Rolling:
Classification of rolling processes, rolling mill types, deformation of metal in rolling, roll bite, elongation, reduction, defects in rolling, rolling of sheets, plates, bars, sections and tubes, applications (3)

Unit-3

Introduction to Extrusion and Drawing

Introduction to Extrusion

Equipment and principles, types of extrusion, direct, indirect, impact, hydrostatic, tube extrusion, metal flow in extrusion, defects, factors affecting extrusion load, (3)

Introduction to Drawing:

Types of Drawing, Rod/wire drawing, equipment and principles of process, defects, Tube drawing, Seamless pipe manufacturing. (3)

Unit-4

Introduction to Forging and Advanced Metal forming Processes

Introduction to Forging :

Basic operations, types of forging, forging hammers/ presses, forging stress and force calculations, die design considerations, forging defects, applications. (4)

Advanced Metal forming Processes:

Explosive forming, Electro-hydraulic forming, Electromagnetic forming, Magnetic pulse forming, hydro forming . (2)

Unit-5

Introduction to Plastic Materials and processes

Types, , thermosetting plastics, thermoplastics, laminated and reinforced plastics, applications.

a) Injection Molding: Process, equipment, applications.

b) Plastic extrusion: Process, equipment, extruders.

c) Calendaring- various calendaring processes, applications . (6)

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Unit-6

Introduction to plastic molding and Thermoforming

a) Blow molding: Principles, material characteristics in blow molding, production of parison,

b) Rotational molding process for making hollow plastic articles.

c) Compression molding: Process, equipment, transfer molding.

d) Thermoforming- Process, heating equipment. (6)

Term Work:

The term work shall consist of the following.

1. Die design for a simple forged component including calculations and drawing
2. Designing layout for multi-pass wire drawing
3. Making simple components of suitable material using the following processes / equipment (Any two different components for a group of maximum four students each).
   a) Hot Forging
   b) Wire Drawing
   c) Extrusion
   d) Rolling
   e) Injection Molding
   f) Plastic Extrusion
4. Industrial visits (minimum two) for studying the metal forming and plastic processing and submission of reports

Reference Books:

1. Mechanical Metallurgy (S.I. Units) - Dieter, McGraw Hill
2. Manufacturing Processes – Begman, Amstead etc.(John Wiley)
3. Rowe, Principles of Industrial Metal working Processes,

4. ASM Handbook on Forming.
5. Forging and Forging Die Design - Sharan, Prasad, Saxena.
6. Rolling of Metals: Ivankove and Chaturvedi (Yantrik Publications, Mumbai)
7. Extrusion - Pearson (McGraw Hill)
8. Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao (TMH)
9. Plastic Technology: Theory, Design & Manufacture – William J. Patton
10. Plastics-6/e, J. Harry DuBOIS, Frederick W. John, Van Nostrand Reinhold Co.
11. Manufacturing Engineering Technology by Kalpakjian (Addison Wesley)
12. Manufacturing Processes for Engineering Materials by Kalpakjian (Addison Wesley)
13. Injection Mold Design, R.G.W. Pye 4/e, Affiliated East West Press Pvt. Ltd. New Delhi.
17. Plasic Manufacture: Properties & Applications – N. J. Miss, ELBS
18. Plastics for Industrial Use- Sasse John

Shivaji University, Kolhapur.
T.E. (Production Engineering) – Part I, Semester V

6. METAL CUTTING THEORY

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 1 Hr. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

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Course Objective:
To study the metal cutting technology including the process, measurements, design and selection of various cutting tools and their industrial specifications.

Course Outcome:
The students shall have the knowledge of fundamentals of metal cutting technology including the process, measurements, design and selection of various cutting tools and their industrial specifications.

Unit-1
Theory of Metal Cutting: Speed, Feed, Depth of Cut, Orthogonal Cutting and Oblique Cutting, Geometry of single point cutting tool, Mechanism of chip formation, Chip Breaker, Strain in Chip, Shear plane angle, Cutting ratio, Force relationship, Velocity relationship, Merchant circle, Ernst Merchant theory, dynamometer. (9)

Unit-2
Machinability: Concept of Machinability,

i) Cutting force: Effect of speed, feed, depth of cut, tool materials, angles and work material on cutting forces, specific cutting force, specific power consumption.
ii) Tool life: Flank and Crater wear, Mechanism of wear, effect of cutting parameter on tool life, Taylor's tool life equation.
iii) Surface Roughness: : Effect of speed, feed, depth of cut, tool materials, angles and work material on surface roughness, built up edge, chatter and its elimination. (9)

