SHIVAJI UNIVERSITY, KOLHAPUR

REVISED SYLLABUS AND STRUCTURE
FINAL YEAR (B. Tech.)

MECHANICAL ENGINEERING

To be introduced from the academic year 2021-22
(i.e. from June 2021) onwards

(Subject to the modifications will be made from time to time)

FINAL YEAR MECHANICAL ENGINEERING – CBCS PATTERN

SEMESTER –VII

Sr. No	Course (Subject Title)	TEACHING SCHEME									EXAMINATION SCHEME											
		THEORY			TUTORIAL			PRACTICAL			THEORY					PRACTICAL			TERM WORK		
		Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Credits	No. of Lecture	Hours	Hours	Mode	Marks	Total Marks	Min	Hours	Max	Min	Hours	Max	Min
1	PCC ME401	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10
2	PCC ME402	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		25	10	2	25	10
3	PCC ME403	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40				2	25	10
4	PCE ME404	3	3	3	-		-	1	2	2		CIE ESE	30 70	100	40				2	25	10
5	PCE ME405	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40		-	-	2	25	10
6	PCC ME406	-	-	-	-	-	-	1	2	2									2	25	10
7	SI ME407	-	-	-				1	-	-		-	-	-	-		-	-	-	25	10
8	PW ME408	-	-	-				3	6	6		-	-	-	-		25	10		25	10
	TOTAL	**15**	**15**	**15**				**10**	**18**	**18**				**500**			**75**			**200**	

SEMESTER –VIII

1	PCC ME409	3	3	3	-	-	-	1	2	2		CIE ESE	30 70	100	40	As per BOS Guidelines	25	10	2	25	10
2	PCC ME410	3	3	3	-	-	-	1	2	2				100	40				2	25	10
3	PCC ME411	3	3	3	-	-	-	1	2	2		ESE	70	100	40		25	10	2	25	10
4	PCE ME412	3	3	3	-	-	-	1	2	2				100	40		-	-	2	25	10
5	PCE ME413	3	3	3	-	-	-	1	2	2		ESE	70	100	40		-	-	2	25	10
6	PCC ME***414	2	-	-	-	-	-	-	-	-		-	-	-					2	25	10
8	PW ME415	-	-	-	-	-	-	3	6	6		-	-	-	-		25	10	6	50	20
	TOTAL	**17**	**15**	**15**				**8**	**16**	**16**				**500**			**75**			**200**	

	TOTAL	**32**	**30**	**30**				**18**	**34**	**34**		**1000**		**150**		**400**	

CIE- Continuous Internal EvaluationESE – End Semester Examination

• Candidate contact hours per week : 30 Hours(Minimum)	• Total Marks for B.E. Sem VII & VIII :**1550**
• Theory/Tutorial Duration:60 Minutes and Practical Duration:120 Minutes	• Total Credits for B.E. Sem VII & VIII :**50**
• In theory examination there will be a passing based on separate head of passing for examination of CIE and ESE.	
• There shall be separate passing for theory and practical (term work)courses.	

Note:

1. Professional Core Courses-Mechanical Engineering (PCC-ME) are compulsory.
2. Professional Core Electives –Mechanical Engineering (PCE-ME) are compulsory.
3. Summer Internship -Mechanical Engineering (SI-ME) is compulsory.
4. Project Work Mechanical Engineering (PW-ME) is compulsory.
5. **PCC-ME***- Online Certificate Course.**

The Student should register the online course with Moodle/Swayam/MOOC/NPTEL. etc. of his interest in Recent Advances in Mechanical Engineering at a Start of his/her final year (i.e. at Semester VII.) and Same is intimated to Head of Department or Coordinator. For Term Work, Student has to Submit Completion Certificate of Course to the Department till end of Semester VIII. Term Work will be given at the end of Semester VIII. The Head of Department has to assign a Coordinator or Supervisor for Online Certificate Course.

Semester VII

Sr. No	Code No.	Subject	Credits
1.	PCC ME 401	Refrigeration and Air Conditioning	4
2.	PCC ME 402	Mechanical System Design	4
3.	PCC ME 403	Finite Element Analysis	4
4.	PCE ME 404	Elective I	4
5.	PCE ME 405	Elective II	4
6.	PCC ME 406	Seminar	1
7.	SI ME 407	Summer Internship @	1
8.	PW ME 408	Project Phase -I	3
		Total	25

Semester VIII

Sr. No	Code No.	Subject	Credits
1.	PCC ME 409	Mechatronics	4
2.	PCC ME 410	Energy and Power Engineering	4
3.	PCC ME 411	Noise and Vibration	4
4.	PCE ME 412	Elective III	4
5.	PCE ME 413	Elective IV	4
6.	**PCE ME414*** **	**Online Certificate Course**	**2**
7.	PW ME 415	Project Phase –II	3
		Total	25

