Punyashlok Ahilyadevi Holkar Solapur University, Solapur
Faculty of Science & Technology

*Credit System **MODIFIED** structure of T.Y. B. Tech. **Mechanical Engineering** W.E.F. 2020-21*

Semester -V

Theory Courses

Course code	Name of Theory Course	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME311	Machine Design –I	3	-	-	-	3	30	70	-	100
ME312	CAD-CAM & CAE	3	-	-	-	3	30	70		100
ME313	Metallurgy	3	-	-	-	3	30	70	-	100
ME314	Industrial Engineering and Operation Research	3	-	-	-	3	30	70	-	100
ME315	Professional Elective –III	3	-	-	-	3	30	70	-	100
SLH	*Self Learning: HSS*					2#		50		50
	Sub Total	**15**	**-**	**-**	-	**15**	**150**	**400**	-	**550**

Semester5 Laboratory / Tutorial Courses

Course code	*Name of Laboratory /Tutorial Course*	*Hrs./week*				*Credits*	*Examination Scheme*				
		L	*T*	*P*	D		*ISE*	*ESE*		*ICA*	*Total*
								POE	*OE*		
ME311	Machine Design –I	-	-	2	-	1	-	-	-	25	25
ME312	CAD-CAM & CAE	-	-	2	-	1		25	-	25	50
ME313	Metallurgy	-	-	2	-	1	-	-	25	25	50
ME314	Industrial Engineering and Operation Research	-	-	2	-	1	-	-	-	25	25
ME315	Professional Elective –III	-	-	2	-	1	-	-	-	25	25
ME316	Advanced ProgrammingConcepts	1		2		2	-	-	-	50	50
ME317	Mechanical Workshop –II	-	-	2	-	1	-	-	-	25	25
	Sub Total	01	-	14	-	08	-	50		200	250
	Grand Total	**16**	**-**	**14**	-	**23**	**150**	**450**		**200**	**800**

Abbreviations: L-Lectures, T-Tutorials, P-Practicals, D-Drawing, ISE- In-Semester Exam, ESE- End Semester Exam, ICA- Internal Continuous Assessment

***Professional Elective –III: A**. Gas turbines **B.** Industrial Hydraulics and Pneumatics **C.** Non Conventional Machining D. Tool Engineering*

 # indicates credits over and above.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Faculty of Science & Technology

*Credit System **MODIFIED** structure of T.Y. B. Tech. **Mechanical Engineering** W.E.F. 2020-21*

Semester -VI

Theory Courses

Course code	Name of Theory Course	Hrs./week				Credits	Examination Scheme			
		L	T	P	D		ISE	ESE	ICA	Total
ME321	Machine Design –II	3	-	-	-	3	30	70	-	100
ME322	Instrumentation & Control	3	-	-	-	3	30	70	-	100
ME323	Heat Transfer	3	-	-	-	3	30	70	-	100
ME324	Industrial & Quality Management	3	-	-	-	3	30	70	-	100
ME325	Professional Elective –IV	3	-	-	-	3	30	70	-	100
ME326	Mini Project	-	-	-	-	-	-	-	-	-
ME327	Metrology	-	-	-	-	-	-	-	-	-
SLH 32	Self-Learning Technical	-	-	-	-	2#	-	50	-	50
	Sub Total	**15**	**-**	**-**	**-**	**15**	**150**	**400**	**-**	**550**

Semester 6 Laboratory / Tutorial Courses

Course code	*Name of Laboratory / Tutorial Course*	*Hrs./week*				*Credits*	*Examination Scheme*				
		L	*T*	*P*	D		*ISE*	*ESE*		*ICA*	*Total*
								POE	*OE*		
ME321	Machine Design –II	-	-	2	-	1	-	-	--	25	25
ME322	Instrumentation & Control	-	-	2	-	1	-	-		25	25
ME323	Heat Transfer	-	-	2	-	1	-	25	-	25	50
ME324	Industrial & Quality Management	-	1	-	-	1	-	-	-	25	25
ME325	Professional Elective –IV	-	-	2		1	-	-	-	25	25
ME326	Mini Project	-	1	-	-	1	-	-	-	25	25
ME327	Metrology			2		1			25	25	50
ME328	Mechanical Workshop –III	-	-	2	-	1				25	25
	Sub Total	**-**	**02**	**12**	**-**	**08**	**-**	**50**		**200**	**250**
	Grand Total	**15**	**02**	**12**	**-**	**23**	**150**	**450**		**200**	**800**

Abbreviations: L-Lectures, T-Tutorials, P-Practical, D-Drawing, ISE- In-Semester Exam, ESE- End Semester Exam, ICA- Internal Continuous Assessment , Professional Elective –IV: A.** Project Management* **B.** Industrial Product Design ***C.** Plastic Engineering **D.** Mechanical Vibrations E. Railway Transportation.* ***# indicates credits over and above

- **Note** –

1. Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 9, then a new batch shall be formed.
2. Industrial Training (evaluated at B. Tech Sem.-VII) of minimum 15 days shall be completed in any vacation after B.Tech Sem.-III, but before B. Tech. Sem.-VII & the report shall be submitted and evaluated in B.Tech. Sem.-VII
3. Students shall select one Self Learning Module at B.Tech. Sem-V and B.Tech. Sem. VI each from Humanities and Social Sciences and Technical Groups Respectively.
4. Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology.

6. Self-Learning Subjects:

A. Semester-V (HSS): Student can select a Self Learning Course from Solapur University, Solapur HSS Course List and appear for its examination as and when conducted by Solapur University, Solapur.

OR

Student can enroll for National Programme on Technology Enhanced Learning (NPTEL) course, complete its assignments and Appear for certificate examination as and when conducted by NPTEL.

For more details about Self Learning Course (HSS) please refer to separate rule document available from Solapur University, Solapur. More details about NPTEL are available at http://nptel.ac.in

B. **Semester-VI (Technical) :** Students can select any one of the following self-learning technical subjects ;

- **a.** Manufacturing of Composites
- **b.** Design Practices
- **c.** Joining Technology for Metals
- **d.** Steam Power Engineering

7. ICA assessment shall be a continuous process based on student's performance in class tests, assignments, homework, subject Seminars, quizzes, laboratory books and their interaction..

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

NAAC Accredited-2015,
'B' Grade (CGPA 2.62)

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: MECHANICAL ENGINEERING

Name of the Course: T.Y. B. Tech. (Sem. - V & VI)

(Syllabus to be implemented from June, 2020)

PUNYASHLOK AHILYADEVI HOLKAR
SOLAPUR UNIVERSITY, SOLAPUR
FACULTY OF ENGINEERING & TECHNOLOGY
Mechanical Engineering

Programme Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

1. Graduate will excel in professional career in Mechanical and allied interdisciplinary areas.

2. Graduate will exhibit strong fundamentals required to pursue higher education and continue professional development in Mechanical and other fields.

3. Graduate will adhere to professional ethics; develop team spirit and effective communication skills to be successful leaders with a holistic approach.

4. Graduate will be sensitive to ethical, societal and environmental issues while serving at their professional work.

B. Program Outcomes:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex

engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes:

1. Graduate will be able to design and develop mechanical equipments, devices and contrivances that would be able serve the society in a sustainable manner.
2. Graduate will be able to handle the problems associated with manufacturing of goods using latest technology and tools while ensuring productivity, quality and economy.
3. Graduate will be able to analyze complex problems related to IC engines, RAC equipments, Turbo Machines for improvement of performance.

ME 311 MACHINE DESIGN-I

Teaching Scheme	*Examination Scheme*
Lectures– 3 Hours/week	**ESE– 70 Marks**
Practical – 2 Hour/week	**ISE –30 Marks**
	ICA- 25Marks

Course Introduction:

This course seeks to provide an introduction to machine design and discusses various procedures, requirements, design methods. It introduces engineering materials and describes the different kinds of irons, steels and alloys used in engineering design with IS Codes. A further content explains in detail the manufacturing considerations in design. Components design procedures for design against static load and fluctuating load is also covered in content of the course. The features and varieties of threaded joints, and welded and riveted joints are explained with design considerations. Similarly design of shafts and keys with IS codes, design of couplings; springs and selection of belt drives from manufacturers catalogue is covered in content of the course.

Course Prerequisite:

Student shall have knowledge of function of machine elements such as keys, couplings, pulleys, joints etc. A sound background of analysis of mechanical element is essential for successful completion of this course.

Course Objectives: During this course, student is expected

i. To design machine elements such as springs, shafts, joints, lever etc.
ii. To design mechanical component subjected to fluctuating loads
iii. To implement standardization in design of machine elements.

Course Outcomes: At the end of this course, student will be able to

i. Design machine elements such as springs, shafts, joints, lever etc.
ii. Design mechanical component subjected to fluctuating loads.
iii. Implement standardization in design of machine elements.

Section I

Unit 1–Fundamentals of machine design and Design against Static load

No. of lectures – 09

Procedure of machine design, Procedure of design of machine element, Types of loads, Factor of safety- its selection and significance, Theories of elastic failure and their applications, selection of preferred sizes. (No Numerical treatment)

Socket and Spigot Cotter joint, knuckle joint, levers (lever loaded safety valve and right angled bell crank lever) (Numerical treatment).

Unit 2– Design against fluctuating loads **No. of lectures – 06**

Stress concentration causes and remedies, fatigue failure, endurance limit, notch sensitivity, Goodman and Soderberg diagram, modified Goodman diagram, design for finite and infinite life under reversed and fluctuating stresses. (Numerical Treatment).

Unit 3– Selection of Belt. **No. of lectures – 05**

Selection of flat and V belt from standard manufacturers' catalogue/Design data book. (Numerical Treatment)

Section II

Unit 4– Manufacturing considerations in Design and Design of shafts, keys and couplings. **No. of lectures – 09**

Design considerations for casting, Design considerations for forging, Design considerations for machined parts, Design for manufacture and assembly.

Materials for shaft, Design of solid and hollow shaft on strength basis (maximum principal stress theory and Maximum shear stress theory) and on basis of torsional rigidity. ASME code for shaft design. Design of square and flat keys. Splined shaft (Introductory treatment). Types of couplings- Muff, Rigid flange. (Numerical treatment excluding Splined shaft)

Unit 5 – Design of springs. **No. of lectures – 05**

Types of springs and their applications, terminology of helical spring, styles of end, spring materials, stress and deflection in helical spring, series and parallel springs. Introduction to leaf springs. (Numerical treatment excluding leaf spring)

Unit 6– Design of Joints **No. of lectures – 06**

Bolted joint- Simple analysis, eccentrically loaded bolted joint in shear, eccentric load perpendicular to axis of bolt. (Numerical limited to static loading).

Welded Joints- Strength of butt welds, transverse fillet welds, axially loaded unsymmetrical lap joint, eccentrically loaded welded joint in shear (Numerical treatment).

Riveted joints- Types of failure and strength equations (Introductory treatment. No numerical Treatment).

ICA:

Part A: Assignment based on the following. (Any five)

a) Selection of materials for various engineering applications showing their IS codes, composition and properties
b) Selection of belts.
c) Design of helical springs subjected to static load.
d) Design of bolted and welded joints.

e) Design of shaft using ASME codes.
f) Manufacturing Considerations in Design.

Part B:

Design and drawing of Turn buckle.

Or

Design and drawing of flexible bush pin type coupling.

Students are required to draw assembly and details of above Mechanical component on drawing sheet.(Suitable software may also be used.)

Text Books:

1) "Design of Machine Elements", V.B. Bhandari, 4th edition, McGraw Hill.
2) "Machine Design Data Book", V.B. Bhandari, 2nd edition.

Reference Books:

1) Design of Machine Element by J.F. Shigley, McGraw Hill Publications
2) Design of Machine Element by M.F.Spotts, Pearson Education Publication
3) Design Data: Data Book of Engineers By PSG College- Kalaikathir Achchagam - Coimbatore

T.Y. B.Tech (Mechanical Engineering) Semester- V w.e.f Year 2020-2021

ME312 CAD-CAM & CAE

Teaching Scheme	Examination Scheme
Lectures– 3 Hours/week	ESE– 70 Marks
Practical – 2 Hour/week	ISE - 30 Marks
	ICA –25Marks
	POE- 25 Marks

Course Introduction:

Now a day's industries cannot survive worldwide competition unless they introduce new products with better quality, at lower cost, and with shorter lead time. Accordingly, they have tried to use the computer's huge memory capacity, fast processing speed, and user-friendly interactive graphics capabilities to automate and bind together thus reducing the time and cost of product development and production. Computer-aided design (CAD), computer-aided manufacturing (CAM), and computer-aided engineering (CAE) are the technologies used for this purpose during the development of mechanical product with best quality and lowest cost. Students must have knowledge of CAD, CAM, and CAE. Therefore, this course contains syllabus related to CAD, CAM and CAE activities.

Course objectives:

i. To create an awareness regarding Geometric Modeling activities in Industries.
ii. To create an awareness regarding CAM activities in Manufacturing Industries.
iii. To develop part programming capabilities for CNC machines.
iv. To empower students to learn advanced tools in Automation.
v. To utilize modern tools for design, analysis and manufacturing activities.

Course Outcomes: After completion of the course the students will be able to:-

1. Apply CAD fundamentals as well as advanced manufacturing technology to industry problems.
2. Analyze application of geometric modeling and FEA to industrial products.
3. Write CNC part program Handle CAM related problems from industry and develop CNC part program.

.