Unit-3
Sources of Heat Generation and Economics of Machining: Sources of heat generation, Types of cutting fluids, Selection of cutting fluids. Economics of machining; criteria for minimum cost and maximum production. (4)

Unit-4

Cutting Tool Materials: Single point tools - Definition of angles as per ASA system and ORS system, tool signature, Study of modern tool materials such as uncoated / coated carbides, Ceramics, cermets, cubic boron nitride, diamond etc., Desirable properties of tool material, Selection of tool grades and styles including specifications from commercial catalogues for different processes like turning, milling, drilling, grinding for different operations. (5)

Unit-5

Design of Form Tool: Design of flat form tool and circular form tool. Geometry, nomenclature, types, selection and applications of drills, reamers, milling cutters and broach. (5)

Unit-6

Design of single Point Cutting Tool: Design procedure of single point turning tool, High speed machining, Minimum Quantity Lubrication. (3)

Term Work:

1) Measurement of Cutting force with the help of Tool Dynamometer (Any Two)
    a. Lathe tool dynamometer
    b. Drill tool dynamometer
    c. Milling tool dynamometer
2) Machining of minimum two jobs of different materials such as C.I., Steel, Aluminium etc. and measurement of surface roughness to study the effect of parameters such as feed, tool nose radius, depth of cut on the surface roughness.
3) Design of form tool and broach for given components
4) Industrial visit to study applications of tools for different metal cutting processes.

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Reference Books:

1) Cutting tools - P.H. Joshi - Tata McGraw Hill Publishing Co. Ltd..
2) Production Technology - HMT Handbook (TMH)
3) Metal Cutting Theory and Cutting Tool Design - Arshinov V. and Alekseev G., Mir Publication.
4) Metal cutting Theory and Practice- A. Bhattacharya, New Central Book Agency.
5) Metals Handbook, Vol. 16 Machining, A.S.M., Metals Park, Ohio.
6) Metal Cutting and Tool Design - Dr. Ranganath - Vikas Publishing House.
7) Metal Cutting Principals - Shaw M.C. - Oxford Calrendon Press, 1984.
8) Theory of Metal Forming and Metal cutting by Sinha, Prasad (DhanpatRai).
9) Machine Tool Engineering: K. R. Nagpal, Khanna Publication.
10) Tool Engineering handbook - ASTME, Frank Wilson (Editor) (TMH)
11) Text Book of Production Engineering (Tool Design) by K. Surendar and Umesh Chandra.
12) Commercial catalogues of tool manufacturers like SANDVIK, KENNAMETAL,TAEGUTECH, ISCAR, MITSUBISHI, Grindwell Norton, Carborundum Universal etc.
13) Fundamentals of Metal Cutting and Machine Tools B. L. Juneja, Nitin Seth.

Shivaji University, Kolhapur.
T. E. (Production Engineering) – Part I, Semester V

7. WORKSHOP PRACTICE – V

Teaching Scheme:
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Term work: 25Marks

Course Objectives:

1) Student should able to select the machine and do the planning of job operations.
2) Student should able to perform machining operations on various metal removing machines.

Contents & Term Work:

One composite job assembly consisting of at least 4 parts requiring the machining processes like turning, drilling, threading, tapping, milling, grinding etc. is to be completed under Workshop Practice – V (Two parts) and CAM lab and CNC Workshop Practice (Two parts) of T.E.(Prod) Sem-VI by each student.

Notes :

1. The composite job assembly is to be carried on to Semester VI under CAM lab and CNC Practice.
2. The term work of 25 marks based on Workshop Practice – V
3. The student shall maintain a diary of the work consisting of the process plan and work done in semester V – for Workshop Practice – V and in semester VI- for CAM lab and CNC Workshop Practice.

Shivaji University, Kolhapur.
T.E. (Production Engineering) – Part II, Semester VI

1. INDUSTRIAL MANAGEMENT

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Teaching Scheme:
Lectures: 3 Hrs./Week
Practicals: 1 Hr./Week

Examination Scheme:
Theory Paper (3 Hrs.): 100 Marks
Term Work: 25 Marks

Course Objective

To study the various functions of management essential for efficient & effective working of an industrial organization.

Course Outcome:

The students shall be able to demonstrate the knowledge of the functions of industrial management and an ability to identify, formulate and solve industrial management problems.