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech (Mechanical Engineering) **CBCS PATTERN Semester VII**

REFRIGERATION AND AIR CONDITIONING

SUBJECT CODE: PCC ME401

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks
	Oral Exam: 25 Marks

Pre-requisites: Applied Thermodynamics, Heat and Mass Transfer

Course Objectives:

The course aims to:

1. Study basic refrigeration cycles and Psychometric.
2. Performance Evaluation of Refrigeration and Air Conditioning Systems
3. Enable thestudentstoanalyzeandsolverefrigerationrelatedproblems byapplying principles of mathematics, science and engineering

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Demonstrate an understanding of the need and importance of HVAC technology, the typical and some advanced and innovative schematic designs, and the goals of HVAC engineering andHVACsystems.
2. Demonstrate an understanding thermal comfort conditions with respect to temperature and humidity and human clothing and activities and its impact on human comfort, productivity,andhealth.
3. Demonstrate an understanding of psychometrics and its application in HVAC engineering and design and will practice or observe psychometric measurements.
4. Demonstrate an understanding of heat transfer in buildings with a given architectural design and its application to heating and cooling load estimation especially including thermal lag effects by conducting a detailed annual load analysis for a representative building and present the results of this analysis in a formal report possibly including recommendations forenergyconservation.
5. Demonstrate an understanding of the engineering and operation of vapour compression and possibly heat-driven refrigeration systems and evaporative cooling systems and understand contemporary issues of ozone depletion and global warming potential with respect torefrigerationsystems.

Unit 1

Application of Second Law of Thermodynamics [03]

A Refrigerating Machine – The Second Law Interpretation,Introduction to Heat pump, Heat Engine and Refrigerator (with Numerical treatment), Energy Ratios (EER), BEE star rating COP, Power Consumption of a Refrigerating Machine, Refrigeration Cycle, vapour as a Refrigerant Reversed Carnot Cycle Limitations of Carnot Cycle with Gas as a Refrigerant, Reversed Brayton or Jouleor Bell Coleman Cycle, Introduction to aero-plane air conditioning cycles (Only Theory)

Unit 2

Vapour Compression System [08]

Limitations of Reversed Carnot Cycle with vapour as a Refrigerant, Dry versus Wet Compression, Throttling versus Isentropic Expansion, Introduction to Vapour Compression Cycleand Vapour Absorption cycle.Pressure Enthalpy Diagram and Calculations (Numerical on VCR Cycle) and effect of Operating Conditions, effect of Evaporator Pressure Effect of Condenser Pressure, effect of Suction Vapour Superheat, effect of Liquid Sub cooling, Using Liquid- Vapour Regenerative Heat Exchanger, Actual Vapour Compression Cycle.Removal of flash gas, Flash intercooling, Introduction to cryogenic Engineering and applications,

Unit 3

Refrigerants and Refrigeration Equipment [09]

Classification, Desirable Properties like Thermodynamic, physical, and chemical.Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerants. Environmental Protection protocol and India's commitment. Introduction to role of ASHRAE &ISHRAE in refrigeration and air conditioning area, ASHRA Nomenclatures. Insulation, types and different applications, properties of ideal insulations.Introduction to Equipment such as Compressor, Condenser, Evaporator, Expansion devices. Applications of Refrigeration in Dairy plant, Ice-plant, Cold storage.

Unit 4

Psychrometry and Human Comfort [09]

Moist air as a working substance, Psychrometric properties of air, Use of Psychrometric tables and charts, Processes, Combinations and Calculations (Numerical on Psychrometry), ADP, Coil Condition lime, Sensible heat factor, Bypass factor, Air washer and itsapplications. Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements.

Unit 5

Heating andCooling load calculations [05]

Design of air conditioning systems, different Heat sources,- Adiabatic mixing of two air streams, sensible heat factor, RSHF, GSHF, ERSHF, Room apparatus dew point and coil apparatus dew point, Ventilation and infiltration, Inside and Outside Design condition. Cooling Load estimation, Introduction to, Variable Refrigerant Flow systems, VAV control systems, Inverter Units. Introduction to Inverter technology and its use in power failure, Introduction to Phase change material used for temperature retention inrefrigerator.