Section-I

Unit 1: Introduction to CAD / CAM/CAE **No. of Lectures: 04**

• Unit content:

Product Cycle and CAD / CAM/CAE, Advantages of CAD / CAM/CAE, Hardware used for CAD/CAM/CAE system, List of input/output devices, Functions of Graphics Software, `Selection of CAD / CAM/ CAE Software.

Unit 2: Computer Graphics and Geometric Modeling **No. of Lectures: 08**

• Unit content:

Geometric Transformations, Homogeneous Coordinates, Windowing and Viewing Transformations, Coordinate Transformations, Standardization in Graphics Software, CAD / CAM Data Exchange. Introduction to Geometric Modeling and its types, Parametric representation of basic entities like line and circle, Introduction to basic curves - Bezier, B-Spline, NURBS, concept of CSG and Boolean operations, Feature based modeling.

Unit 3: Finite element method and Automation **No. of Lectures: 08**

• Unit content:

FEA: Definition, Types of analysis, terms used in FEM, types of nodes and elements, General Steps of the FEM, Structural and thermal analysis of 1-D bar elements, Introduction to latest FEA software.

Automation: Concept & Definition of Automation, Types, Advantages and Limitations of Automation, Automation and CAD/CAM, CIM and CAD / CAM, Group Technology, part family, Classification and Codification System, Merits and Demerits of Group Technology, CAPP, Retrieval and Generative type of CAPP, MRP, concept of ERP, concept of Rapid Prototyping.

Section II

Unit 4: Fundamentals of NC system **No. of Lectures: 06**

- **Unit content:**

Evolution of NC and Retrofitting, Elements of NC Manufacturing System, concept of work zero and machine zero, Types of NC systems, Structure, Drives and other devices, Steps in NC Manufacturing, Advantages and Disadvantages of NC Technology, Flexible Manufacturing System (FMS), Elements of FMS, Applications of FMS, Merits and Demerits in FMS.

Unit 5: CNC- DNC Technology and Tooling **No. of Lectures: 06**

• Unit content:

Classification of CNC machine tools, CNC controllers, Features and Advantages of CNC, Adaptive Control, Advantages of Adaptive Control, Direct Numerical Control, Types of Direct Numerical Control, Advantages and Disadvantages of Direct Numerical Control, Tool holders, Adapters, Tool magazines, Automatic tool changers, Pallets, Tool setting, Modular tooling.

Unit 6: Manual Part Programming **No. of Lectures: 08**

- **Unit content:**

Principles of an NC Program, Word Address Format (WAF), Machining Formulas, Tool Length and Cutter Diameter Compensation, Canned Cycles for Lathe, Milling and Drilling, Introductory treatment of Subprogram, Subroutines, DO Loop, Macros.

ICA:
List of Experiments

1. Assignment on Modeling & Drafting of any two mechanical components.
2. Assignment on Modeling of simple Assembly of around 3-5 machine components.
3. Assignment on FEA based structural analysis of simple mechanical component.
4. Assignment on FEA based thermal analysis of simple mechanical component.
5. Part programming of one job using CAM software or Programming and manufacturing of one job on CNC lathe or CNC Milling machine.
6. Assignment based on Industrial visit and its report based on CNC/FMS/Automation.

Note:
1. The practical examination should be using suitable software.
2. Oral examination will be based on the full syllabus

Text books:

1. Introduction to CAD/CAM, Rao P.N., -Tata McGraw Hill Publishing Co.
2. Automation, Production Systems and Computer Integrated Manufacturing, Grover M.P.- Prentice Hall of India
3.Numerical Control -Computer Aided Manufacturing, Kundra, Rao, Tiwari- TMHillPub.Co.
4. CAD/CAM/CAE, Chougule N.K.- SCITECH Publications (I) Pvt. Ltd.
5. CAD/CAM/CIM, P. Radhakrishanan.

Reference Books:

1. Theory and Practice, Ibrahim Zeid – CAD/CAM - Tata McGraw Hill Publishing Co.
2. CAD/CAM - Mastering, Ibrahim Zeid –-Tata McGraw Hill Publishing Co.
3. Computer Integrated Design and Manufacturing, D.D. Bedworth, M.R Henderson & P.M. Wolfe- -Tata McGraw Hill Pub. Co.
4. CAD/CAM Theory and Concepts, Kuldeep Sareen, C. Grewal, -S.Chand & Co.Ltd.
5. Computer Graphics by Hearn and Baker.

T.Y. B.Tech (Mechanical Engineering) Semester- V w.e.f Year 2020-2021
ME313 METALLURGY

Teaching Scheme	*Examination Scheme*
	ESE: 70 Marks
Theory: 3Hrs/week	**ISE –** 30Marks
Practical: 2Hrs/week	**ICA:** 25Marks
	OE: 25Marks

Course Introduction:

Course Introduction: Metallurgy is an art of extracting the pure metals from its ore. Its full scope is in:

a) Mixing two or more metals to form an Alloy.
b) Shaping the metals & alloys by different processes such as Casting, Forming, and Joining etc.
c) Undergoing suitable Heat treatment for modifying the properties.
d) And finally, in Inspecting & testing before putting the products in to use.

Course Prerequisites: Engineering Chemistry, Work shop practices, Manufacturing processes.

Course Objectives: To make the students proficient in:

1. Structures, composition, properties, applications of materials and their selection for design purpose.
2. Testing of materials and its significance.
3. Heat treatment processes for different engineering materials.
4. Powder metallurgy process and composite materials with its applications.

Course Outcomes: At the end of course, students will be able to-

1. Select of ferrous alloys and demonstrate the significance of heat treatment processes for engineering applications.
2. Establish the characteristics of nonferrous alloys and Composite materials.
3. Select suitable testing method & implication of Powder metallurgy for manufacturing of products.

SECTION-I

UNIT-1 Introduction to ferrous alloys **No. of lectures-06**

Brief classification of Metals, Concept of alloying, Classification of cooling curves, Types of equilibrium diagram, Lever rule, phase rule, Solid solution & its types, Intermetallic compounds, allotropy.

UNIT-2 Ferrous metals and alloys **No. of lectures-11**

Fe-Fe3C equilibrium diagram, critical temperatures, Plain carbon steels: composition, applications & properties, Effect of alloying elements on steels, Eutectic, Eutectoid and Peritectic transformations, Plain carbon steels, classification, composition, properties &

applications, Types of cast irons, composition, properties, applications. Alloy steels, alloying elements added to steels and their purpose.
Study of composition, properties and applications of following alloying steels.

1. HSLA steels	2. Spring steels	3. Silicon steels
4. Hadfield 'Mn' steels	5. HCHC steels	6. Water hardening steels
7. Oil hardening steel	8. Air hardening steel	9. Hot working tool and Die steel
10. Chisel steels	11. HSS	12. ONHS
13. Stainless steels and its types	14. Invar	15. Steels for subzero applications

UNIT-3 Non-ferrous alloys, composites and Nano materials No. of lectures-04

Non-ferrous alloys
Copper alloys: brasses, bronzes. Aluminum alloys: Al-Si alloy, Al-Cu alloy.
Steps in precipitation hardening (Steps only), Pb-Sn alloys, Study of Babbits. Introduction to Ni alloys.
Composite materials: Classification, properties and Applications
Nano materials – Concept, effect of particle size on mechanical properties.

SECTION II

UNIT-4 Heat treatments of steel No. of lectures-9
Objectives of Heat Treatment, TTT and CCT diagram for eutectoid Steel (Introductory treatment only)
Annealing - purposes, types, applications, limitations.
Normalizing- purposes, types, applications, limitations.
Hardening & Tempering: purposes, types, applications. Types of Tempering, structural changes during tempering, Subzero treatment.
Methods of hardening such as Austempering, Martempering, limitations of these process, Surface hardening treatments.
Carburising – types, Nitradiing.
Cyaniding and carbinitriding – Purposes, chemistry of process, applications, limitations.
Induction hardening -, Flame hardening – Concept process, advantages, limitations and applications.

UNIT-5 Destructive and Non Destructive testing No. of lectures-06
A. Destructive testing methods, test procedure in brief, significance of
i) Tensile testing ii) Hardness testing iii) Impact testing iv) Creep v) Fatigue testing.

B. Study of Non Destructive Testing methods (NDT) such as
i) dye penetrant test ii) magnetic Particle test iii) Ultrasonic test iv) Radiography test v) Eddy current test. Introduction to advanced NDT methods.

UNIT–6 Introduction to powder metallurgy No. of lectures-04

Significance, steps in powder metallurgy process, Applications, Methods of powder manufacture, mixing / blending, compaction methods, sintering processes & types, advantages & limitations, Typical powder metallurgy applications and their flow chart: - Self lubricated bearings, cemented carbide cutting tools, friction materials, etc

ICA: Any Eight experiments out of the following:

1. Study of metallurgical microscopes & specimen preparation for microstructure observations.
2. Demonstration of Macro examination such as Spark test
3. Study of microstructures of P.C. steels
4. Study of microstructures of white, grey, S.G. iron, Malleable iron.
5. Microstructures of Bronzes, brasses, Al-Si alloy.
6. Demonstration of Annealing, Normalizing, Hardening and Tempering
7. Demonstration of Tensile, Impact, and Hardness tests.
8. Demonstration of at least one NDT methods.
9. Grain size measurement.
10. Microstructures of carburized, nitroded, Induction hardened steels.

Text Books:

1. Material Science and Metallurgy – Dr. Kodgire (Everest, Pune).
2. Engineering Metallurgy I & VI – A. S. Gholap& M. S. Kulkarni
3. Introduction to Engg. Materials – B. K. Agarwal (TMH).

- **Reference Books**

1. Heat treatment principles and technique - Rajan Sharma & Sharma
2. Introduction to Physical metallurgy – Avner, TMH.
3. Engineering Metallurgy Vol. I & VI – R. A. Higgins (ELBS).
4. Engineering Metallurgy – E. C. Rollason (ELBS)
5. Engineering Metallurgy - Lakthin (MIR Publishers).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T.Y. B.Tech (Mechanical Engineering) Semester- V w.e.f Year 2020-2021

ME 314 INDUSTRIAL ENGINEERING AND OPERATION RESEARCH

Teaching Scheme	*Examination Scheme*
Theory: 3 Hrs/Week	ISE : 30 Marks
Practical: 2 Hrs/week	ESE : 70 Marks
	ICA: 25 Marks

Course Introduction:
Industrial Engineering and Operation Research is concerned with the design, improvement and installation of integrated system of people, material, information, equipment and energy, use of optimization techniques in the organizations to reduce the time and cost of production. Its draws upon specialized knowledge and skill in the mathematical, physical and social science together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems.

The syllabus is divided into two sections, each section contains three chapters. Section I includes concept of method study, work measurement, Job evaluation and merit rating for improving overall productivity. Section VI contains different optimization techniques assisting the organizations in managing their resources optimally, better decision making, transportation issues, effective planning, and allied issues in conducting their activities

Course Prerequisite:
1. Knowledge of various manufacturing process.
2. Knowledge of industrial working environment through industrial training and Industrial visits.
3. Mathematics concepts, Probability Basics, Analytical Approach with exposure to industrial activities.

Course Objectives: During this course,. student is expected to
1. To acquire knowledge of work study and techniques for improving overall productivity and Performance.
2. Acquire knowledge of various techniques under operations research.
3. Study quantitative techniques in management decision-making and its applications by using mathematical models and project plan.

Course Outcomes: At the end of this course, student will be able to
1. Analyze & measure productivity.
2. Perform method study and work measurement etc.
3. Describe optimization process and OR models.
4. Apply and develop various optimization techniques and prepare project plan to industrial applications.

Section I

Unit 1– Introduction to Industrial Engineering No of lectures – 4

Unit Content:
Definitions and meaning of I.E., contribution by F.W. Taylor, Gilbreth, objectives of I.E.
Productivity - Factors affecting productivity and ways to improve productivity.

Unit 2–Method Study No of lectures – 7

Unit Content:

Definition, objective, Scope of method study, Basic procedure symbols and recording of facts, Charting conventions, Charts – Operation process chart, Flow process chart, Multiple activity chart, Two handed process chart, Diagrams – Flow and string diagram, travel chart Templets and models, Micro motion study. Therbligs simo chart, Critical examination and selection, Implementation method.

Unit 3 –Work Measurements and Job evaluation No of lectures – 09

Unit Content:

Definition, objective and techniques of work measurement, time study, stop watch method, performance rating, allowance, relaxation interference contingency, policy, calculation of standard time, work sampling its need and procedure, predetermined motion time study (PMTS).

Job evolution: objectives, advantages and procedure, job analysis, job description, job specification, methods of evolution. Merit rating: Objectives And Method of Merit rating.

Section II

Unit 4– Introduction & LPP No of lectures – **07**

Unit Content:

History and development of OR, methodology in operation research, O.R. models and their applications. Introduction to LPP, Formulation of problem, Graphical Method, Simplex method.

Unit 5– Assignment and Transportation Model No of lectures – **07**

Unit Content:

Mathematical statement, Methods to solve balanced and unbalanced assignment problems, Maximization problems, Assignment with restrictions, Traveling salesman problem.

Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR matrix minima method and VAM, conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems, Degeneracy and its resolution.

Unit 6– CPM & PERT No. of lectures – 06

Unit Content:

Fundamentals of CPM / PERT networks, CPM – construction of networks, critical path, forward and backward pass, floats & their significance.

PERT – Time Estimates, Construction of Networks, Probability of completing projects by scheduled date.