Unit-1

INTRODUCTION:

Management – meaning, definition, scope, importance, functions of management, development of management thought, contribution by Fayol, Taylor, Drucker, different approaches to management – scientific, operational, human and system approach, role and social responsibilities of a manager. (3)

PLANNING: Meaning, definition, scope, importance, objectives of planning, steps in planning, decision making, strategic planning, management by objectives (MBO) (3)

Unit-2

ORGANIZING: Meaning, definition, principles of organization, delegation of authorities and decentralization, span of management, types of organization – line, staff, project, functional and informal organizations (3)

STAFFING: Definition, functions of staffing, selection process, training and development, performance appraisal. (Numerical Problems on Man Power Planning) (4)

Unit-3

DIRECTING: Definition, principles of direction, importance motivation, theories of motivation – theory X and theory Y, Maslow's hierarchical needs, Herzberg theory, leadership – meaning, styles of leadership, types of leaders, trait theories, behavioral theories – managerial grid, Rensis Likert's leadership systems communication – importance, types of communication, barriers to effective communication, methods to overcome barriers (5)

CONTROLLING: Definition, steps in control process, requirements of effective control process, various control techniques (2)

Unit-4

FORMS OF ORGANIZATION: Proprietor, partnership firms, private limited, public limited, co-operative organizations, joint stock and public sector undertakings – structure of management, advantages and limitations, authorities and liabilities of owners (3)

HUMAN RESOURCE MANAGEMENT: evolution, objectives, functions, organization, introduction to industrial relations, trade unions and their functioning, significance of labor laws, human behavior at work, supervisor's role. (3)

Unit-5

FINANCE MANAGEMENT: Objectives, functions, kinds of capital, sources of capital, financial planning and control, profit planning, basic terms in financial accounting, reading and interpretation of balance sheet and profit and loss account. (Numerical Problems on Financial Planning & Accounting) (6)

PRODUCTION AND MATERIALS MANAGEMENT: Primary and secondary objectives, functions, organization, types and procedure of purchasing (3)

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Unit-6

MARKETING MANAGEMENT: Objectives, functions, difference between marketing and selling, introduction to marketing mix, product planning, pricing policies, channels of distribution, advertising, market research. (Numerical Problems on Market segmentation, Pricing Strategies) (3)

INDUSTRIAL PSYCHOLOGY: Basic concepts of psychology, industrial psychology, scope, causation of behavior, individual differences, differences in psychological characteristics – intelligence, interest, physique, learning ability, perception, concept of psychological test (2)

Term Work:

Total Nine assignments based on the six units given above. The assignments shall include at least six numerical problems on Unit 2,5 & 6. (Two problems on each of these three units).

Reference Books:

1. Management by James A. F. Stoner, R. Edward Freeman, PHI
2. Management Today: Principles and Practice by Gene Burton and Manab Thakur, TMH
3. Essentials of Management by Koontz and O'Donell, TMH
4. Organizational Behavior by Keith Davis, TMH
5. Management (Tasks, responsibilities and Practices) by Peter Drucker, Harper Business
6. Production Management by Lockyer, ELBS
7. Modern Production Management by E. S. Buffa (John Wiley)
8. Financial Management by Vanhorne, PHI
9. Financial Management (Theory and Practice) by Prasanna Chandra, TMH
10. Marketing Management by Philip Kotler, Pearson Edition
11. Marketing Management by Rajan Saxena, TMH

12. Personnel Management by Edward Flippo, TMH
13. Managing Human Resources by Gorrez, Balkin, Candy, PHI

Shivaji University, Kolhapur.
T. E. (Production Engineering) – Part II, Semester VI

2. INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks
External Practical examination: 25 Marks

Course Objective:
To study of fundamental concepts, components, circuits and applications in industrial hydraulics and pneumatics.

Course Outcome:
The student shall demonstrate the knowledge of fundamental concepts, components, circuits and applications in industrial hydraulics and pneumatics.

Unit-1
Fundamental concepts of fluid & Introduction to fluid power : Classification of fluids, derivation of Pascal's law, continuity equation and Bernoulli's equation ,Introduction to fluid power: Types, advantages and applications, ISO symbols for hydraulic and pneumatic systems; hydraulic fluids-functions, desirable properties, grades and selection of fluid, conditioning of fluids, study of reservoirs, strainers, filters, heat exchangers. (7)

Unit-2
Hydraulic system elements: pumps – types, working, characteristics and applications, power and efficiency calculations (numerical treatment expected), types of conductors and connectors, their selection, seals and packing – types, materials, applications, hydraulic actuators – linear and rotary - types, working, cushioning effect, mounting, calculation of force and velocity of piston (numerical treatment expected), system components: accumulators, intensifiers, their types, working, applications, Control Elements: a)construction and working of pressure control valves – direct acting type, pilot operated, sequence, counterbalancing, unloading, pressure reducing, b)Direction control valves – types, construction and working, spool actuation methods, spool center positions, c)Flow control valves – compensated and non compensated types, construction and working. (8)