Unit 6

Air Distribution System [06]

Re-circulated air, Ventilation air, Duct work, Use of friction loss and rectangular equivalent of round duct chart, duct system, principle of duct sizing, and air distribution it's norms, diffusers, dampers, layout, duct systems for theaters, auditorium, hospitals, assembly shop etc. Energy Conservations and Green Buildings, Freeze drying, Pharmaceutical and hospital air conditioning, textile, car air conditioning (plant layout, system components and design conditioning)

TermWork:

1. Study of various conventional and Nonconventional methodsofrefrigeration.
2. Studyanddemonstrationofrefrigerationsystem.(Water cooler, refrigerators,chiller,ice plant andcoldstorage).
3. Trial on Electrolux-RefrigerationTestRig.
4. Trial on heat pumptestrig.
5. Study and trial on vapourabsorptionsystem
6. Trial two stagecascadesystem.
7. Trial on ice planttestrig
8. Trial on window air conditioner or Air ConditioningTestRig
9. Study and demonstration on air conditioningsystems. (Unitary viz Room/Split and Packaged Air Conditionersand central air conditioning/system)
10. Study and demonstration on Compressor, Condenser, Evaporator, Expansion, devices, Types, selection. Component balancing, safety devices and refrigeration controls
11. Study anddemonstration of dehydration, charging leak testing and testing of refrigeration system with trouble shooting.
12. Study and demonstration of controls and safety devices in refrigeration and air conditioning.
13. Visit to central air conditioning or cold storage or dairy plant to ice plant related with refrigeration and air conditioning system.
14. Market survey of various refrigeration and air conditioning systems which include the equipment's with related specifications, manufacturers, cost and comparison with respect to tonnage, coat and presentation of report inthelaboratory.

(Three trials and market survey report is compulsory.Total 10 are compulsory)

Reference Books:

1. "Basic Refrigeration And Air Conditioning", PNAnanthanarayanTataMcGrawHillPublishing Company Ltd., New Delhi, 3rd Edition,(1981).
2. "Principles of Refrigeration" RoyJ. Dossat, Pearson Education, 4thEdition.
3. "Refrigeration andAir Conditioning", Stoker.
4. "Refrigeration and Air Conditioning", Arora Domkundwar, Pearson Education,3rd Edition.
5. "Refrigeration and Air Conditioning",V.K.Jain.
6. Air Conditioning Principles and Systems",Pita,PrenticeHall of India Publisher, 4thEdition.
7. "Air Conditioning Applications and Design",W. P. Jones, Elsevier,2ndEdition.
8. "Air Conditioning Engineering", W. P. Jones,Elsevier,5thEdition.
9. "Thermal Environmental Engineering", Tnerellaild Prentice Hall of India Publisher,3rdEdition.

Text Book:

1. "RefrigerationandAir Conditioning",C. P.Arora,TataMcGraw-HillPublishingCompany Ltd., New Delhi,1981,2ndEdition.
2. "Refrigeration and Air Conditioning", by Er.R.K.Rajput.(3rdEdition,Katsonbook.)

SHIVAJI UNIVERSITY, KOLHAPUR,
Final Year B.Tech (Mechanical Engineering) CBCS PATTERN Semester VII

Mechanical System Design

SUBJECT CODE:PCC-ME402

Teaching Scheme:	Examination Scheme:
Lectures: 3Hrs/ Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25 Marks
	Oral Exam: 25 Marks

Pre-requisites: Applied Mechanics, Analysis of Mechanical Elements, Theory of Machines (I&II), Machine Design (I&II),

Course Objectives:

The course aims to

1. Enable student to develop competency for new system by involving Industrial engineering aspects.
2. Acquaint student about the use of IS Codes during the design of pressure vessels.
3. Introduce student to design the mechanical Systems. Like Clutch and Braking.
4. Familiarize student about design machine tool gearbox, design internal combustion(IC) engine components and material handling systems.

Course Outcomes:

On completion of the course, students will be able to

1. Understand the role of aesthetics, ergonomics and creativity in design.
2. Understand theories and principles used in design of pressure vessels. IC Engine and material handling equipments.
3. Analyze and select suitable materials and design parameters during the design of pressure vessels, IC engine components, machine tool gear box and material handling systems as per industrial and societal requirement.
4. Evaluate the load carrying capacity, stress bearing capacity in various mechanical systems like unfired pressure vessels, IC engine components.
5. Design various mechanical systems like pressure vessels, machine tool gear boxes, material handling systems, etc. as per industrial and societal requirement.
6. Create the competency in mechanical system design by applying industrial design aspect

Unit 01

Aesthetic and Ergonomic Consideration in Design: [6]

Basic types of product forms, Designing for appearance, shape, Design features, Materials, Finishes, proportions, Symmetry, Contrast etc. Morgon's colour code. Ergonomic considérations- Relation between man, machine and environmental factors. Design of displays and controls. Practical examples of products or equipment's using ergonomic and aesthetic design principles. Creativity concept in designing. Theoretical treatment of optimum design and adequate design.

Unit 02

Pressure Vessel Design [7]

Thin and thick cylinders; Failure criteria of vessels; Lame's equation; Clavarino's and Birnie's equation; Autofrettage and compound cylinders; Types of pressure vessels-Horizontal and vertical; Classification of pressure vessel as per IS2825, 1969, Introduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening and nozzles in shell and covers. Types of pressure vessel support.