ICA:

Total six assignments

1. Any Three assignment based on productivity, time study, method study from section I

2. Any Three assignment based on LPP, assignment and transportation problem, CPM/PERT from Unit VI of Section-II

Text Books:

Books Recommended:

1. Industrial engineering and Production management by Martand Telsang. (S. Chand)
2. Engineering management by A. K. Gupta (S. Chand)
3. Industrial Engineering and Management by O. P. Khanna.
4. Work Study by O. P. Khanna. (Dhanpat Rai and Sons)
5. Hamdy Taha, "Operations Research – An Introduction", 7th edition PHI (2003)
6. S. D. Sharma, "Operation Research", Kedarnath and Rannalt Pub.
7. Hira and Gupta, "Operation Research", S. Chand and Co.
8. N. D. Vohra, "Quantitative Techniques in Management", TMGH

Reference Books:

1. Introduction to work study by ILO. (Universal Publication)
2. Operations Research by Hillier and Lieberman TMGH
3. Swarop Kanti Gupta P.K. & Manmohan- OR Sultan Chand & Sons, New Delhi

(A) GAS TURBINES

Teaching Scheme	*Examination Scheme*
Lectures – 3 Hours/week	**ESE–** 70 Marks
Practical – 2 Hour/week	**ISE –**30Marks
	ICA-25 Marks

Course Introduction:

The aim of the course is to provide fundamental knowledge and understanding about the functionality of turbine turbines. This knowledge will enable the students how a turbine can be highly efficient while having the least impact on environment. That is to aim for a green energy to contribute in sustainable development.

Course Prerequisite:
Thermodynamics -Basics and Cycles, Fluid Mechanics

Course Objectives: During this course, student is expected to-

1. Study the classification of gas turbines and its applications
2. Study Analysis of gas turbine cycles
3. Study Basic gas dynamics
4. Study dynamic compressors and their performance parameters.
5. Explain types of combustion chambers in gas turbines

Course Outcomes: At the end of this course, student will be able to-

1. Classify and analyze gas turbine cycles.
2. Discuss gas dynamics terms, construction, working and performance of dynamic compressors
3. Draw T-S diagram, Velocity diagrams and calculate work, efficiency.

Section-I

Unit 1– Introduction **No. of lectures – 04**

Development of gas turbine, Classification of gas turbines, Comparison of Gas turbine and reciprocating I.C. Engines, Comparison of Gas turbine and steam turbine, Applications of gas turbines

Unit 2- Analysis of gas Turbine Cycles **No. of lectures – 08**

Brayton cycle and its analysis, Effect of maximum temperature on cycle efficiency and work ratio, Optimum pressure ratio for maximum work output, Intermediate temperature for optimum work and equation for maximum work output. Actual gas turbine cycle, effect of parameters on performance of cycle. Methods of improving the thermal efficiency and specific work output of gas turbine cycle, Gas turbine cycle with regeneration, intercooling,

reheating. Gas turbine cycle with water injection. **(Numerical treatment)**

Unit 3– Basic gas Dynamics **No. of lectures-08**

Introduction , Propagation of small disturbance-the velocity of sound, Mach number, Mach cone and Mach angle, Total or stagnation properties, One-dimensional adiabatic flow, Isentropic flow, Isentropic flow in a passage of variable cross-section area, Flow through a convergent nozzle-effect of pressure ratio, Flow through a convergent-divergent nozzle. **(Numerical treatment)**

Section-II

Unit 4– Centrifugal Compressors **No. of lectures-08**

Steady flow compressors, Construction and working of centrifugal compressor, Representation of processes in suction pipe, impeller, diffuser and delivery pipe on T-S diagram, Actual and isentropic work done, Analysis of centrifugal compressors-velocity diagrams, Euler work, ideal power, width of impeller blades, vane shapes and their characteristics. Slip factor, power input factor, Pressure coefficient, prewhirl **(Numerical treatment)**

Unit 5–Axial flow compressors **No. of lectures – 08**

Introduction, Components and working of axial flow compressor, velocity diagrams for axial flow compressors, representation of processes on T-S for single stage compression, degree of reaction, relation between blade angles for 50% degree of reaction, work input factor, polytropic efficiency, Surging and chocking, losses in axial flow compressors, comparison between axial flow and centrifugal compressors **(Numerical treatment).**

Unit 6–Gas Turbine Combustion Chamber **No. of lectures – 04**

Introduction, requirements, combustion process in gas turbines, types of combustion chamber, gas turbine materials- requirements and selection, fuels for gas turbine, cooling of gas turbine blades

ICA:

Any eight experiments/assignments based on the syllabus

- **Text Books:**

1. Gas Turbines, V. Ganeshan, Tata McGraw Hill Education
2. Gas Turbines and Jet & Rocket Propulsion, Dr.Mathur & R.P.Sharma, Standard Publishers, New Delhi
3. Applied Thermodynamics-VI,B.L.Singhal, Tech-Max Publications,Pune

- **Reference Books:**

1.Gas Turbines Theory ,Cohen and Rogers, , Wesley Longman, 1996.
2. Steam & Gas Turbines,R.Yadav, Central Publishing House

(B) INDUSTRIAL HYDRAULICS AND PNEUMATICS

Teaching Scheme	*Examination Scheme*
Lectures– 3 Hours/week	**ESE– 70 Marks**
Practical – 2 Hour/week	**ISE –30 Marks**
	ICA-25 Marks

Course Introduction:

This course introduces hydraulic system & pneumatic system. Initially it covers the construction & working of various components of these systems. Preparation of hydraulic & pneumatic circuit diagrams for various applications using the IS symbols of hydraulic & pneumatic components is covered. Inclusion of use of catalogues of hydraulic & pneumatic component manufacturers for selection of components is also done in this course. Students will be made familiar with use of software for hydraulic & pneumatic circuit design.

Course Prerequisite:

Students shall have knowledge of basics of fluid mechanics -properties of fluids, continuity equation & various laws related to fluid.

Course Objectives: During this course, student is expected

1. To choose proper components for hydraulic & pneumatic circuits
2. To prepare hydraulic & pneumatic circuits for various applications

Course Outcomes: At the end of this course, student will be able to

1. Describe construction & working of various hydraulic components & devices
2. Draw hydraulics circuits for various applications & explain working of pneumatic actuators
3. Select proper pneumatic components & prepare pneumatic circuits for any application

Section I

Unit 1–Introduction to Hydraulic system & Hydraulic actuators

No of lectures – 06

Introduction to Fluid power system, hydraulic system Advantages, limitations & applications of hydraulic system Hydraulic Actuators - Linear & Rotary, Types, Working, Construction of linear actuator, Seals & Packing- Types, materials, Applications, Cushioning effects

Unit 2–Pumps, Accumulators, Intensifiers & Valves No of lectures – 08

Pumps- Types, working, Characteristics, Applications, Calculation of force & velocity of piston. System components: Accumulators, Intensifiers, their types, working, applications Symbols used in hydraulic circuits
Hydraulic Pressure control valves- Direct acting type, pilot operated, sequence, counter balancing, unloading, pressure reducing, Construction & Working
Direction control valves- Types, construction & working, Spool actuation methods, spool centre positions
Flow control valves- Compensated & Non-Compensated, Construction & Working, One way valve

Unit 3– Hydraulic circuits **No of lectures – 06**

Simple circuit, Speed control circuits: Meter in, Meter out & bleed off circuits, Regenerative circuit, Sequencing circuit, Counter balancing, Synchronizing, Circuits with accumulator & intensifier, Hydraulic clamping circuit, hydraulic braking system

Section II

Unit 4–Introduction to Pneumatic system & Actuators No of lectures – 06

Pneumatic system: Advantages, limitations & applications of pneumatic system, Comparison of hydraulic & pneumatic system, IS symbols used in pneumatic circuits, pneumatic cylinders and air motors, construction and working, types

Unit 5–Pneumatic System Elements & Valves **No of lectures – 08**

Piping, materials and pressure ratings, piping layout, air compressors, types, working, selection criteria, FRL unit, construction and working

Direction control valves, Flow control valves and pressure control valves – types and working, Quick Exhaust valve, time delay valve

Unit 6– Pneumatic circuits **No of lectures – 06**

Simple Pneumatic circuits, Pneumatic clamping system, Pneumatic braking systems, Pneumatic power tools, time delay circuits

ICA:

Assignments:

1. IS symbols for different components of Hydraulic and Pneumatic system
2. Study of hydraulic valves

3. Study of pneumatic valves Demonstration of Hydraulic speed control circuits

Demonstration: (Any 4)

4. Demonstration of hydraulic speed control circuits
5. Demonstration of Traverse & feed circuit
6. Demonstration of sequencing circuit
7. Demonstration of pneumatic circuits
8. Test on Gear/Vane/Piston pump and plotting of performance characteristic
9. Software use for hydraulic & pneumatic circuit design

Others:

10. Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturers' catalogues)
11. Visit to Service station of Earth Moving equipment (Note: Students should write visit report based on the observations made during the visit)

Text Books:

1. "Oil Hydraulics- Principle & Maintenance", S. R. Majumadar, Tata McGraw Hill
2. "Pneumatics- Principle & Maintenance", S. R. Majumadar, Tata McGraw Hill
3. "Hydraulics and Pneumatics" H.L.Stewart –, Industrial Press

Reference Books:

1. Vickers Manual on Industrial Hydraulics
2. Festo's Manual on Pneumatic Principle, applications
3. "ABC's of Hydraulic Circuits", H L Stewart, (Taraporwala Press)
4. "ABC's of Pneumatic Circuits", H L Stewart, (Taraporwala Press)

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ME 315 Professional Elective –III

(C) NON-CONVENTIONAL MACHINING

Teaching Scheme	*Examination Scheme*
Lectures– 3 Hours/week	**ESE–**70 Marks
Practical – 2 Hour/week,	**ISE –**30 Marks
	ICA- 25 Marks

Course Introduction:

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and work pieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes.

Course Prerequisite:

Student shall have knowledge of different machining processes such as turning, milling, drilling, grinding, etc. A sound background of different energy sources like thermal, electrical, mechanical, chemical, etc. is essential for successful completion of this course.

Course Objectives: During this course, student is expected to

1. Study the various non-traditional machining processes
2. Predict the application of these machining methods in various fields
3. Use of advance coating technology in various fields

Course Outcomes: At the end of this course, student will be able to

1. Elaborate the different non-conventional machining process for suitable materials
2. Select suitable machining process for suitable materials
3. Summarizes the merits and demerits of the non-traditional manufacturing process

Section I

Unit-1 : Overview of Non-Conventional Machining Processes No of Lectures-03

Unit Content:

Non-conventional machining Process: Need, classification, Comparison with conventional machining processes, Brief overview of all techniques.

Unit-2: Mechanical Energy based Processes **No of Lectures-09**

Unit Content:

Abrasive Jet Machining – Water Jet Machining- Abrasive Water Jet machining- Ultrasonic Machining. (AJM, WJM, AWJM and USM): Working Principles, equipment used, Process parameters, MRR-Variation in techniques used, Applications.

Unit 3–Electrical Energy Based Processes **No of lectures – 08**

Unit Content:

Electric Discharge Machining (EDM) and Wire cut EDM: working Principles, equipment, Process Parameters, MRR, electrode /Tool, Tool Wear, Dielectric Flushing, Applications

Section II

Unit 4–Chemical and Electro-Chemical Energy Based Processes **No of lectures – 08**

Unit Content:

Chemical machining, Electro-Chemical machining, Electro-chemical Grinding and Photochemical Machining (CHM, ECM, ECG and PCM): Principles, equipment, Etchants, maskant-techniques of applying maskants, Process Parameters, MRR, Applications.

Unit 5–Thermal Energy Based Processes **No of lectures – 08**

Unit Content:

Laser Beam machining (LBM), Plasma Arc machining (PAM),Ion Beam Machining (IBM) and Electron Beam Machining (EBM): Principles, Equipment, Types, Beam control techniques, Parameters, MRR, Applications.

Unit 6–Introduction to Coating Technology **No of lectures – 04**

Unit Content:

Principle of Coating Technology: Mechanism, Chemical and Physical vapour deposition, Application, Metal Spraying, Metallic coating, Plasma flame spraying

ICA

Total Eight Assignments:

1) Minimum Six Assignments based on above six topics
2) Two Case studies for effect of parameters on MRR of non-conventional machining processes (Refer Journal paper from Reputed Journals)

Text Books:

1. Advanced Machining Processes, V.K. Jain, Allied Publishers, 2009.
2. Non-Conventional Machining, P. K. Mishra, Narosa Publication
3. Manufacturing Science, A. Ghosh, A. K. Mallick, East West Publication
4. Modern Machines Process, P. C. Pandey, H. S. Shan, Tata McGraw Hill Publication
5. Nontraditional Manufacturing Processes, Gary F.Benedict, Taylor & Francis, 1987.
6. Advanced Methods of Machining, J.A. McGeough, Springer, 1988.
7. Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, Hassan El-Hofy, McGraw-Hill Prof Med/Tech, 2005.
8. Introduction to Micromachining,V.K. Jain,Alpha Science International Limited, 2010

Reference Books:

1. Manufacturing Processes and Systems, P. F. Ostwald, J. Munoz, John Wiley Sons.
2. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T. Black, R. A. Kohser, B. E. Klamecki, Wiley Publication
3. Advanced Machining Processes, H El-Hofy, McGraw Hill Publication
4. Introduction to Manufacturing Processes, J. Schey, McGraw-Hill
5. Micromachining Using Electrochemical Discharge Phenomenon, R. Wuthrich, William Andrew

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ME 315 Professional Elective –III

(D) TOOL ENGINEERING

Teaching Scheme	*Examination Scheme*
Lectures– 03 Hours/week	**ESE–**70Marks
Practical – 02 Hour/week	**ISE –**30Marks
	ICA- 25Marks

Course Introduction:

This course seeks to provide an introduction to tool engineering and discusses various procedures, requirements, tooling methods. It introduces engineering materials and describes the different kinds of tools, jig & fixture used in industries. A further content explains in detail the design of press tool draw tool jig & fixture as well as tool nomenclature and geometry.