Unit-3
Hydraulic circuits and their applications: Speed control circuits, regenerative, sequencing, counterbalancing, interlocking, synchronizing circuits, use of accumulator and intensifier, methodology to design hydraulic circuits. , maintenance of fluid power system , Electro -Hydro sytems: concept, working and applications (descriptive treatment only) (5)

Unit-4
Pneumatics: Basic principle, applications, comparison with hydraulic system, Pneumatic system elements: Piping, materials and pressure ratings, piping layout, calculation of pressure drop in pneumatic line; air compressors, types, selection criteria; FRL unit- construction and working; pneumatic cylinders

and air motors- construction, working and types, calculation of force and air consumption, comparison of air, hydraulic and electric motors. (6)

Unit-5

Pneumatic system control elements: Direction control valves- types and working, flow control valves, working of variable flow control, quick exhaust, time delay and shuttle valve. Fluidics: Concept, study of logic gates and applications. (6)

Unit-6

Pneumatic circuits: Basic circuit, impulse operation, speed control, sequencing, time delay circuits and their applications, pneumatic clamping systems, pneumatic power tools , maintenance of pneumatic system. (4)

Term Work :

1) Verification of Bernoulli's Theorem on Bernoulli's apparatus.
2) Study of pressure, direction and flow control valves in hydraulics and pneumatics using cut section models
3) Meter-in, Meter-out and Bleed-off, Sequencing, Counterbalancing, Synchronizing, Interlocking, pressure reducing circuits on hydraulic trainer.
4) Manual / automatic forward – reverse, sequencing, Basic logic circuits on pneumatic trainer.
5) Eletcro-Hydraulic systems- study and simple circuits.
6) Design of a hydraulic circuit for a given application and selection of components from commercial catalogs.
7) At least one industrial visit to study industrial applications of hydraulics and pneumatics with submission of the relevant report.

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Note: Practical examination will consist of performing an actual experiment by a group of maximum two students, from the above list (Sr. Nos. 3 to 4) and to show working / results by the candidates, followed by oral examination on the term work.

Reference Books:

1) Fluid Power with Applications by A. Esposito (Pearson)
2) ABCs of hydraulic Circuits by H. L. Stewart and J. M. Storer (Taraporwala)
3) ABCs of Pneumatic Circuits by H. L. Stewart and J. M. Storer (Taraporwala)
4) Industrial Hydraulics by J. J. Pipenger, Hicks (McGraw Hill)
5) Hydraulics and Pneumatic Power for Production by H. L. Stewart (Industrial Press)
6) Fluid mechanics by R.K.Bansal, Laxmi publications. New Delhi.
7) Oil Hydraulic Systems by S. R. Majumdar (TMH)
8) Industrial Hydraulics Manual by Vickers Sperry
9) Pneumatic Systems-Principles and Maintenance by S. R. Majumdar (TMH)
10) Hydraulic Text Book Basic Level (Festo Controls Pvt. Ltd. Bangalore, (Part No. 93281)
11) Pneumatic Text Book Basic Level (Festo controls Pvt. Ltd. Bangalore) (Part No. 93131)
12) Pneumatics and Hydraulics by H. L. Stewart (Taraporwala)
13) Hydraulics and Pneumatics, A Technician's and Engineer's Guide by Andrew Parr (JAICO)
14) Fluid power engineering, M Galal Rabie, (McGrawHill)

Shivaji University, Kolhapur.
T. E. (Production) – Part II, Semester-VI

1. DESIGN OF JIGS, FIXTURES AND DIES

Teaching Scheme:
Lectures: 4 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (4 Hrs): 100 Marks
Term work: 25 Marks
External Oral Examination: 25 Marks

Course Objective:
To introduce the students to the design practices of tooling's (Jigs and Fixtures) and die design for presswork.

Course Outcomes:

1) The student shall be able to design drilling and reaming jigs for simple components
2) The students shall be able to design turning and milling fixtures for simple components
3) The student shall be able to design press tools and cutting/punching dies for simple components
4) The students shall be able to design drawing dies and blanks for simple component
5) The students shall be able to design different miscellaneous dies.