Unit 03
Design of Braking and Clutch System [7]

Brakes: Design consideration in brakes, Band, Internal expanding shoe, External contracting shoe. Thermal consideration and rating of brakes.

Clutches: Design requirement of friction clutches, Selection criteria, Torque transmitting capacity of single plate, Multi disc clutch, Cone clutch and Centrifugal clutch.

Unit 04
Design of Gear boxes for machine tool applications [7]

Determination of variable speed range- Graphical representation of speeds- Structure diagram- Deviation diagram- Ray diagram- Selection of optimum ray diagram- Difference between number of teeth of successive gears in a change gear box- Analysis of twelve speed gear box- Compound ray diagram

Unit 05
Design of I. C. Engine Components [7]

Introduction to selection of material for I. C. engine components, Design of cylinder and cylinder head, Design of cylinder liners, Design of piston and piston-pins, Piston rings, Design of connecting rod, Design of crank-shaft and crank-pin.

Unit 06
Design of Material Handling System [6]

Design of belt and chain conveyors – Power requirement, Selection of belt and chain, Design of tension take up unit, Idler pulley.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. A detail design report and A2 size sheet containing working drawing of detail and assembly of
   a) Design of Machine Tool Gear Box.(Three Stage, Twelve speed gear Box)
   b) Pressure vessel design/ Brake design or Clutch design.
2. Assignment based on
   a) Aesthetic and Ergonomic design considerations –case study.
   b) Problems on Material Handling System.
   c) Minimum four Problems on Design of IC Engine components. such as connecting rod, crank shaft, piston with piston rings and pins, cylinder and cylinder head.

TEXT BOOKS:

1. "Design of Machine Elements", V.B.Bhandari, Tata Mc- Graw Hill Publication, 3rdEdition.
2. "Mechanical Engineering Design", Shigley and C.R.Miscke, Tata Mc- Graw Hill Publication.
3. "Mechanical Design Analysis", M.F.Spotts, Prentice Hall Publication.
4. "Design of Machine Tools", S.k. Basu and D.K. Pal Oxford and IBH Publication, 6thEdition.
5. "Machine Tools Design",N.K. Mehta, Tata Mc- Graw Hill Publication, 5th Edition.
6. "Design Data Book",P.S.Gill (PSG) 3rd Edition.
7. I.S.:2825 Code for Unfired Pressure Vessels.

REFERENCE BOOKS:

1. "Handbook of Gear Design",JitinMaitra,TataMc-Graw Hill Publication.
2. "Machine Design", Black P.H.and O.Eugene Adams, Tata Mc- Graw Hill Publication.
3. "Mechanical Design Synthesis with Optimisation Applications",Johnson R.C.,Von-Nostrand-Reynold Publicaion.
4. "Engineering Design",Dieter G.E., Tata Mc- Graw Hill Publication, 4th Edition.
5. "Mechanical System Design",S.P.Patil, Jaico Publication House,New Delhi,2nd Edition.
6. "Product Design and Process Engineering",Benjamin W. Niebel , Alan B. Draper, TataMc-Graw Hill Publication.
7. "Design of Pressure Vessel", Harve, CBS Publishers and Distributors Van Nostrand Reinhold.
8. "Engineering Optimization Theories and Practice", S.S.Rao, New Age Publication, 3rdEdition.
9. "Process Equipment Design", M.V.Joshi ,Macmillal Publication, 3rd Edition.
10. "Machine Design", Robert L.Norton, Tata Mc- Graw Hill Publication.
11. "Machine Design", P. Kannaiah, Scitech Publication, 2nd Edition.
12. "Fundamentals of Machine Component Design",Junvinall Wiley India, 5th Edition.
13. "Mechanical System Design", Anurag Dixit, SCITECH Publication.
14. "Principles of Machine Tool", Sen. Bhattacharya, New Central Book Agency.
15. Material Handling Equipments by N. Rudenko, Peace Publication.
16. Material Handling Equipments by Alexandrov, Mir Publication.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBSE PATTERN Semester VII**

FINITE ELEMENT ANALYSIS

SUBJECT CODE: PCC ME 403

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	ESE : 70 Marks
Practical : 02 Hrs. per week	CIE : 30 Marks
Credits: 04	Term Work : 25 Marks

Pre-requisites: Matrices, Partial differentiation, Strength of materials.

Course Objectives:

1. To define the basic finite element formulation techniques
2. To derive the finite element equations for 1D, 2D Elements.
3. To formulate and solve basic problems in Solid Mechanics & heat transfer.
4. To use commercial software to solve Basic Engineering problems in Solid Mechanics & heat transfer.

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

1. Elaborate the fundamental concepts of Finite Element method.
2. Understand the key concepts like Shape function, element stiffness and boundary conditions by finite element formulations for 1D problem.
3. Apply the finite element formulations for two dimensional problems using constant strain triangle.
4. Demonstrate the modeling aspects of axisymmetric solids subjected to axisymmetric loading.
5. Apply the finite element formulations for Planer Trusses using 1D element.
6. Solve Scalar field problems by Finite element formulation.