Course Prerequisite:

Student shall have knowledge of function of press tool and draw tool, cutting tools and theory of metal cutting etc.

Course Objectives: During this course, students are expected:

To enlighten the students about the basics in mechanics of cutting & non cutting operations.

1. To explain the students about the basics in economics of cutting & non cutting operations.
2. To explain the concepts, principles & practices in designing various tooling.

Course Outcomes: At the end of this course, students will be able to:

1. Calculate cutting forces & economics of operations.

2. Design & draw the tools & tooling for the given situation & operation.

3. Develop solutions, devices, contrivances to overcome present problems of the real world.

Section-I

Unit 1– Basics of Tool Engineering **No of lectures – 08**

a) Single point cutting tools- Geometry & Tool signature as per ASA system & ORS system, effect of geometry on tool life, cutting force, surface finish.

b) Types of metal cutting process –orthogonal and oblique cutting, Force analysis for orthogonal cutting, types of chips, chip thickness ratio, shear angle, Tool dynamometers and Merchant circle.

c) Geometry and nomenclature of multi point cutting tool like a drill, milling cutter, broaches, and reamers.

d) Cutting tool materials - types, composition, properties and applications

Unit 2– Machinability & Tool Life **No of lectures –04**

a) Machinability Index, factors affecting Machinability.
b) Tool life- Flank & crater wear, effect of variables on tool life, Taylor's equation of tool life
c) Coolants- Heat generation, types of coolants.

Unit 3– Press Tools **No of lectures –08**

a) Elements of press tools, types of dies, types of operations.
b) Design of die for cutting operation, mechanics of shearing, cutting force estimation, punch & die clearance, stock strip lay out, design of punches & die block functioning & place of other elements.
c) Centre of pressure, selection of die set & press
d) Design of drawing dies determination of blank size, no. of draws, stage wise component drawing, drawing radii, clearance, and estimation of drawing force.
e) Types of Bending die, related estimates.

Section-II

Unit 4–Locating & Clamping Devices for jig and fixture. **No of lectures – 08**

a) Definition concept of locating and clamping.
b) Types of locating and clamping devices.
c) Types of redundant locations.
d) Fool proofing and indexing techniques.

Unit 5–Design of Jigs & Fixtures **No of lectures – 08**

a) Design of Jigs- Principles of Jig design, types &applications, types of bushes &selection, use of standard parts, design procedure & drawing.
b) Design of Fixtures- Principles of Fixture design, standard elements & types of fixtures, design of milling fixtures.

Unit 6– Economics of Tooling **No of lectures – 04**

a) Elements of cost: methods of depreciation
b) Estimation of total cost & sales price
c) Break- even analysis for equipment selection
d) Economics of small tool selection, equipment replacement
e) Economic Order Quantity for Batch production

ICA
(Minimum Six of the following)

1. Exercise on theory of metal cutting.
2. Design and drawing of press tool for particular component.
3. Design and drawing of draw tool for particular component.
4. Design and drawing of a jig for given component.

5. Design and drawing of milling fixture for particular component.
6. Demonstration of lathe tool dynamometer
7. Drawing sheet on geometry and nomenclature of multi point cutting tool like a drill, milling cutter, broaches, reamers.
8. Software modeling - Jig design- Exercise & modeling

*__Note:__ Use any Engineering software package suitable for modeling.

• **Text Books:**

1. Text Book of Production Engineering – P. C. Sharma (S. Chand Publication)
2. Machine Tool Engineering – G. R. Nagpal (khanna Publication)
3. Press Tools – P. H. Joshi (S. Chand Publication)
4. Jigs & Fixtures - P. H. Joshi (S. Chand Publication)

• **Reference Books:**

1. Metal cutting Theory & tool design- Mr. Arshinnov (MIR Publication)
2. Fundamentals of Tool design- ASTME Publication
3. Tool design – Donaldson (TMH Publication)
4. Jig & Fixture Design – Kempster (ELBS Publication)

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ME 316 ADVANCED PROGRAMMING CONCEPTS

Teaching Scheme	*Examination Scheme*
Lectures – 1 Hours/week	
Practical – 2 Hour/week	**ICA - 50 Marks**

Course Introduction

By the end of this course, students will have gained a fundamental understanding of programming in **Python** by creating a variety of scripts and applications for the Web and for systems development. Python is a versatile programming language, suitable for projects ranging from small scripts to large systems. The course emphasizes best practices such as version control, unit testing and recommended styles and idioms. Students will explore the large standard library of Python, which supports many common programming tasks.

Course Prerequisites

This course is intended for absolute beginners in programming, but includes review of elementary features. Students are expected to be able to open command prompt window or terminal window, edit a text file, download and install software, and understand basic programming concepts.

COURSE OBJECTIVES:

1. Introduce procedural and object-oriented style for writing Python scripts.
2. Introduce standard library packages and modules in Python.
3. To teach debugging and profiling of Python scripts.

COURSE OUTCOME:

At the end of this course, students will be able to

1. Use Python standard library modules in writing Python scripts for problem solving.
2. Write Python scripts in procedural and object-oriented style.
3. Write Python scripts to perform database, network and web related operations.
4. Debug and profile Python scripts.

SECTION I

Unit 1 - Introduction to Python and Computer Programming

1.1 What is Python?
1.2 Types of Python
1.3 A basic program in python

Unit 2 - Data Types, Variables, Basic Input-Output Operations, Basic Operators

2.1 Sample python program
2.2 Python literals
2.3 Operators - data manipulation tools
2.4 Variables - data-shaped boxes
2.5 How to talk to computer?

Unit 3 - Boolean Values, Conditional Execution, Loops, Lists and List Processing, Logical and Bitwise Operations

3.1 Making decisions in Python
3.2 Python's loops
3.3 Logic and bit operations in Python
3.4 Lists - collections of data
3.5 Sorting simple lists - the bubble sort algorithm
3.6 Lists - some more details
3.7 Lists in advanced applications

SECTION II

Unit 4 - Functions, Tuples, Dictionaries, and Data Processing

4.1 Writing functions in Python
4.2 How functions communicate with their environment?
4.3 Returning a result from a function
4.4 Scopes in Python
4.5 Tuples and dictionaries

Unit 5 - Modules, Packages, String and List Methods, and Exceptions

5.1 Using modules
5.2 Some useful modules
5.3 What is package?
5.4 Errors
5.5 The anatomy of exception
5.6 Some of the most useful exceptions
5.7 Characters and strings vs. computers
5.8 Python's nature of strings
5.9 String methods
5.10 Strings in action
5.11 Four simple programs

Unit 6 - The Object-Oriented Approach: Classes, Methods, Objects, and the Standard Objective Features; Exception Handling, and Working with Files

6.1 Basic concepts of object programming
6.2 A short journey from procedural to object approach
6.3 Properties
6.4 Methods
6.5 Inheritance - one of object programming foundations
6.6 Exceptions once again
6.7 Generators and closures
6.8 Processing files
6.9 Working with real files

ICA

1. Any two computer programs on data types, variables, basic input-output operations, basic operators.
2. Any two computer programs on Boolean Values and Conditional Execution,
3. Any two computer programs Loops, Lists and List Processing, Logical and Bitwise Operations
4. Any two computer programs on Functions and Tuples
5. Any two computer programs on Dictionaries and Data Processing
6. Any two computer programs on Modules, Package and String
7. Any two computer programs on List Methods and Exceptions
8. Any two computer programs on The Object-Oriented Approach: Classes, Methods and Objects
9. Any two computer programs on the Standard Objective Features; Exception Handling and Working with Files

Note: Use suitable Python IDE.

Text Books

1. e-Resource: Python 2.7.16 documentation https://docs.python.org/2/
2. e-Resource: Python 3.7.3 documentation https://docs.python.org/3/
3. Programming in Python 3, Second Edition, Mark Summerfield

Reference Books

1. Python Cookbook, Third Edition, David Beazley and Brian K. Jones, Shroff Publishers &
2. Distributors Pvt. Ltd., ISBN: 978-93-5110-140-6
3. Learning Python FIFTH EDITION Mark Lutz
4. Programming Python (English) 4Th Edition Mark Lutz
5. Testing Python, David Sale, Wiley India (P) Ltd., ISBN: 978-81-265-5277-1

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ME 317 MECHANICAL WORKSHOP – III

Teaching Scheme: ***Examination Scheme*:**

Practical: 2 Hours / week **ICA: 25 marks**

Course Prerequisite

This course is important to understand fundamentals of machine shop starts from safety measures, practical use of measuring tools, use of all conventional machine tools, operations of all conventional machines, use of tolerances, fits and finally their practical use and applications.

Course Objectives

1. To learn and understand different machining operations practically studied in theory subjects.
2. To get hands on experience of machining operations such as grinding, drilling, shaping, turning etc.
3. To develop skills to operate different machine tools.

Course Outcomes

At the end of this course, the student will be able

1. To grind the tools.
2. To operate different machine tools such as grinders, lathes, milling, drilling machines etc.
3. To machine the component as per specified dimensions.

ICA

Course Contents

1. Tool Grinding Demonstration and actual grinding to understand the tool geometry (01 turns)
2. One composite job in M.S**.** consisting of one component and inclusive of following operation shall be performed by students (Any 5 Operations)

Facing, Turning, Step turning, Chamfering, Grooving, drilling, Knurling. At least one dimension of the job shall carry close tolerance (04turns)

4. Preparation of process sheet for the above job (01 turns)

Note

Students shall prepare a work book involving brief write up regarding machine/machines employed for job. Students should prepare a work book which involves a process sheet for each job and inspection report of the job. Based on the job performed, attendance record, work book, internal viva, faculty may carry internal assessment.

Books

1. Workshop Technology (Volume VI) by Raghuvanshi.
2. Workshop Technology (Volume VI) by Hajra Chowdhary.
3. Workshop Technology (Volume VI) by W .A .J. Chapman.
4. Production Technology by P. C. Sharma.
5. Production Technology – HMT Handbook.
6. Production Technology (Volume VI) by Gupte - Patel.
7. P. L. Jain, Principles of Foundry Technology.
8. P .N. Rao, Manufacturing Technology: Foundry, Forming and Welding.

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Reference Books

1. Manufacturing Processes & systems by Phillip F. Ostwald, Jairo Munoz-Wiley India.
2. Fundamentals of modern Manufacturing by Mikel P. Groover-Wiley India.

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ME 321 MACHINE DESIGN-II

Teaching Scheme	*Examination Scheme*
Lectures – 3 Hours/week,	**ESE– 70 Marks**
Practical – 2 Hour/week,	**ISE –30 Marks**
	ICA- 25 Marks

- **Course Introduction:**

This course seeks to provide an introduction to design of various machine elements and discusses various design procedures, requirements, and design methods. It introduces the design procedure for various types of gears like spur gears, helical gears, bevel gears and worm gears along with the introduction to AGMA standard. A further content explains in detail the significance of pressure vessels, design procedure, and introduction to various standards used for pressure vessels. The different types of bearings, their significance and the selection of the rolling contact bearings from Manufacturer's Catalogue and the design considerations for sliding contact bearing are also included in the course content.

- **Course Pre-requisite:** Student shall have knowledge of function of different machine elements such as different types of gears, bearings, shafts, keys, etc. A sound background of Mechanics of material and fundamentals of design of machine elements essential for successful completion of this course.

- **Course Objectives: During this course, student is expected**

1. To design gears and pressure vessels.
2. To select bearing from Manufacturer's catalogue
3. To use standards in design of machine elements.

- **Course Outcomes: At the end of this course, student will be able to**

1. Design gears and pressure vessels.
2. Calculate the load acting on shaft to select bearing from Manufacturer's catalogue.
3. Use standards in design of machine elements.

Section I

Unit 1– Spur and Helical Gears **No of lectures – 11**

Spur Gear

- **Unit Content:**

Design considerations of gears, gear materials, types of gear tooth failures, hunting tooth, gear tooth loads, minimum number of teeth, face width, Lewis equation, Spott's equation, Buckingham's' Equation (Introductory treatment), gear design for maximum power transmission, Introduction to AGMA code.

Helical Gear:

Virtual number of teeth, force analysis, beam and wear strength, effective load on gear tooth.

Unit 2– Pressure vessel **No of lectures – 06**

- **Unit Content:**

Thin cylinders-Types of stresses, design of thin cylinders. (Numerical)
Thick cylinders- Types of stresses, failure criteria– Lame's equation, Clavarino's equation, Birnies equation. (Numerical, No derivations).
Introduction to compound cylinders, autofrettage, unfired pressure vessels (code), types of end closures (No Numerical).
Effect of opening and nozzle in shell and covers. (Numerical)
Introduction to ASME codes used for design of pressure vessels (Introductory treatment).

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Unit 3– Statistical Considerations in Design **No of lectures –03**

- **Unit Content:**

Frequency distribution, probability distribution, normal curve, design and natural tolerances.

Section II

Unit 4– Bevel Gear **No of lectures – 05**

- **Unit Content:**

Terminology and geometrical relation, force analysis, mounting of bevel gears, beam strength and wear strength, dynamic tooth load.

Unit 5– Worm Gear **No of lectures – 05**

- **Unit Content:**

Terminology and geometrical relations, materials, standard dimensions and recommendations of worm gearing, force analysis of worm drive, friction in worm gear, efficiency and design

criteria of worm drive as per IS7443-1974, load rating of worm drive, strength and wear rating of worm gear, thermal considerations in worm drive.