Unit-1
Introduction to Jigs and Fixtures : Necessity, applications and types, basic concept of jigs and fixtures for different manufacturing processes, dependency of jig and fixture design on operation sequence. (3)

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Unit-2
Location and clamping system : Principles, types, applications, locating pins, pads, diamond pins, adjustable supports, Vee and post locators, clamping system -principle, types, screw clamp, strap, lever, hinge type, cam operated, toggle clamps, centralizer and equalizer clamp, multiple clamping, quick acting clamps, pneumatically operated clamps. (7)

Unit-3
Design of Jigs & fixtures :
A) Design of jigs: Principles of jig design, types of jigs- plate, template, box, channel, sandwich, latch, turn-over, tumble jig etc., types of bushes, selection of bushes and liners, construction of jig and fixture bodies, use of standard parts.
B) Design of fixtures: Principles of fixture design, types of fixtures- gang, straddle, vertical, slot, string milling fixture etc, selection of the suitable type, design of milling fixtures, use of setting block, tennons, T-bolts etc, design of turning fixture for lathe. Indexing System: Necessity, different indexing systems for jigs and fixtures. Concept of Modular Fixtures. (14)

Unit-4
Introduction to press tools: Dies, punches, types of presses, types of dies, simple, compound, combination and progressive dies, press tools for operations like blanking, piercing, drawing, shaving, trimming, etc. (4)

Unit-5
Design of die set for cutting operations: Theory of metal cutting, cutting force and blank holding force estimation, punch and die clearance, scrap strip layout, design of punches, design of dies, pilots, strippers, stock stops, finger stops, auto stops, center of pressure, selection of die set. (8)

Unit- 6

Design of drawing die: blank size determination, no. of draws, stage wise achievement of drawn component, stage wise component drawings, drawing radii and clearance, drawing forces, defects in drawing, Miscellaneous dies like- cut off dies, trimming, shaving, bulging, rubber, lancing, slitting, horn type, side cam dies, bending, forming, curling dies etc. (theoretical treatment only) (12)

Term Work:

1) At least one industrial visit to study industrial practices related to the subject and submission of the visit report.
2) Study of various elements of jigs and fixtures
3) Design and drawing of two drilling / reaming jigs. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)
4) Design and drawing of two milling fixtures. (Details of at least one sheet showing manufacturing drawing with tolerances, material specification and heat treatment.)
5) Design and drawing of one progressive die.
6) Design and drawing of one drawing die.

Note: All standard components shall be selected using relevant IS codes in the following exercises.

Reference Books:

1) Tool Design, Donaldson, (TMH)
2) Tool Design, Pollock, Reston Pub. Co. Inc.
3) An Introduction to Jig & Tool Design, M.H.A. Kempster, (ELBS)
4) Fundamentals of Tool Design, Ed. Frank Wilson, ASTME (TMH)
5) Jigs and Fixture Design Manual, Henrikson (Industrial Press, NY)
6) A Text Book of Prod. Engineering, P. C. Sharma, S. Chand
7) Handbook of Die Design- Suchy, (McGraw Hill)
8) Die Design Fundamentals, J. R. Paquin, R. E. Crowley, Industrial Press Inc.
9) Jigs and Fixture, P. H. Joshi, Tata Mc-Graw Hill Pub. Co
10) Techniques of Press Working of Metals by Eary and Reed
11) CMTI Machine Tool Design Handbook, (TMH)
12) Design Data Handbook –PSG College of Tech., Coimbtore

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4. QUALITY MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs. / Week
Practical: 2 Hrs. / Week/ Batch

Examination Scheme:
Theory Paper (3 Hrs): 100 Marks
Term work: 25 Marks

Course Objectives:

1) Student should able to demonstrate to the core concepts and the emerging trends in Quality Management.
2) Student should able develop hands-on-skills on tools and techniques of Quality management for industrial problem-solving.
3) To student should able to demonstrate implementation and documentation requirements for Quality system.

Course Outcomes: The student should have the-

1) Ability to describe quality.
2) Ability to design quality based manufacturing system.
3) Ability to document and implement quality systems.
4) Hands on skill in problem solving and controlling and improvement of quality.
5) Ability to use statistical tools and techniques

Unit -1

1. Introduction to quality management, historical background, contribution by quality gurus. (3)

Unit-2

2. Quality Planning: Designing for quality, capturing voice of customer, quality function deployment, quality loss function, signal to noise ratio, parameter design and optimization, tolerance design. (9)

Unit-3

3. Organizing for quality:, Quality systems: ISO9001 and TS 16949, Control of Non- conforming products, certification requirements, introduction to ISO 14000. (3)

Unit-4

4. Quality Control: Stages of inspection, Acceptance sampling plans, Product vs. Process control, Statistical quality control, Variable (Xbar –R) and Attribute (p, np, c and u) charts, Introduction to basic seven tools of quality control. (10)

Unit-5

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5. Quality Improvement: Single parameter experiments, Orthogonal array, Analysis of Means, Analysis of Variance ANOVA (one - way), Statistical inferences, Variance reduction, Process capability, Correlation analysis, Linear regression models (9)

Unit-6

6. Introduction to Six Sigma methodology, D-M-A-I-C approach. Reliability, availability and maintainability (RAM) approach (3)

Term Work:

Any eight assignments using suitable statistical analysis software. on following topics.