Unit 1 FUNDAMENTAL CONCEPTS 04

Introduction to FEA, Brief History, General FEM procedure, Simplification of problem through Symmetry, Various terminologies associated with FEA (Discretization, nodes and element) Stiffness matrix and its properties.) Application of FEM in various fields.Advantages and Disadvantages of FEA

Unit 2 ONE DIMENSIONAL ELEMENT 07

Introduction to One dimensional element, Types of One dimensional element, Derivation of Stiffness matrix and Shape function for one dimensional Linear and Quadratic element. Stress analysis of a Stepped bar, Thermal analysis of a Composite Wall and Torsion analysis of a shaft using 1 D element. Treatment of Boundary conditions by Elimination approach and Penalty approach

Unit 3 TWO-DIMENSIONAL ELEMENT 08

Introduction to two-dimensional element, Derivation of Stiffness matrix and Shape function for two dimensional linear element. Numericals on Two-Dimensional analysis using 2Delements (Constant Strain Triangle

Unit 4 ANALYSIS OF AXISYMMETRIC SOLIDS 06

Introduction & applications of Axisymmetric elements, axisymmetric formulation, finiteelement modeling, triangular element and stress calculations

Unit 5 ANALYSIS OF TRUSS 08

Trusses:-Plane trusses, Local and Global coordinate systems, Derivation of Global stiffness matrix, Formulae for calculating L and M, element stiffness matrix, Stress Calculations,Assembly of global stiffness matrix.

Unit 6 SCALAR FIELD PROBLEMS 07

Introduction, Steady state heat transfer, one dimensional heat transfer in thin fins, Twodimensional steady state heat conduction, Two dimensional fins.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Assignment on Discretization – types of elements, choice of element and type of meshing – automatic, mapped, meshing in criticalareas.

2. Finite Element Analysis of Stepped bar (Two or Three Steps only)using,
a) Finite Element Approach(Theory)
b) Finite Element Software (ANSYS / HYPERWORKSetc.)
Compare the results obtained by abovemethods.

3. Finite element analysis of Composite wall (Minimum threeslabs)

a) Finite Element Approach(Theory)
b) Finite Element Software (ANSYS / HYPERWORKSetc.) Compare the results obtained by abovemethods.

4. Use of any ONE Standard software package like ANSYS / HYPER WORKS etc. for solving following problems: **(ANY FIVE)**

- □ Static Analysis of Truss
- □ Static Analysis of Beam
- □ Static Analysis of Plate with a circular hole
- □ Thermal analysis of Composite wall under Convection &Conduction.
- □ Torsional Analysis of ashaft.
- □ Analysis of Wallbracket.
- □ Analysis of 1Dfin.
- □ Introduction to Ansys Work bench
- □ Importing external geometry file into ANSYSClassic.
- □ Analysis of a machine element using ANSYS / HYPER WORKS etc.

5. Finite element analysis of STEPPED BAR in ANSYS using**APDL.**

TEXT BOOKS:

1. "Introduction to Finite Elements in Engineering"; Chandrupatala-Belgundu, PHI.
2. "Finite Element Method with Application in Engineering" Y. M. Desai, T. I. Eldho, A. H. Shah, Pearson.
3. "Textbook of Finite Elements Analysis", P. Sheshu, Prentice-Hall of India Private Limited, New Delhi.
4. "An Introduction to Finite Element Method"; J. N. Reddy; 2/e, McGraw Hill International Editions, ISBN 0-07-112799-2
5. Finite Element Analysis – Theory and Practice"; M.J. Fagan, Longman Scientific &Technical.
6. "Finite Element Analysis", UdaiBorker, Nandu Printers & Publishers Pvt. Ltd.Mumbai.

REFERENCE BOOKS:

1. "Practical Finite Element Analysis", N.S. Gokhale, S.S. Deshpande, S.V. Bedekar, A.N.Thite,Finite to Infinite Publication.
2. "Concepts of Finite Element Methods",ManickaSelvam, SCITECH publication
3. "Finite Elements Analysis – Theory and Application with ANSYS, Sawed Mouveni, Prentice HallInc.
4. "Applied Finite Elements Analysis", Larry J. Segerlind, BSP Books Pvt Ltd.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech (Mechanical Engineering) **CBCS PATTERN Semester VII**

Experimental Mechanics (Elective- I)

SUBJECT CODE: PCE ME404

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Analysis of mechanical elements, material science

Course Objectives:

1. Introducetheconceptofexperimentalstressanalysis
2. Prepare mechanical engineering students for advanced graduate studies in various experimental stress analysis techniques like photo elasticity, strain gauge etc.
3. Supply qualified personnel to meet the requirement in experimentalstress analysis