Unit 6 -Rolling Contact and Sliding contact Bearing No of lectures – 10

Rolling Contact Bearing:

Types, static and dynamic load capacities, Stribeck's equation, Equivalent bearing load, load life relationship, bearing life, load factor, selection of bearing from manufactures catalogue. Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other than 90 %. Lubrication and mountings, dismounting and preloading of bearings.

Sliding contact Bearing:

Bearing material and their properties, bearing types and their construction details, Hydro-dynamic lubrication: Performance analysis of Hydrodynamic bearing by Raimondi and Boyd method.

Introduction to hydro static bearings (Introductory Treatment).

- **ICA**

a) Design and drawing using design data book
   1) Gear box
      OR
   2) Pressure vessel

b) Assignments on (minimum five)
   1. Spur gears
   2. Helical gears
   3. Bevel gears
   4. Worm gears
   5. Rolling and sliding contact bearings
   6. Pressure vessels
   7. Design and natural tolerances
   8. Study of different codes

Text book:

1) Design of Machine Elements by V.B. Bhandari.
2) Machine Design by Robert L. Norton.
3) PSG Design data Book.

Reference Books:

1) Design of Machine Elements by J.E. Shigely
2) Design of Pressure Vessel by Harvey.
3) Machine Design by Hall, Holowenko, Schaum's outline series.
4) Introduction to Tribology by Mujumdar.

T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME 322 INSTRUMENTATION & CONTROL

Teaching Scheme	*Exam Scheme*
Lectures– 3 Hours/week	**ESE– 70Marks**
Practical – 2 Hour/week	**ISE –30Marks**
	ICA-25Marks

Course Introduction

In recent Years, Instrumentation & Control system has been rapidly increasing an importance in all fields of engineering. The applications of Instrumentation & Control cover a very wide range, from design of precision control devices such as delicate electronic equipment to the design of massive equipments such as those are used for the manufacture of steel or other industrial processes. The principles of control theory are applicable to the engineering as well as non –engineering fields.

Course Objectives: During this course, student is expected

1. To study the principles, construction and working of various measuring instruments used for measurement of various mechanical properties such as geometrical, dimensional, pressure, temperature etc and of parameters such as force, strain etc.
2. To study the concepts related to interchangeability, limits, fits, guidelines by BIS and design of limit gauges.
3. To learn the use of various measuring instruments with different setups for accurate measurements.
4. To get acquainted with various standards of measurements & the calibration process of instruments.

Course Outcomes: At the end of this course, students will be able to,

1. Describe construction, functioning and application of various measuring instruments.
2. Design control systems and draw block diagrams.
3. Analyze root locus diagram, Bode plot and discuss stability of mechanical system.

Section - I

Unit I: Introduction, Pressure & Temperature measurement No of lectures –08

Generalized measurement system & its functional elements, Static & Dynamic characteristics and terms, calibration, classification of sensors &transducers.

Measurement of Temperature and Pressure: Thermometer, Thermocouples, RTDs, Thermistors, Electronic IC temperature sensors. Pressure & vacuum measurement, Bourdon tubes, Deadweight pressure gauge, Diaphragm gauge, Piezo-electrical pressure gauge, Vacuum gauges, Pressure transmitters.

Unit VI: Measurement of Acceleration, Velocity and Displacement No of lectures – 06

Measurement of Linear Position, potentiometers, LVDT, capacitance sensors. Angular Acceleration Measurement using gyroscope, Angular Position Measurement with Gyroscopes Angular Velocity Measurement of Fluid Velocity using Hot wire and hot film anemometer, turbine meters, positive displacement meters, differential pressure type meters, mass flow meters.

Unit VII: Measurement of Force, Torque No of lectures – 06

Force measurement- Load Cells for Force Measurement, Type of Load Cells, Strain gauges, strain gauge load cell, Torque Measurements using dynamometers, types of dynamometers. Bridge circuits, introduction to signal conditioning, filters

Section – II

Unit IV: Introduction of control systems No of lectures – 8

Automatic control, open loop and closed loop (feedback) control systems, modern control systems, Modes of Controls: P Control, P+I Control, P+I+D Control.

Block diagram Algebra**:** General representation of a feedback control system, transfer functions, rules of block diagram algebra, reduction of block diagram to obtain closed loop transfer function.

Steady State response, transient response, system stability (Routh's criterion). State Space representation (introduction only)

Unit V: Root Locus method No of lectures –06

Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps.

Unit VI: Bode Plots **No of lectures – 06**

Magnitude and Phase angle plots, standard form of open loop T.F. G(jω) H(jω), Bode plots for standard factors of G(jω) H(jω),steps to sketch Bode plots for following factors :System gain K, Poles & zeroes at the origin, simple poles &simple zeroes, frequency response specifications, calculation of Gain Margin and Phase margin from Bode plots.

ICA

Any **five** out of the following experiments:

1. Temperature Measurement using thermo couples, RTD, Thermistor.
2. Testing of mechanical pressure gauge using Dead Weight pressure tester.
3. Vacuum measurement using U tube manometer & Mechanical Vacuum Gauge.
4. Angular speed measurement using mechanical tachometer, stroboscope, photo electric pickup, inductive pickup.
5. Flow measurement using Rotameter.
6. Measurement of bending strain or load using strain gauges.
7. Use of proving ring, load cells.
8. Measurement of torque.

Any **three** of the following to be completed
1. Fundamentals of control and control systems
2. An experiment on DC/AC motor speed control (open loop / closed loop)
3. An experiment to demonstrate various modes of control: P, P+I, P+D & P+I+D.
4. Assignment on formulation of mathematical model for different types systems, linearization of nonlinear functions and operating curves.

Textbooks

1. Mechanical Measurement & Control: Dr.D.S. Kumar
2. Automatic control Engineering: F. H. Raven., McGraw Hill International editions, NewDelhi, Fifth edition.
3. Control Systems: U.A. Bakshi and V.U. Bakshi: Technical Publications, Pune, Fifth revised Edition –2007.

Reference Books

1. Mechanical Measurement: Sohni& Dr. Radhakrikshan.
2. Mechanical Measurement: Beckwith, Buck, Ro
3. Modern Control Engineering: K.Ogata, Prentice Hall of India Pvt. Ltd., New Delhi., 4 Edition.
4. Process Control: C. Johnson: Prentice Hall of India Pvt. Ltd., 1996.
5. Closed loop control systems: S.C.Goyal and U.A.Bakshi, Technical Publications, Pune, 2002.

6. Feedback Control systems: Bhide, Satyanarayana and Jalgoankar, Technova Publishers, Pune
7. Automatic control systems: B.C. Kuo, Prentice Hall of India Ltd.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME323 HEAT TRANSFER

Teaching Scheme	*Examination Scheme*
Lectures– 3 Hours/week,	**ESE– 70 Marks**
Practical – 2 Hour/week,	**ISE –30 Marks**
	ICA- 25 Marks
	POE-25 Marks

Course Prerequisite: Basic concepts of Thermodynamics, Laws of Thermodynamics, Fluid mechanics.

Course Objectives:

1. To classify the important modes of heat transfer & also to formulate and apply the general three dimensional heat conduction equations to study the thermal systems with and without internal heat generation, lumped heat capacitance and fin analysis.
2. To elaborate the mechanism of convective and radiative heat transfer
3. To describe the various two phase heat transfer phenomenon and carry out the effectiveness and rating of heat exchangers.

Course Outcomes: At the end of course, students will be able to

1. Compare and distinguish the Modes of heat transfer & apply the laws of conduction to the analysis of heat transfer in steady & unsteady state as well as for extended surfaces.
2. Apply the different laws to the radiation phenomenon.
3. Analyze Heat transfer in case of natural & forced convection, Boiling & condensation as well as in the heat exchangers.

SECTION-I

Unit- I Conduction

Modes of Heat Transfer **No. of lectures 02**

Modes of heat transfer. Basic laws of heat transfer, Thermal conductivity and its variation with temperature for various Engineering materials (Description Treatment).

Steady State Heat Conduction **No. of lectures 04**

Derivation of Generalized Heat Conduction equation in Cartesian co-ordinate & its reduction to Fourier, Laplace and Poisson's equations. Generalized Heat conduction equation in cylindrical and spherical coordinates (no derivation) and its reduction to one dimension (1D) heat conduction through plane wall, cylinder, sphere; composites, critical radius of insulation for cylinder and sphere. One dimensional steady state heat conduction with uniform heat generation for wall & cylinder (Numerical Treatment)

Unsteady State Heat Conduction **No. of lectures 02**

Systems with negligible internal resistance, Biot and Fourier number and their significance, Lumped Heat capacity Analysis (Descriptive Treatment)

Unit- II Extended Surfaces **No. of lectures 04**

Types and applications of fins, Governing equation for constant cross section area fins, Solution for fins with convective tip, adequately long (with insulated end) and infinitely long. Fin effectiveness and efficiency (Numerical Treatment)

Unit-III Radiation **No. of lectures 08**

Nature of thermal radiation, definitions of absorptivity, reflectivity, transmissivity, monochromatic emissive power. Total emissive power and emissivity, Concept of black body& gray body, Kirchhoffs law, Weins law and Plancks law. Lambert cosine rule, Intensity of radiation. Energy exchange by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces.

Concept of radiation shape factor and its properties (Description only). Energy exchange by radiation between two gray surfaces without absorbing medium and absence of reradiation and Radiosity. Radiation network method, network for two surfaces which see each other. (Numerical Treatment)

SECTION-II

Unit-IV Convection

Forced Convection **No. of lectures 04**

Mechanism of convection and its types, Concept of Hydrodynamic and thermal boundary layer, local and average convective coefficient.

Dimensional analysis, dimensionless numbers and their physical significance, Empirical correlations for internal and external flow in forced convection problems. (Numerical Treatment)

Natural Convection **No. of lectures 04**

Introduction, Dimensional analysis, dimensionless numbers and their physical significance, Empirical correlations for natural convection problems. (Numerical Treatment)

Unit-V Boiling and condensation **No. of lectures 06**

Boiling Heat Transfer, types of boiling, Pool boiling curves, Force boiling phenomenon, Condensation Heat transfer, Film wise and drop wise condensation.

Introduction of Heat pipe (Construction, working, advantages and applications) (Descriptive Treatment)

Unit-VI Heat Exchangers **No. of lectures 06**

Classification & Types of Heat exchangers, Fouling factor, and Overall heat transfer coefficient, Analysis by LMTD and NTU method for parallel and counter flow, Design consideration for Heat exchangers. (Numerical Treatment)

ICA :

Any 08 Experiments based on following list

1. Determination of thermal conductivity of insulating powder.

2. Determination of thermal conductivity of Composite wall .
3. Determination of thermal conductivity of metal rod .
4. Determination of Heat Transfer Coefficient for natural convection.
5. Determination of Heat Transfer Coefficient for forced convection.
6. Determination of Emissivity of test plate.
7. Determination of Stefan Boltzmann Constant.
8. Determination of critical heat flux in boiling heat transfer.
9. Determination of heat transfer coefficient in Dropwise and Filmwise condensation.
10. Determination of effectiveness of Heat Exchanger.
11. Heat Pipe Demonstration/Trial.
12. Determination of temperature distribution, fin efficiency in Natural /forced convection.

Instructions for Practical Exam:

1. Four to Five experiments may be selected for Practical Examination.
2. The Number of Students for each practical set up may not be more than 04 Students.
3. Oral will be based on the Practical performed in the examination and the experiments included in the Journal.

Text Books :

1. A Text Book on Heat Transfer by Dr. S. P.Sukhatme, Orient Longman Publication, Hyderabad
2. Heat Transfer by P.K. Nag, Tata McGraw hill Publishing Company Ltd., New Delhi.
3. Heat and Mass Transfer by R.K. Rajput, S. Chand & Company Ltd., New Delhi. 110055
4. Engineering Heat and Mass Transfer, Mahesh M.Rathore,University Science Press, New Delhi-110002

Reference Books :

1. Heat Transfer by J.P. Holman , McGraw Hill Book Company, New York.
2. Fundamentals of Heat and Mass Transfer by R.C. Sachdev, Willey Eastern Ltd.,
3. Heat Transfer – A Practical approach by – Ynus -A – Cengel(Tata cGraw Hill)
4. Heat Transfer by Chapman A.J. McGraw Hill Book Company, New York.
5. Heat and Mass Transfer, S.C. Arrora and S. Dokoundwar, DhanpatRai and Sons, Delhi.
6. Fundamentals of Heat and Mass Transfer by C.P. Kothandaraman
7. Heat and Mass Transfer by Dr. D. S.Kumar S.K. Kataria& Sons, Delhi.
8. Fundamentals of Heat & Mass Transfer (Fifth Edi.), Frank P.Incropera, David P.

Dewitt, Wisley India.

9. Heat & Mass Transfer, G. Kamraj, P.Raveendran SciTech Publi.
10. Heat Transfer V C RAO University press
11. Heat Transfer Dr. S. N. Saphali, Techmachpublication Pune

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T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME324-INDUSTRIAL AND QUALITY MANAGEMENT

Teaching Scheme	*Examination Scheme*
Lectures– 3 Hours/week	**ESE– 70 Marks**
Tutorial – 1 Hour/week	**ISE – 30 Marks**
	ICA- 25 Marks

Course Introduction:

Industrial management includes studies structure and organization of industrial companies. The knowledge of Industrial management comprises those fields of business administration that are necessary for the success of companies within manufacturing sector and the encompassing services (primarily operations management, marketing and financial management). This subject having two sections, Section I about general functions of Management applicable to industrial & other organizations and Section II contains concept of quality, total quality management and Quality control tools and techniques applicable to understand quality issues in industry, manufacturing and service industry.