1. Quality loss function
2. Parameter design and tolerance design
3. Quality function deployment
4. Variables control charts (X-bar &R charts)
5. Attributes control charts (P-chart)
6. Process capability study
7. Single parameter experiment and statistical inferences using one-way ANOVA
8. Correlation and regression analysis
9. Industrial case study on quality audit

Reference Books:

1. Armand V. Feigenbaum, Total Quality Control, McGraw Hill Inc. New York
2. J. M. Juran, F. M. Gryna, Quality Planning and Analysis, Tata McGraw Hill Publishing Co., New Delhi
3. E. Grant, R. Leavenworth, Statistical Quality Control, McGraw Hill International.
4. John Hardesky, Total Quality Management Handbook, McGraw Hill Inc.

5. D. H. Besterfield, Total Quality Management, Pearson Education
6. Logothetis, Managing for Total Quality, PHI Publication
7. Gregory Hutchins, Introduction to Quality, Maxwell McMillan International
8. Genichi Taguchi, Quality Engineering in Production Systems, McGraw Hill
9. John M. Ryan, Total Quality Control, Tata McGraw Hill Publishing Co.
10. P. F. Wilson, L.D. Dell & L.F. Anderson, Root Cause Analysis, A Tool for Total Quality Management, Tata McGraw Hill Publishing Co.
11. Montgomery D (2004). Introduction to Statistical Quality Control, 5/e, (John Wiley)
12. Ross, Phillip J. (1996) – Taguchi Techniques for Quality Engineering, 2/e. (New York, McGraw Hill)
13.Montgomery D (2001). Design and Analysis of Experiments, 5/e, (New York, John Wiley & Sons)
14. Montgomery D, Peck E, Geoffrey Vining G (2003). Introduction to Linear Regression Analysis, 3/e, (New York, John Wiley & Sons)
15. Phadke, M (1989). Quality Engineering using Robust Design, (Prentice Hall.)
16.Subburay Ramasamy, Total Quality Management (Mc Graw- Hill)
17.V.A.Kulkarni,A.K.Bewoor ,Quality Control(Wiley India)

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5. MACHINE TOOL DESIGN

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Teaching Scheme:
Lectures: 3 Hrs/Week
Practical: 2 Hrs/Week/Batch

Examination Scheme:
Theory Paper(3 Hrs): 100 Marks
Term Work: 25 Marks

Course Objectives:
1. To understand core concepts of Machine Tool & Product Design.
2. To understand the basic approach for designing machine tool components and implement the appropriate method.
3. To compute the power requirements of various machine tools.
4. To learn to design quality based manufacturing system.
5. To learn to design a product using innovative concepts of 'Product Design'

Course Outcomes:
At the end of this course the student will be able to -
1. The student shall be able to apply the concepts of machine tool design.
2. The student shall be able to select the correct design approach & design the important components of machine tools.
3. The student shall be able to calculate the forces acting and the subsequent power requirements of machine tools.
4. The student shall be able to specifically design the critical components comprising a manufacturing system & emphasize on the quality of the system.
5. The student shall be able to analyse the various phases of the design cycle sequentially and envision the concept of "Scratch to Market" w. r. t a product.

Unit-1

Introduction to Machine & Machine Tool

Types, capabilities, features of construction like working & auxiliary motions in machine tools, parameters defining the working motions of a machine tool, machine tool drives, general requirements of machine tool design, methodology for machine tools design considering quality, quantity of production and economic aspects.

Principle of Machine Tool Design from the point of view of quality, production rate, strength, rigidity, assembly, ergonomics, aesthetics, maintenance and interchangeability

(6)

Unit-2

a) Analysis of forces

Forces affecting machine tool elements, determination of motive power for different operating conditions, use of handbooks. (2)

b) Design considerations and selection of standard components

Drive systems with pulleys, belts, ropes and chains; selection of oil seals, gaskets and electric motors from standard catalogues. (3)

Unit-3

Kinematics of Machine Tools

Classification of various driving systems, basic considerations in the design of drives, aims of speed & feed regulation, stepped regulation of speeds, design of gear box, laws of stepped regulations, selection of range ratio, G.P. ratio, break up of speed steps, structural diagram, Ray diagram & speed chart, design of feed box, machine tool drives using multiple speed motors, general recommendations for developing gearing diagram, determining the number of teeth on gears, stepless regulation of speed and feed rates.(8)