Course Outcomes:

1. To analyze photo elastic technique for stressanalysis
2. To explain the concept of strain gages and itsapplications
3. To elaborate the concept of coatingmethods.
4. To applythe knowledge of Moiré fringe method for stressanalysis

Unit 01 Principles ofExperimentalApproach- [03]

Introduction to Experimental Mechanics, advantages scope of Experimental Mechanics in design, various experimental methods of stress analysis and their relative merits and demerits

Unit 02 Two DimensionalPhoto elasticity- [11]

- □ Stress optics law, material fringe value in terms of stress and strain, significance of material fringevalue
- □ Nature of light, Wave theory of light - opticalinterference

- □ Photoelastic Materials - Criteria for selection, common photoelastic materials and their properties, Photoelastic sheet casting and model making, calibration of photoelastic material, calibration methods using circulardisc
- □ polariscope, its scope in photo elasticity, various configurations of polariscope
- □ effect of stressed model in plane and circular polariscope, isoclinics, isochromatics, their significance in photoelastic stressanalysis
- □ Properties of 2D photoelastic model materials, Materials for 2Dphotoelasticity
- □ Methods for fractional fringe measurement , Tardy's method of compensation (Derivation)

Unit 03 Analysis of Photo elastic Data– [06]

Principle of photoelasticity, methods of photoelastic stress analysis, temporary and permanent double refraction

Determination of direction of principal stresses at a given point, shear difference method, oblique incidence method and electrical analogymethod.

Unit 04 Strain Measurement Using Strain Gauges– [07]

Concept, meaning of strain gauges, desirable properties of strain gauges, types of strain gauges, Strain measurement using electrical resistance strain gauge, Selection and mounting of strain gauge, criteria for selection, mounting of gauge and checking its installation

Unit 05 Strain Gauge Circuitry– [07]

Wheatstone bridge circuit, its role in measurement of resistance change, condition for bridge balance, different configurations of Wheatstone bridge, output voltage of Wheatstone bridge, relationship between output voltage and strain, commercial strain indicators, potentiometer circuit.

Introduction to strain gauge rosettes, two, three and four element rosettes, different configurations of rosettes and their comparison, determination of magnitudes and direction of principal stresses when principal stress directions are specified and notspecified.

Unit 06 Coating Methods and Moire Fringemethod– [06]

Introduction, Brittle coating, coating stresses, crack patterns, crack detection techniques, selection of brittle coating, advantages, Birefringent coating:- Limitations and applications, Introduction to Birefringent coating, Birefringence coating stresses, Effects of coating thickness: Reinforcing effects, Poisson's effect , reflection polar scope

Introduction to Moiré fringe method of stress analysis – Mechanism of fringe formation, approaches to moiré fringe analysis, advantages, limitations and applications

TERM WORK :

Any eight out ofthe following list

1. Bonding of strain gauge and checking itsinstallation.
2. Determination of gauge factor for one arm sensitive and two armsensitive configuration.
3. Determination of gauge factor for four arm sensitive and four arm sensitive two linear and two lateralconfiguration.
4. Transducer applications of strain gauge- determination of unknown weight using load cell.
5. Study of photo elastic stress analysis – use of diffused light transmissionpolariscope.
6. Determination of fractional fringe order using Tardy's method.
7. Calibration of photoelastic materials - determination of material fringevalue.
8. Study of Moiré Fringe Technique.
9. Study of Brittle Coating Method.
10. Study of photo elastic materials.

TEXT BOOKS:

1. "Experimental Stress Analysis", Dr. Sadhu Singh; Khanna Publishers, 5 thEdition.
2. "Experimental Stress Analysis", U.C. Jindal, Pearson Publications, 1 stEdition.
3. "Experimental Stress Analysis", Abdul Muben; DhanpatRaiandCo., 1 stEdition.
4. "Experimental Stress Analysis", Vazirani, KhannaPublications.
5. "Stress Analysis and Experimental Techniques an Introduction", J. Srinivas,Narosa Publications.

REFERENCE BOOKS:

1. "Experimental Stress Analysis",J.W. Dally and W.F.Riley, Tata McGraw Hill Book Company, 3rdEdition.
2. "PrinciplesofExperimentalStressAnalysis",byAmericanSocietyforMetals,6thEdition.
3. "Experimental Stress Analysis", L.S.Srinath., Tata McGrawHill.
4. "Experimental Stress Analysis", Dove and Adams Merrill, 1 stEdition.
5. "The Strain Gauge Primer", Perry Listner McGraw Hill Book Company2 ndEdition.
6. "Moiré Fringes", Theocoris., Pergamon Press limited.
7. "Experimental Stress Analysis Principles and Method", by Holister G.S., Cambridge Engineering Services.