Course Prerequisite:

1. Knowledge of various manufacturing process.
2. Knowledge of industrial working environment through industrial training and Industrial visits.
3. Mathematics concepts, Probability Basics, Analytical Approach with exposure to industrial activities.

Course Objectives:

1. To give the students an overview of the general functions of Management applicable to industrial & other organizations
2. To give insight to the philosophy & techniques of quality management applicable to industry

Course Outcomes: At the end of this course, student will be able to

1. Demonstrate various management functions.
2. Predict various quality control/statistical tools for industrial / organizational problems.

Section I
Industrial Management

Unit 1–Introduction to Management and Industrial Functions: No of lectures – 06

Nature & purpose of Management. System approach to Management, Function of Managers, Social responsibility & Ethics in Managing.

Introduction to Industrial Organizations: Production /Operations Management, Marketing Management, Financial Management

Unit 2–Planning, Organizing and Staffing No of lectures – 08

Planning: Meaning, Types of plans, steps in planning, planning process, decision making.
Organizing: Nature & purpose of organizing, Organization structure, Span & levels,
Depart mentation, Authority delegation, decentralization.
Staffing: Definition, Human resource management & selection, Performance appraisal, Training &development.

Unit 3–Leading and Controlling No of lectures – 06

Leading: Human factors in managing, Motivation, 'Carrot & Stick', Maslow's theory,
Hierarchy of needs, leadership, styles, communication: process. Types- oral, written & nonverbal.
Controlling: Process of controlling, control techniques.

Section II

Unit 4–Introduction to Quality No of lectures – 08

Definition of Quality, Elements of quality, quality specifications. Factors affecting quality of design & quality of conformance, quality control, quality costs.
Benchmarking, Quality Management Systems, Environmental Management System,

Unit 5–Total Quality Management: No of lectures – 06

Quality Gurus, Customer satisfaction, continuous process improvement, employee involvement,
supplier partnership, Tools of quality control: Check sheets, graphs, Pareto analysis, cause & effect diagram, Scatter diagram, control charts, Six Sigma, etc.

Unit 6–Statistical Process Control: No of lectures – 06

Introduction to SPC, Control charts for variable & attributes, interpretation & applications of X, R, P& C charts, Process capability. Acceptance sampling, sampling plans- types single & double, Operating characteristic curve, Producer & consumer risks. (Numerical treatment only on P & C charts and on sampling plans)

- **ICA**
  Minimum 6 assignments based on each topic out of which 2 case studies related to industry /Establishments (1 case study may be from Good Quality Journal Papers.)

- **Text Books:**
  1. Essentials of Management – Koontz Weihrich By TMH
  2. Principles of Management & Administration – D. Chandra Bose. PHI
  3. Statistical Quality Control – M. Mahajan By Dhanpat Rai& Co.
  4. Total Quality Management – Besterfield& Others PHI
  Reference Books: Principles of Management – Tripathy, Reddy by TMH

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T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME 325 Professional Elective –IV

(A) PROJECT MANAGEMENT

Teaching Scheme	*Examination Scheme*
Theory: 03 Hours / Week	**ESE– 70 Marks**
Practical – 2 Hours/week	**ISE- 30 Marks**
	ICA- 25

Course Pre-requisites: The Students should have

1. Basic knowledge about concept of general management.
2. Basic knowledge about various terms and concept in statistics
3. Basic knowledge of industrial management

Course Objectives:

The objective of the course is to create awareness of the concept, components and scope of project management to the students

Course Outcomes:

Students will be able to:

1. Describe concept, importance & Professional responsibilities of project management
2. Implement various techniques used to analyze of risk & cost estimation of a project.
3. Use methods for planning, scheduling, monitoring and control of a project.

SECTION-I

Unit-I Introduction to Project Management **No of lectures - 06**

Definition & Characteristics of Project, Classification of Projects, Project Management, Benefits, Project Management Process, Role of Project Manager. Project Lifecycle

Unit-II Project Management Techniques and Risk Management **No of lectures - 08**

Feasibility Studies, Numerical Models (Payback Period, Return on Investment, Net Present Value, Internal rate of Return), Scoring Models, Break Even Analysis.
Project Risk Management: Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks.

Unit -III Project Cost Estimating **No of lectures - 06**

Estimating terminology, Project Costs, Estimating Methods (Jobbing, Factoring, Inflation, Economies of Sales, Unit Rates, Day Work), Analogous Estimating, Parametric Estimating, Bottom-Up Estimating, Three-Point Estimates, Monte Carlo Simulation, Project Budgeting, Resource Allocation, Cost Forecasts.

SECTION-II

Unit-IV Project Planning and Scheduling **No of lectures - 06**

Project Planning: Introduction, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS) Scheduling: Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System.

Unit-V Project Monitoring and Control **No of lectures - 08**

Project Execution and Control: Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control.

Project Management Information System: Introduction, Project Management Information System (PMIS), Planning of PMIS, Design of PMIS.

Project Performance Measurement and Evaluation: Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

Unit-VI Computer Applications in Project Management **No of lectures – 06**

Introduction to MS Projects – Understanding the MS Project screen & different views, Defining the project, Working with calendar, Outline the project, Create dependencies between tasks, Creating WBS, Format task list and Gantt chart, Resource planning, leveling and preparing resource graph, Working with baseline, tracking the project.

Use of excel and MS project for feasibility studies, risk management, project cost estimating, project planning and scheduling etc.

ICA:

Total Eight Assignments

1. (Six Assignment) One assignments on each unit: Including numerical on various techniques
2. Two case studies: project cost estimation and project scheduling

Text Books/Reference Books:

1. S. Choudary, Project Management, Tata McGraw Hill
2. Narendra Singh; Project Management & Control; Himalaya Publishing House, Mumbai
3. Maylor, Project Management, Pearson Education,
4. Project Management Institute; “A Guide to the Project Management Body of Knowledge (PMBOK Guide)”; 5th Revised edition (1 January 2013)
5. Harold Kerzner; “Project Management: A Systems Approach to Planning, Scheduling and Controlling Paperback”; Wiley; tenth edition (20 November 2012)

6. Erik Larson, Clifford Gray; “Project Management: The Managerial Process”; McGraw Hill Education; Sixth edition (1 July 2014)
7. Panneerselvam R; “Project Management”; Prentice Hall India Learning Private Limited; 1 Edition (2009)
8. Samuel J. Mantel, Jack R. Meredith; “Project Management: A Managerial Approach”; Wiley; Eighth edition (6 August 2012)
9. Gupta R; “Project Management”; Prentice Hall India Learning Private Limited; Second edition (2014)

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T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME 325 Professional Elective –IV

(B) INDUSTRIAL PRODUCT DESIGN

Teaching Scheme	*Examination Scheme*
Theory: 03 Hours / Week	**ESE– 70 Marks**
Practical – 2 Hours/week	**ISE- 30 Marks**
	ICA- 25

Course Introduction:

Industrial design is a creative discipline focused on solving real-world problems with a blend of art and design, technology, and science. This drives innovation through a combination of practical ideas and scientific processes. Industrial design is concerned with bringing artistic form and usability, usually associated with craft design and ergonomics, together in order to mass-produce goods. The knowledge of industrial product design helps to understand and satisfy the need of customer by considering cost, quality and flexibility.

Course prerequisites:

Basic knowledge of strength of material, machine drawing and manufacturing.

Course objectives:

1. To impart knowledge and skill set required for industrial design profession which includes ergonomic and aesthetic in design.
2. To enable student to understand industrial design practices includes new product design.
3. To enable student to understand role of design engineer which impact at national and international level.

Course outcomes:

After successful completion of course, student should be able to

1. Apply product design process to industrial and consumer products
2. Use aesthetic and ergonomic concepts in the product design
3. Implement critical and creative thinking in the design of products

SECTION-I

Unit I: An approach to Industrial Design: **No of lectures - 06**

Technical requirements, Ergonomic requirements, Aesthetic requirements. Ergonomics and Industrial, Anthropometric data, Agronomical design aspects of machine tools; Testing machines; instruments automobiles; process equipment; etc.

Unit II: Visual Effects of Line and Formal: **No of lectures - 06**

Mechanics of seeing psychology of seeing, general inference of line and form, color and light, color terms color combinations, color of engineering equipments/color and machine, their forms.

Unit III: Aesthetic Concepts: **No of lectures - 08**

Concept of unity; concept of order with variety; concept of purpose; style and environment; Aesthetic expression; symmetry balance; contract continuity proportion; rhythm radiance

Style : Component of style; Basic factor; environment factor ; social factor; Basic style; observing style in capital goods.

SECTION-II

Unit IV: Industrial Design in Practice: **No of lectures – 06**

General design situation, specifying design requirement, rating the importance of industrial design; industrial design in the design process analysis; Market question influencing industrial design, "Production" questions, synthesis presentation working with the specialist

Unit V: New Product Development **No of lectures – 08**

Initiation, Idea collection, creative design; brain storming; creative thinking; creative development, inventiveness; conceptional design. Function and use: What will it do? Legal standard requirement; international standards; do by dimensions, vision, interpretation of information. Design of Production; Costs; standardization; design evolution techniques, estimation of production cost; Reduction of cost, impact of DFP on other factors, prototype design pre production, inspection. Design for maintenance: Life test; classification of components for facilitating maintenance.

Unit VI: Decision Making and Computer Aided Product Design

No of lectures – 06

Decision Making: Optimization, Probability, Reliability

Computer Aided Product Design: Manufacturing consideration: For casting, welding, machining, forgoing, forming etc.

ICA

Total six assignments

1. Three assignment based on any three topics.

2. Case Studies: Design of new product devices, utility products (Concept generation and evaluation using different methods)
3. Aesthetic and ergonomic evaluation of any one consumer product and suggesting improvements
4. One Case study on New Product Development.

References:

1. Product Design and development – Kari T. Ulrich Steven D. Eppinge.

2. Industrial Design for Engineers – W.H. YALI VIfff Books Ltd., London.

3. Cost Reduction in product Design – Willian Chow – VenNostand Reinhold Co.,

4. Engineering Design Connectional stage – N.J. French. Heinmenn Educational Books.

5. Product Design – Otto- Pearson Education

6. Principles of Machine Design – R.C. Pujara.

7. Design Engineering John Diwan McGraw Hill Ltd.,

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ME 325 Professional Elective –IV

(C) PLASTIC ENGINEERING

Teaching Scheme	*Examination Scheme*
Theory: 03 Hours / Week	**ESE– 70 Marks**
Practical – 2 Hours/week	**ISE- 30 Marks**
	ICA- 25

Course Introduction: During this course, student is exposed to following knowledge-

1. Study of extraction, manufacturing of plastic and classification.
2. Also study of various properties of plastic materials, comparative study of the plastics on the basis of parameters like structure, cost and processing time etc.
3. Study and Comparison of the different processes on the basis of parameters like cost and processing time etc.
4. Design of plastic part and molds, correct selection & design leads to compact & less cost of systems. Design & development, for an optimum process of a given job / component in a given situation.

Course Prerequisite: For this course, student is expected to have-

Knowledge of Engineering Chemistry and Polymers.
Knowledge of Basic Manufacturing Process.
Basic knowledge of welding processes
Basic Design Knowledge

Course Objectives:

1. To make students understand about the polymerization, types and applications of plastics in different areas.

2. To make the students familiar about processing and welding of plastics

3. To provide the knowledge of part design, mould design including cooling systems for injection moulds.

Course Outcomes: At the end of this course, student will be able to

1. Select the plastic materials for particular end user application.

2.Suggest the suitable plastic moulding process and welding technique for the end user application.

3. Design simple plastic component and injection & compression mould for it.

Section I

Unit –1 Introduction to Plastics: No of Lectures-7

Definition and Classification of Plastic Materials, Properties of plastics, applications, Testing methods for plastics, additives in plastics, Monomers & Polymers, Polymerization - Types of Polymerization. Applications of plastics in various areas such as: Agriculture, Packaging, Building, Transport, Electrical, Electronics, Medical and Furniture.

Unit 2- Processing and Welding of Plastics No of Lectures-7

Processes of Plastic: Injection molding, Extrusion molding, sheet forming processes, calendaring, Blow molding, Processing of thermosetting plastics, compression molding, Transfer molding, rotational molding. Welding of Plastic: Hot gas welding, hot tool welding, High frequency induction welding, laser welding, infrared welding, ultrasonic welding, friction welding

Unit3- Design of Plastic Parts No of Lectures-6

Tolerances of molded plastics parts, allowances in plastics, Design aspects of: minimum wall thickness, corners, undercuts, Holes, ribs, inserts and brief information about mold materials, design procedure of simple plastic component.

Section II

Unit 4 – Design of Compression Moulds No of Lectures-7

a) Mould heating, Mould venting, Design aspects of Ejector Pin, Basic design parameters of Compression mould such as bulk factor, projected area, clamping force, land dimension, ejector pin length and other etc, design procedure for compression mould for simple component.

b) Technology of transfer mould, types, main parts, automation in transfer mould.

Unit 5- Injection Mould Design No of lectures-7

Types of Injection moulds: Single, multi cavity, two plate-three plate moulds. Feed system, Temperature control system, Ejection System, design procedure for injection moulds for simple component.