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Unit-4

a) Design of Spindle & Spindle Support

Functions of spindle unit and requirements, materials and construction, spindle ends, spindle support, design calculations, mounting arrangements of spindle bearings, spindle bearing lubrication (3)

b) Selection of Machine Tool Bearing

Journal, rolling and hydrostatic bearings, basic principles, assembly, mounting and maintenance, procedure for selection of bearings from manufacturer's catalogue based on load and life considerations

(4)

Unit-5

a) Design of Machine Tool Structures

Functions of machine tool structures and their requirements, design criteria, materials, static and dynamic stiffness, profiles of machine tool structures, basic design procedure, design of beds, columns, housings, rams etc, Causes of vibrations in machine tools and methods of elimination. (4)

b) Design of Guide ways

Functions and types of guideways, materials, design criteria and calculations of slide-ways based on wear and accuracy, design of anti-friction guideways, hydrostatic and hydrodynamic lubrication of guideways.

(4)

Unit-6

a) Product Design and Development

Product design by evolution and innovation, essential factors of product design, analysis of the product, product characteristics, 3 S's – simplification, standardization and specialization, basic design considerations, functional design practice, product value, design for safety, reliability and environmental conditions, ergonomic design of controls and displays, introduction to rapid prototyping. (3)

b) Intellectual Property Rights (IPR)

Trademarks, copyrights, patents and its procedures. (2)

Term Work:

1) Design of a gear box for speed and feed drive, design of shafts and gears with assembly drawing.
2) Selection of bearings from manufacturer's catalogue
3) Study of different machine tools from the point of view of types of machine parts.
4) Exercise on design of machine tools from ergonomic aspects suitable in India.
5) One case study on product design and development. (Report to be submitted)
6) Assignment on IPR with case study.

Text Books

1) Basic and Applied Thermodynamics by P.K.Nag (TMH).
2) Thermal Engineering by R.K. Rajput (Laxmi Publications).
3) Thermal Engineering by P.L. Ballaney (Khanna Publishers).
4) Thermal Engineering by B.K. Sarkar (TMH).
5) Thermal Engineering by Kodandaraman (New Age International Publication).

Reference Books

1) Machine tool design by N.K.Mehta (TMH).
2) Principles of machine tools by Gopal Chandra Sen and Amitabh Bhattacharya (New Central Book Agency).
3) Machine Tool Design Handbook, C.M.T.I, Bangalore, (TMH).
4) Design Data Handbook, PSG College of Tech., Coimbatore.
5) Design of Machine Tool, Dr. S. K. Basu (Oxford IBH)
6) Design of Machine Elements, Dobrovalsky.
7) Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publishing Company Ltd.
8) Elements of Machine Design, N. C. Pandya and C. S. Shaha, Charotkar Publishing House
9) Design Data Handbook, K. Mahadevan and Balveera Reddy, C.B.S Publishers & Distributors.
10) Engineering Design, a Materials and Processing Approach, G. Dieter, Tata McGraw-Hill Publishing Company Ltd.
11) Product Design and Manufacturing, (3/e), A. K. Chitale and R. C.Gupta, Prentice Hall of India Pvt. Ltd.
12) Catalogues of Bearing Manufacturers, example, S.K.F, NACHI, TIMKEN, NRB etc.

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6. CAM LABORATORY AND CNC WORKSHOP PRACTICE

Teaching Scheme:
Practical: 4Hrs/batch/week

Examination Scheme:
Term Work: 50 Marks
Practical Examination: 50 Marks

Course Objective:
To study advanced features of Computer Aided Manufacturing practices followed in the industry.

Course Outcome:
The student shall demonstrate the knowledge of advanced features of Computer Aided Manufacturing practices followed in the industry.