SHIVAJI UNIVERSITY, KOLHAPUR

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

HUMAN AND PROFESSIONAL ETHICS (Elective-I)

SUBJECT CODE: PCE ME 404

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	ESE: 70Marks
Practical : 02 Hrs. per week	CIE: 30Marks
Credit:04	Term Work: 25Marks

Pre-requisites:NA

CourseObjectives:

1. The objective of the course is an exploration of human values which go into making a good human being, a good human society and a good life. The context is the work life and the personal life of modern Indian professionals.
2. The movement to identify and remote the values shared by societies around the world is relatively new.
3. It is only in recent years as globalization extended its reach to even remote corners of the earth that he need to refocus and build upon what we as a human society have in common, has become apparent.
4. Increased contact between peoples and nations enhances awareness of our kinship and the shared code of ethics and conduct that underlies all civilization.
5. It's the Human values that we must now promote to create a common vision and means for moving forward toward a more peaceful and sustainable world.
6. The course also aims to have students appreciate the vastness of the Universe and the

wonder of its parts, and the philosophical significance of this for improving the quality of human life through value clarification.

Course Outcomes: Upon successful completion of this course, the student will be able to:

1. Understand the role of cognitive and moral values in world views, by discussing and writing about the ethical implications of modern scientific and technological results
2. Recognize the difference between matters of fact and matters of value, while understanding the important ways in which facts influence value assessments and how value judgments shape our vision of "the facts"
3. Understand ethical methodologies and competency in ethical deliberation on rationally applying these methodologies to contemporary ethical questions related to scientific progress and technological power
4. Understand why ethics plays an important role in science and technology
5. To help students apply this understanding to make their living better at different levels- individual, family, society and nature
6. To facilitate the students in applying this understanding in their profession and lead an ethical life

Unit 1 Human Values [8]

The value, crisis in the contemporary Indian Society, The Indian system of values in the Indian constitution, Aesthetic values: perception and enjoyment of beauty, Relative and absolute values, Morals Values and Ethics, Integrity Service Work Ethic Service Learning Civic Virtue, Respect for Others, Respect for the Environment, Quest for Living Peacefully and happily, Attitude of Nonviolence Innate dignity for human life, Bring out the best in oneself caring Sharing Honesty Courage, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence Character, Spirituality

Unit 2 Harmony in the Human Being [6]

1. Human Being is more than just the Body 2. Harmony of the Self (I) with the Body 3. Understanding Myself as Co-existence of the Self and the Body 4. Understanding Needs of the Self and the Needs of the Body

Unit 3 Harmony in the Family and Society and Harmony in the Nature [6]

1. Family as a basic unit of Human Interaction and Values in Relationships 2. TheBasics for respect and todays Crisis: Affection, Care, Guidance, Reverence, Glory,Gratitude and Love 3. Comprehensive Human Goal : The Five dimensions of Human Endeavour

Unit 4 Safety [5]

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – The Government Regulator's Approach to Risk- the three mile island, Chernobyl and Bhopal case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality -conflicts of interest - occupational crime

Unit 5 Responsibilities and Rights [5]

Engineers responsibility, Professional rights - Employee rights - Intellectual Property Rights(IPR) - Discrimination

Unit 6 Experimentation and Global Issues [10]

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

Multinational corporations - Business Ethics -Environmental ethics –Role in Technological Development- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -Honesty-moral leadership-sample codes of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India, etc.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

The term work should be carried out with the methodology of Lectures, group discussions (based on case studies), movies, field visits, essays, and student self-investigation sessions.

1. TEN modules based on the topics mentioned above and including –

• Group Discussions based on Case Studies with Report/Essays.

• Undergoing the Art of Living's ***YES+ / Happiness Programme*** on the Awareness of Human Values conducted by VyaktiVikas Kendra ,Bangalore in assistancewith

INTERNATIONAL ASSOCIATION OF HUMAN VALUES.(IAHV).

• Visits (with report writing) to Public Institutes like MunicipalCorporation,ZP,Co-op organizations, social clubs like charitable trusts, Waste Water/Air Pollution Control Plant, Slum Areas etc.

• Conduction of Health and Hygiene Awareness Camp forSociety.

• Studyofeconomicstatusofthe society–Surveydata collection,analysisandany suggestions.

• Study of impacts of technology onsociety.

TEXT BOOKS:

1. "Professional Ethics and Human Values", M.P. Raghavan, Scitech Publications (India) Pvt Ltd.

2. "Human Values and Professional Ethics", Jayashri and Suresh B S ,S Chand .

3. "Ethics in Engineering", Mike Martin and Roland Schinzinger, , Tata McGraw-Hill, New York, (1996).

4. "Engineering Ethics(Including Human Values)",Govindarajan M, Natarajan S, Senthil Kumar V. S, Prentice Hall of India, New Delhi.