Unit 6- Cooling of Plastic Injection Mould No of lectures-6

Determining the heat quantity dissipated with cooling, calculating the heat quantity, mass of water, water in let-outlet temperature, time require for cooling etc. Cooling systems used in Injection moulds,

- **ICA:**
    1. Introduction to basic parameters of Injection moulding.
    2. Design of Injection mould for simple component.
    3. Design of Simple plastic component.
    4. Design of Compression mould.
    5. Basic design aspects of Blow moulding.
    6. Case study for mould manufacturing
    7. Visit to Plastic industry.

- **Text Books:**

1) Prof(Dr.)Sanjay K Nayak, Fundamentals of Plastics Mould Design, Tata McGraw Hill Education Private Limited, New Delhi

- **Reference Books:**

1. J. A. Brydson, "Plastics Materials", Butter worth Heinemann Oxford,1999
2. Schwartz & good man "Plastics materials and processing"
3. Irwin Rubin "Hand book of Plastic Materials and technology"
4. Fred W. Billmeyer, JR., "Text Book of Polymer Science", John Wiley & Sons, Singapore, 1994

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ME 325 Professional Elective –IV

(D) MECHANICAL VIBRATIONS

Teaching Scheme	*Examination Scheme*
Theory: 03 Hours / Week	**ESE– 70 Marks**
Practical – 2 Hours/week	**ISE- 30 Marks**
	ICA- 25

Course Introduction:

Vibration is a common phenomenon occurring in a mechanical system. For example, vibration of a rotor due to unbalanced mass, vibration of a vehicle engine at varying speeds. The study of a dedicated course is required to understand the fundamental and advance concepts of mechanical vibrations for engineers and designers. This course is of basic level. It introduces fundamentals of vibration, free and forced, undamped and damped vibration, vibration of single Degree of Freedom (DOF) system, 2-DoF, theory of vibration absorbers and vibration instruments.

Course Prerequisite:

Student shall have knowledge of Engineering Mechanics, Theory of Machine. A sound background of analysis of mechanical element is essential for successful completion of this course.

Course Objectives: During this course, student is expected

1 To acquire knowledge of fundamental concepts of mechanical vibration and analysis

2 To develop competency in understanding of vibration in systems

3 To develop analytical competency in solving vibration problems

4 To understand the various techniques of measurement and control of vibration

Course Outcomes: At the end of this course, student will be able to

1. Solve problems in vibrations related to single and two degree of freedom system

2. Select proper devices for measurement of various parameters in a vibrating system

SECTION I

Unit 1–Basic Concept of Vibration **No of Lectures-4**

Basic concepts and definitions, terms used in vibratory motion, causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Types of vibrations, static equilibrium position, Steps involved in vibration analysis, undamped free vibrations natural frequency of free vibration

Unit 2–Single Degree of Freedom Vibration System **No of Lectures-8**

Free Undamped single DOF vibration system: Longitudinal, transverse, torsional vibration system, Methods for formulation of differential equations by Newton, Energy, Lagrangian and Rayleigh's Method

Free damped single DOF vibration system: different types of damping, Viscous damped system – under damped, critically damped, over damped; Logarithmic decrement; Coulomb's damping; Combined viscous and coulomb's damping

Unit 3–Forced Single Degree of Freedom Vibratory System **No of Lectures-8**

Introduction, magnification factor, vibrations due to excitation of the support, vibrations with coulomb damping, Vibration Isolation and Transmissibility, Force Transmissibility, Motion Transmissibility, Typical isolators & Mounts, Energy dissipated due to damping, illustrated examples.

SECTION II

Unit 4–Two degree freedom systems **No of Lectures-8**

Introduction, principle modes of vibration, spring mass coupled systems, double pendulum, combined rectilinear & angular modes, systems with damping, Rayleigh's method, illustrative examples. Critical speed of a light shaft having a single disc without and with damping, Holzer method, illustrative examples, whirling of shafts & critical speed

Unit 5–Vibration Measurement **No of Lectures-6**

Instruments for measurement of displacement, velocity and acceleration and frequency of vibration, Sensors and Actuators, Construction & working of FFT analyzer, Principle of seismic instruments, Vibrometers, accelerometer - Undamped, damped, Introduction to signal analysis: Time domain & Frequency domain analysis of signals

Unit 6– Torsional Vibrations **No of Lectures-6**

Introduction, natural frequency of torsional vibration, free torsional vibrations of single rotor system, free torsional vibration of two rotor and three rotor system, torsionally equivalent shafts Eigen values and Eigen vectors for linear system and torsional two degree of freedom.

ICA:

Note: ICA shall consist of minimum 7 experiments from the list

1. Determine the radius of gyration ‘k’ of a given compound pendulum
2. Demonstration of free longitudinal vibration of Helical Spring
3. Demonstration of free torsional vibration of Single/Two Rotor System
4. Demonstration of forced vibration with & without damping
5. Experiments on vibration isolation system and prediction of force transmissibility, motion transmissibility of system
6. Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.
7. Numerical on whirling of shafts
8. Assignment on Two degree of freedom system
9. Assignment on numerical methods for determination of natural frequencies
10. Assignments on vibration analysis using FEA software

Text Books :-

1. Mechanical Vibrations: G K Grover.
2. Mechanical Vibrations: Rao S. S., Pearson Education Inc. New Delhi
3. Mechanical Vibrations: J P Den Hartog ,McGraw Hill.
4. Theory of Vibrations with Applications: W T Thomson CBS Publishers Delhi

Reference Books:-

1. Fundamentals of Vibration: Leonard Meirovitch , McGraw Hill International Edison.
2. Principles of Vibration Control: Ashok Kumar Mallik, Affiliated East-West Press.
3. Mechanical Vibrations : A H Church ,John Wiley & Sons Inc
4. Mechanical Vibration Analysis: Srinivasan, McGraw Hill.
5. Mechanical Vibration: W VIliam J Palm VII, Wiley India Pvt. Ltd, New Delhi
6. Fundamentals of Mechanical Vibration. - S. Graham Kelly. 2nd edition McGraw Hill
7. Mechanical Vibrations: V. P. Singh.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021
ME 325 Professional Elective –IV

(E) RAILWAY TRANSPORTATION

Teaching Scheme	*Examination Scheme*
Theory: 03 Hours / Week	**ESE– 70 Marks**
Practical – 2 Hours/week	**ISE- 30 Marks**
	ICA- 25

Course Introduction:

This course presents a comprehensive overview of passenger and freight railway transport systems, from design through to construction and operation. Moreover, it thoroughly covers freight railway systems transporting conventional loads, heavy loads and dangerous goods. For each system it provides a definition, a brief overview of its evolution and examples of good practice, the main design, construction and operational characteristics, the preconditions for its selection and the steps required to verify the feasibility of its implementation. This subject includes all means of transport whose rolling systems involve at least one iron component.

Course Prerequisite:

Students shall have introductory knowledge of Concept of force in physics and Concept of tensile, compressive & tangential stress.

Course Objectives: During this course, students are expected:

1. To make a student understand concepts of various types of railway transport systems and derailment of railway system.
2. To introduce track engineering and fundamental calculations for railway tracks.
3. To give students an introduction to rolling stock and their dynamics.

Course Outcomes: At the end of this course, students will be able to:

1. Summaries different components of a railway transportation system
2. Interpret various stresses & deflections generated in track under various loads.
3. Analyze forces on track due to various loads.

Section-I

Unit 1– Introduction to Railway Transportation Systems No of lectures – 08

Introduction to railway systems, Components of railway systems: Railway infrastructure, Rolling stock and Railway operation, Fundamental functional principles: Running on a straight path, running in curves, Distinctive features of railway systems, Classification of railway systems. The capabilities of the railway transportation system: Advantages and disadvantages of the railway, Comparison of the characteristics of railway systems, Comparison of the capabilities of different transportation systems.

Unit 2– Behavior of rolling stock on track **No of lectures – 08**

Behavior of a single railway wheel set: Movement on straight path, Movement in curves, Behavior of a whole vehicle: Operational and technical characteristics of bogies- Object and purposes of bogies, Conventional bogies, Bogies with self-steering wheel sets, Bogies with independently rotating wheels, Bogies with creep-controlled wheel sets, Bogies with wheels with mixed behavior. Wheel rolling conditions and bogies inscription behavior in curves. Lateral behavior of a whole vehicle- Vehicles with conventional bogies, Vehicles with bogies with self-steering wheel sets, Vehicles with independently rotating wheels, Comparative assessment.

Unit 3– Derailment of railway vehicles **No of lectures – 04**

Derailment of railway vehicles: Definition, Derailment through displacement of track, Derailment as a result of vehicle overturning, Derailment with wheel climb- Description of the phenomenon, Derailment criteria, Factors affecting derailment.

Section-II

Unit 4– Vertical loads on track **No of lectures – 08**

Classification of loads, Vertical loads on track: Static vertical loads- Axle load, Wheel weight, Daily traffic load. Quasi-static vertical loads: Vertical wheel load due to crosswinds, Vertical wheel load due to residual centrifugal force. Dynamic vertical loads- Dynamic vertical wheel load, Total vertical wheel load, Design vertical wheel load, Design loads of bridges.

Unit 5– Transverse loads on track **No of lectures – 08**

Transverse loads on track: Gravitational forces, Creep forces- Running on straight path, running in curves, Crosswind forces, Residual centrifugal force, Guidance forces, Forces due to vehicle oscillations, Total transversal force.

Unit 6– Longitudinal force Analysis **No of lectures – 04**

Longitudinal forces: Temperature forces, Rail creep forces, Braking forces: Acceleration forces, Traction forces: Adhesion forces, Fishplate forces.

ICA:

- **Minimum Four** case studies on:
    1. Rail transportation systems.
    2. Failure of railway tracks.
    3. FEA analysis of loading conditions of various types of coaches and bogies.
    4. Advanced electric systems in railways
    5. Derailment of railway vehicles

- **Minimum Five assignments on the following**
    1. Assignment and tutorial on Vertical loads on track
    2. Assignment and tutorial on Transverse loads on track
    3. Assignment and tutorial on Longitudinal force Analysis

4. Assignment and tutorial on Behavior of rolling stock on track
5. Assignment and tutorial on Derailment of railway vehicles
6. Assignment and tutorial on Electric Railway Systems

- **Compulsory:** Industrial visit/ field visit to any railway workshop/ railway part manufacturing factory/ railway station.

Text Books:

1. Railway Transportation Systems – Design, Construction and Operation, Christos N. Pyrgidis, 2019, CRC Press
2. A Text Book of Railway Engineering, S.C. Saxena, S.P.Arora, Dhanpat Rai Publications (p) Ltd.-new, Delhi, 2010.
3. Electric Traction for Railway Trains: A Book for Students, Electrical & Mechanical Engineers, Superintendents of Motive Power & Others, E. P. Burch, McGraw- Hill Book Company.

Reference Books:

1. Handbook of Railway Vehicle Dynamics, Simon Iwnicki, Taylor & Francis Group, CRC Press,
   ISBN: 9780849333217, 0849333210
2. Railway Track Engineering, J.S.Mundrey, Tata McGrow Hill Publication.
3. Principles of Railway Engineering, S.C. Rangawala, Charotar Publication, 2015.
4. Traction Rolling Stock- Three Phase Technology, A.K. Rawal, Indian Railway Institute of Electrical Engineering, Nasik Road.
5. Traction Distribution- Power Supply Electric Traction, A.K. Rawal, Indian Railway Institute of Electrical Engineering, Nasik Road.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME326 MINI PROJECT

Teaching Scheme	*Examination Scheme*
Tutorial- 01 Hour/week	**ICA- 25 Marks**

Course Objective:

1. To identify potential problems in engineering.
2. To provide a solution for the problem identified.
3. To express technical ideas, strategies and methodologies in written form.

Course Outcomes:

At the end of this course, the student will be able to

1. Identify and analyze the potential technical problems.
2. Develop solution for a set of requirements for the problem identified.
3. Write a report with all the contents in logical order.

Course Contents:

A mini project /case study/design report is expected to be on a state of the art technical topic, related to Mechanical Engineering discipline.

ICA-

Guidelines for Project content & Mark Distribution

1. A group of maximum 04 students be formed for Mini-Project work.

2. Work diary and reporting to guide fortnightly (At least once in 15 Days)

3. The contents of work diary shall reflect the efforts taken by project group for

   i. Searching suitable mini-project work

   ii. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the mini-project area.

   iii. Brief report of feasibility studies carried to implement the conclusion.

   iv. Rough Sketches/ Design Calculations, etc.

4. The mini-project may be based on software or experimental work.

5. It will be preferable if student will work on the area of mini project in line with their proposed final year project.

6. The group has to give a power point presentation in front of the faculty of department at the end of semester along with the spiral bound report (Limited to 20 Pages).

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME327 METROLOGY

Teaching Scheme	*Examination Scheme*
Practical- 02 Hours/week	**ICA- 25 Marks**
	OE- 25 Marks

Course Introduction-

The students of Mechanical Engineering branch are basically concerned with manufacturing various machine components in shops as per given drawing. Today the industrial processing and manufacturing techniques have become complex and complicated and their control is very much difficult by human judgment only. Therefore, the exact and precise measurements are the basic need of the industries. This course of Metrology & Instrumentation, therefore, provides required knowledge and skills and creates self confidence in students so that they can work on shop floor independently for accurate and precise measurements and manufacturing.

Course Prerequisites-

Fundamental knowledge of linear and angular dimensions.

Course Objectives-

- To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
- To illustrate the use of various measuring tools measuring techniques.
- To understand calibration techniques of various measuring devices.