Contents & Term Work:

1) Selection of cutting parameters including tool specifications for various operations on CNC machines–Turning Center and Machining Center. (2)

2) Study of the features of the controller of the CNC machines (e.g. FANUC, SINUMERIC, MAZAK etc.) including Tool offsets, Wear Compensation etc. (2)

3) CNC Part Programming - Detailed Manual part programming on Turning Center and machining centers using G & M codes for various operations on CNC machines–

   a) CNC Part Programming for Turning Center: Stock Removal Cycles: Facing and turning, Finishing Cycles, Drilling cycles.

   b) CNC Part Programming for Machining Center: Canned Cycles, Pattern Repeat cycles, Sub programming and sub routines, Rotation of Coordinate System, Polar coordinate system. (8)

4) Generating and simulating CNC part programs from the CAD models (at least two exercises each). Preparing a suitable CAD model for a part to be turned and generating the CNC part program to machine the same on a CNC Turning Center from the given form of raw material using suitable CAM software and a post processor. Simulation of the above programs using any suitable CNC simulation software. (8)

5) Preparing a suitable CAD model for a part to be machined and generating the CNC part program to machine the same on a CNC machining center (vertical/horizontal) from the given form of raw material using suitable CAM software and a post processor. (2 dimensional machining like turning, facing, threading, drilling, face/slot milling etc, and rectangular, circular pockets, cavities.) (10)

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6) Generating a simple part program using CAM software and executing it on a CNC machine (at least one exercise each) on CNC lathe and CNC machining center. (10)

IMPORTANT NOTES:

1) During CNC practice each student has to perform the machining of at least two parts of the assembly undertaken during the Workshop Practice-V of B.E. (Prod) Sem-5 on CNC Turning Center or CNC machining center.

2) Each student shall perform the CNC programming for a separate component as referred in point 6 above.

3) The external practical examination shall include execution of one assigned job & its operation on CNC Turning Center or CNC machining center followed by an oral examination.

4) The print outs of CAM & CNC programs and relevant reports of the above mentioned laboratory work shall be included in the journal.

Reference Books:

1) Jon Stenerson and Kelly Curran "Computer Numerical Control", Prentice-Hall India Pvt. Ltd. New Delhi, 2008
2) Ibrahim Zeid "CAD/CAM – Theory and Practice" Mc Hill, International edition, 1998
3) P. N. Rao "CAD/Cam principles and operations", Tata McGraw Hill
4) Thomas M. Crandell "CNC Machining and Programming, Industrial Press ISBN-0-831-3118-7
5) Bedworth, Wolfe and Henderson-Computer aided design and manufacturing, McGraw Hill.
6) A. Ghosh and Malik – "Manufacturing Science" Affiliated East West Press Pvt. Ltd.

7) Tilak Raj – "CNC Technology and Programming", Dhanpat Rai Publication Company.
8) Robert Quesada, T. Jeyapoovan "Computer Numerical Control: Machining and Turning Centers", Pearson Education.
9) Programming Manuals of various CNC machines (Lathes and Machining Centers) e.g. FANUC, SINUMERIC, MAZAK etc.
10) Catalogs of Commercial Tool Manufacturers e.g. SANDVIK, KENNAMETAL, ISCAR, TAEGUTECH, MITSUBISHI etc.
11) Manuals of CNC Simulation and CAM Software.
12) Reference Manuals of controllers like FANUC, Siemens, Mazak, etc.

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7. RESEARCH SEMINAR

Teaching Scheme:	**Examination Scheme:**
Practical: 1 Hr. / Week	Term work: 25 Marks

Course Objective:
To train the students to the techniques of conducting a minor research based on the literature review and compiling systematic report and presenting it before a group of peers and faculty.

Course Outcome:
The students shall demonstrate the knowledge of techniques of conducting a minor research based on the literature review and compiling systematic report and presenting it before a group of peers and faculty.

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Contents & Term Work:
Before the end of Semester VI, each student will deliver a research seminar on a subject related to production engineering. The research seminar topic shall be latest and ahead of the scope of curriculum. The research seminar guide shall help the student in topic selection.

The student, as a part of the term work, shall systematically prepare and submit the report of the research seminar work in duplicate, typed on A4 size sheet in a prescribed format and bound. The report shall be compiled and edited very meticulously right from research problem definition to final conclusions & references. Mere copying and pasting must be avoided.

The student shall present the research seminar before the group of peers & faculty. The performance of the student shall be judged by the research seminar guide along with one more colleague on the basis of the contents, literature review, research problem definition, research objectives, research methodology, results & conclusions, the presentation and discussions.

√ IMPORTANT INSTRUCTIONS FOR INDUSTRIAL TRAINING & PROJECT WORK:

1) Each student should undergo an industrial training in a manufacturing industry during the vacation period for at least 15 days after the end of T.E.(Prod) Sem.VI examinations and prepare a training report in the prescribed format under the guidance of the guide allotted during B.E.(Prod) Sem. VII.
2) For the details, refer the syllabus of B.E.(Production) Sem. VII.
3) The department should guide and orient the students for the said industrial training as well as the selection of suitable problem for the Project Work (B.E.-Prod. Sem. VII & VIII) during T.E.(Prod) Sem.-VI.