Course Outcomes-

At the end of the course, students will be able to

1. Measure the elements and assemblies using analog /digital measuring instruments &Check geometrical accuracy of given application.
2. Explain surface roughness checking instruments and derive important dimensions of various thread forms and gears.
3. Check the dimensions using the gauges and measure variables using appropriate sensors and transducers.

ICA

Compulsory Assignments-

1. Assignment based on Limits, Fits and gauge design- 2 Turns
2. Assignment based on static and dynamic characteristics of instruments- 1 Turn

Any Five Experiments from following

1. Calibration of Vernier caliper and micrometer.
2. Angle measurement using Sine bar or sine centre in combination with slip gauges.
3. Measure gear tooth elements using gear tooth vernier caliper.
4. Measure effective diameter of screw thread using profile projector or Tool maker Microscope.
5. Use dial indicator to check Lathe machine parameters like parallelism, squareness, alignment or measure run out of a cylindrical component.
6. Use of floating carriage micrometer to measure minor, major and effective diameter of screw thread.
7. Measure the surface roughness of given sample using Taylor Hobson's Taly Surf or surface roughness tester.
8. Visit to metrology lab.

Text Books-

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.
3. Rajput R K "Measurement and Metrology", S K Kataria and Sons, 2013.
4. A K Bewoor and V A Kulkarni "Metrology and Measurement", McGraw Hill Education (IND) Pvt Ltd, 2017.

Punyashlok Ahilyadevi Holkar Solapur University, Solapur
T.Y. B.Tech (Mechanical Engineering) Semester- VI w.e.f Year 2020-2021

ME 328 MECHANICAL WORKSHOP – III

Teaching Scheme: ***Examination Scheme*:**
Practical: 2 Hours / week **ICA: 25 marks**

Course Prerequisite

This course is important to make the students aware with various skills involved in manufacturing & assembly, develop skills to operate different machine tools and make students aware of operation sequence, speed, feed selection for different materials & operations along with their operational set up.

Course Objectives

1. To set the manufacturing set up of different machining operations and study the corresponding set up parameters while working on actual machine tools.
2. To select appropriate and proper process parameter for obtaining desired requirement on work piece.
3. To identify the operational / processing problems and suggest remedial solution for adopted manufacturing processes.

Course Outcomes

At the end of this course, the student will be able,

1. Operate various machine tools.
2. Selection operational and process parameters during machining operations.
3. Manufacture a small assembly of components.

Course Contents

Any one noncommercial assembly consisting of at least three components with tolerance involving use of lathe, drilling, milling, grinding and any additional machine tool or processes as per requirement. Use machining operations like boring, slotting, tapping, tapering, external taper turning, shaping, milling etc.(Any 5 Operations)

or

Development and Execution of one simple turning/milling job on CNC (Trainer) including geometric and dimensional tolerances.

Note:

1. Students shall prepare a work book involving brief write up regarding machine/machines employed for job.
2. Students should prepare a work book which involves a process sheet for each job and inspection report of the job.
3. Based on the job performed, attendance record, work book, internal viva, faculty may carry internal assessment.
4. Material specification for conventional practical job is Φ32mm MS bar and Material for CNC is as per machine requirement.
5. Development and Execution of CNC job need to cover all fundamentals of CNC programming and its execution.

Books

1. Workshop Technology (Volume VI) by Raghuvanshi.
2. Workshop Technology (Volume VI) by Hajra Chowdhary.
3. Workshop Technology (Volume VI) by W .A .J. Chapman.
4. Production Technology by P. C. Sharma.
5. Production Technology – HMT Handbook.
6. Production Technology (Volume VI) by Gupte - Patel..
7. Introduction to CAD/CAM, Rao P.N.
8. CAD/CAM/CAE, Chougule N.K.

Reference Books

1. Manufacturing Processes & systems by Phillip F. Ostwald, Jairo Munoz-Wiley India.
2. Fundamentals of modern Manufacturing by Mikel P. Groover-Wiley India.
3. Theory and Practice, Ibrahim Zeid – CAD/CAM - Tata McGraw Hill Publishing Co.
4. CAD/CAM - Mastering, Ibrahim Zeid –-Tata McGraw Hill Publishing Co.

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T.Y.B. Tech. (Mechanical Engineering) Semester-VI Year 2020-2021

SLH32- Self Learning Technical

(a) MANUFACTURING OF COMPOSITES

Teaching Scheme--Nil **Examination Scheme**

ESE: 50 Marks

Course Introduction:

Selecting manufacturing technique has emerged as one the paramount challenge in the field of composites. Composites are now being used in almost every field of industry and students working in the area of the composites need to learn the basics and progressive techniques of composites manufacturing. This course covers the important aspects of composites manufacturing: process selection guidelines, thermoset and thermoplastic Composites manufacturing processes, process parameters and characterizations.

Course Prerequisites: Manufacturing processes, Material science, Introduction to Polymers

Course Objectives: To make the students proficient in:

1. The manufacturing processes of reinforcement fibers and matrices for composites,
2. Selection of different composites in consideration of the properties and characteristics for different engineering applications.

Course Outcomes: At the end of course, students will be able to-

1. Select of different composites in consideration of the properties and characteristics for different engineering applications.
2. Choose suitable manufacturing process depending of type of Composites.

SECTION-I

Unit 1: Introduction to Composites:

Introduction to Composites, Function of the Matrix and Reinforcement in Composites Matrices: Thermosets and Thermoplastic; Fiber Reinforcement, Properties and testing composites; Properties of Composites; Composites testing; Composites design: Laminate theory, Rule of mixtures, symmetry and balance

Unit 2: Thermoset Composites manufacturing processes:

Material selection process cont.; Material selection process cont. Design for manufacturing. Thermoset Composite manufacturing: Lay-up processes, Spray up process; Thermoset Composite manufacturing: Fiber placement process; Thermoset Composite manufacturing: Resin transfer moulding.

SECTION-II

Unit 3: Thermoplastic composite manufacturing processes:

Thermoset Composite manufacturing: Vacuum assisted resin transfer moulding; Thermoset Composite manufacturing: Compression molding process; Thermoset composites manufacturing: Filament winding, Thermoplastic Composite manufacturing: Sheet moulding Thermoplastic Composite manufacturing: Injection moulding, sheet moulding, Calendaring; Thermoplastic Composite manufacturing: Extrusion, Blow molding, rotational molding, Thermoforming

Unit 4: Metal and ceramic matrix composites:

Metal Matrix Composites: Metal matrix and reinforcement; Manufacturing processes for Metal Matrix Composites: Dispersion hardened and particle composite; Manufacturing processes for Metal matrix composites: Layer composites and infiltration method

Recommended Books:

1. Engineering Materials: Polymers, Ceramics and Composites A.K Bhargava Prentice Hall India.
2. Materials characterization, Vol. 10, ASM hand book.

Online resource

https://nptel.ac.in/courses/112/104/112104221/

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T.Y.B. Tech.(Mechanical Engineering) Semester-VI Year 2020-2021

SLH32- Self Learning Technical

(b) DESIGN PRACTICE

Teaching Scheme-Nil **Examination Scheme**

ESE: 50 Marks

Course Introduction:

The course is intended for beginners in engineering studies in Design. It can also serve well for aspiring professionals in industry who will be willing to undertake careers in the field of design.

Course Prerequisites: Mechanics of Materials, Engineering Mechanics

Course Objectives:

1. To train the students with good design engineering concepts
2. To make students proficient in Material selection and analysis

Course Outcomes: At the end of course, students will be able to-

1. Use concurrent engineering approach in product design
2. Select the suitable material and design the work system

SECTION-I

Unit 1. Introduction and stages of engineering designs

Brief introduction of Design systems, Product Development, Basic protocols of industrial design, Design thinking and innovation, Brain Storming, Design prototyping, Generic Phases of the Design, Configurational Design Aspects.

Unit 2. Concurrent Engineering Product design

Concurrent Engineering Approaches, Benefits of concurrent engineering, Concurrent engineering environment influencing dimensions, Program & product Interface dimensions in

Concurrent engineering, Product Development Methodology, Elements of concurrent engineering, Optimization in product development, Business relationships in concurrent

Engineering.

SECTION-II

Unit 3. Material selection processes

Organizational elements in concurrent engineering, Techniques for the Implementation of concurrent engineering environment, Average quality loss, Robustness in Design, Material selection in Engineering design, Basic steps in Material Selection Process

Unit 4. Design and analysis

Design of Work Systems, Motion Study, Axiomatic Design, Introduction to group technology, Failure Mode Effect Analysis

Books:

Design Practice**,** Prof. Shantanu Bhattacharya IIT Kanpur

Online Resource:

https://nptel.ac.in/courses/112/104/112104228/

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T.Y.B. Tech.(Mechanical Engineering) Semester-VI Year 2020-2021

SLH32- Self Learning Technical

(c) JOINING TECHNOLOGIES FOR METALS

Teaching Scheme-Nil **Examination Scheme**

ESE: 50 Marks

Course Introduction:

Course Introduction: It is proposed to include following joining technologies of commercial importance under different groups of processes:

A) Fundamentals of Metal Joining Technologies: mechanisms for obtaining metallic continuity: fusion, deformation, diffusion, chemical interactions.

B) Fusion based processes: principle of fusion welding processes, oxy-fuel gas welding, common arc welding processes, laser beam welding, spot welding processes, newer variants of fusion welding processes

C) Metallurgical Aspects of Welding: weld thermal cycle, solidification of weld metal, weldability of carbon steel, alloys steel, stainless steels, and aluminum alloys, Fe-C, CCT and Schaeffer diagram for understanding the metallurgical transformation in weld and heat affected zone., basics of residual stresses

D) Common issues related with joining technologies their causes and remedies: hardening and softening of heat affected zone, porosity, cracking.

Course Prerequisites: Engineering Metallurgy, Work shop practices, Manufacturing processes.

Course Objectives: To make the students proficient in:

1. To study different metal joining processes
2. To understand metallurgical aspects and common issues related with joining processes

Course Outcomes: At the end of course, students will be able to-

1. Summarize and examine different metal joining processes
2. Discuss and explain metallurgical aspects of metal joining processes

SECTION-I

Unit No.1: Introduction of Metal Joining Technologies:

Manufacturing and Joining Fundamental Mechanisms of joining, heat and pressure in joining, Classification of joining processes, Heat generation and power density concept in welding, Protection of the weld metal approaches, effect of gases on weld properties.

Unit No.2: Fusion Based Joining Processes:

Principle of fusion welding processes: oxy-fuel gas welding, Fundamentals of welding: type of weld, types of joint, welding position, arc heat generation, Physics of welding arc: arc imitation, maintenance, Shielded metal arc welding: Electrode melting rate, effect of electrode polarity and welding parameters, Gas tungsten arc welding: electrode, shielding gases, Introduction of gas metal arc welding.

Variants of Gas tungsten arc welding: GTAW, Submerged arc welding Electro-slag and Electro-gas welding processes Laser beam welding.

SECTION-II

Unit No.3: Metallurgical Aspects of Welding:

Weld thermal cycle, Heat affected zone, Heat affected zone and weld thermal cycle: I & II, Solidification of weld metal, Fundamentals of weldability of metals, Weldability of carbon & alloy steels: Fe-C, CCT, Weldability of stainless steels: Schaeffer diagram, Metallurgical transformation in weld and heat affected zone of steels.

Unit No.4: Weldability and Nondestructive Testing for Weldment:

Weldability of aluminium alloys: Porosity, HAZ softening, PMZ issues, solidification, cracking and their control, Residual stresses in weld joints: effect on joint performance, and control of residual stress, cracking of welded joints: solidification and liquation cracks and cold cracking

Reference Books:

1. Welding Process and Technology by Dr. R.S. Parmar
2. Advanced joining Technology by T. H. North

Online resource

https://nptel.ac.in/courses/112107213/#

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T.Y.B. Tech.(Mechanical Engineering) Semester-VI Year 2020-2021

SLH32- Self Learning Technical

(d) STEAM POWER ENGINEERING

Teaching Scheme-Nil **Examination Scheme**

ESE: 50 Marks

Course Introduction:

This course deals with steam power plants. One part of the course is about Simple steam power cycle, reheat, regeneration and superheating. Further actual cycle with component efficiencies would also be discussed. Then each component of the plant is discussed in detail. Initially, types of steam generators and their parts are highlighted. Then steam turbine, its type, efficiency and arrangements are focused. Thus this course would provide an understanding on electricity generation or transportation application using steam as working medium.

Course Prerequisites: Thermodynamics, Fluid Mechanics

Course Objectives: To make the students proficient in:

1. Performance evaluation of different thermal cycles and techniques
2. Working principles of steam turbines and cooling towers.

Course Outcomes: At the end of course, students will be able to-

1. Analyze and evaluate the performance of different cycles & efficiency enhancement techniques
2. Illustrate various types of boilers (steam generators)

SECTION-I

Unit No.1: Vapour Power Cycles

Carnot cycle, Rankine cycle, reheat cycle, Regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration, Low temperature power cycles, ideal working fluid and binary/multi-fluid cycles

Unit No.2: Steam Generator

Subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water tube boilers, mountings and accessories

SECTION-II

Unit No.3: Steam Turbine

Impulse and reaction stage, degree of reaction, velocity triangle, efficiencies Velocity and pressure compounding, Reheat factor and nozzles

Unit No.4: Cooling Tower

Significance of Cooling tower, Hygrometry and psychometric chart

Books

1. Thermal Engineering RK Rajput
2. Steam and Gas Turbines and Power Plant Engineering Dr. R. Yadav
3. Steam Power Engineering: Thermal and Hydraulic Design Principles 1st Edition
4. NPTEL online course material