5. "A Textbook on Professional Ethics and Human Values", Naagarazan, R.S. ,New Age Publishers .

REFERENCE BOOKS:

1. "Engineering Ethics", Charles D. Fleddermann, Pearson Education / Prentice Hall of India , New Jersey, (Indian Reprint now available).(2004)
2. "A foundation course in Human Values and professional Ethics", R. R. Gaur, R. Sangal, G P Bagaria, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2
3. "Engineering Ethics –Concepts and Cases" Charles E Harris, Michael S. Protchard and Michael J Rabins, , Wadsworth Thompson Leatning, United States, (Indian Reprint now available), (2000).
4. "Ethics and the Conduct of Business", John R Boatright, Pearson Education, New Delhi, (2003).
5. "Fundamentals of Ethics for Scientists and Engineers", Edmund G Seebauer and Robert L Barry, Oxford University Press, Oxford.
6. "Business Ethics – An Indian Perspective", Prof. (Col) P S Bajaj and Dr. Raj Agrawal, Biztantra, New Delhi, (2004).

RELEVANT WEBSITES, MOVIES AND DOCUMENTARI

1. Value Education websites, http://uhv.ac.in, http://www.uptu.ac.in
2. Story of Stuff, http://www.storyofstuff.com
3. Al Gore, An Inconvenient Truth, Paramount Classics, USA
4. Charlie Chaplin, Modern Times, United Artists, USA
5. IIT Delhi, Modern Technology – the Untold Story
6. Gandhi A., Right Here Right Now, Cyclewala Productions

SHIVAJI UNIVERSITY, KOLHAPUR

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

AUTOMOBILE ENGINEERING (ELECTIVE –I)

SUBJECT CODE: PCE ME 404

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits: 4	Term work: 25Marks

Pre-requisites: IC Engine & Power plant

Course Objectives:

The course aims to:

1. Describe importance and basic knowledge of automobileengineering.
2. Classify various automobile layouts andbodies.
3. Demonstrate automobile systems, wheels and tyres and automobile electrical and electronic systems for understanding construction and workingprinciple.
4. Enable students to analyze and solve problems on automobile system by focus and critical thinking.
5. Demonstrate use of modern trends, techniques and skill to fulfill industrial needs by arranging industrialvisit.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Explain components ofautomobile.
2. Distinguish various types of automobile lay outs as per drive given towheels.
3. Identify types of automobile bodies and materials used for thesame.
4. Demonstrate various automobile systems like clutch, gearbox final drive, brake,steering suspension wheels and Tyres, and its construction andworking.
5. Demonstrate various electrical and electronic systems like lighting, starting charging electronic controlled management system and its construction and working principle, sensors used inautomobile
6. Solve the problems related with various resistances for the automobile, engine power calculation.
7. Explain modern trends, techniques used inindustries.

Unit 1. Introduction **[06]**

Automobile history and development, Classification, vehicle layouts- engine location and drive arrangement, safety regulations, specifications of vehicles, Type of vehicle bodies, body parts and its advanced materials, Type of vehicle coaches , Chassis types, constructional details, Types of Frames, sub frames, frameless vehicles, details of chassis material.

Unit 2. TransmissionSystem **[06]**

Clutch – Function and requirements, Classification, Construction and working of Single-plate, Multi-plate, Diaphragm spring and centrifugal clutches, Fluid flywheel.

Gear Box – Necessity, classification, construction of manual gear boxes like Sliding mesh, constant mesh, Synchromesh, Epicyclic gear train, Automatic transmission, Torque convertor, Electronic transmission control, Overdrive. Propeller shaft, Differential and final drive.

Unit 3 Steering andSuspension Systems **[08]**

Live and dead axles, live axle arrangementSteering systems, function, principle of steering, Ackerman and Davis, steering geometry, center point steering, cornering force, slip angle, scrub radius, steering characteristic, steering gearbox, power steering, collapsible steering.

Suspension system- Functions, Sprung and un sprung mass, Types of suspension linkages, types of spring - leaf, coil, air springs, telescopic shock absorber, hydro gas suspension, rubber suspension, Air suspension

Unit 4 Brakes, WheelsandTyres **[07]**

Brakes: Need, principle, types, Mechanical, hydraulic and pneumatic brakes disc and drum types, airbrakes, servo and power braking, ABS, brake adjustments, defects and causes, Electronic Brake Distribution(EBD).

Wheels and Tyres: Wheel construction, alloy wheel, Types, tyre construction, tread design, specification, factors affecting tyre performance, tyre wear and its causes, wheel balancing.

Unit 5 Electrical andElectronicSystems **[07]**

Automotive batteries - lead acid batteries, Advances in batteries ,battery charging system, alternators, principle and operation of cutout and regulators, starter motor, Bendix drive, lighting and electrical accessories, automobile air conditioning, panel board instruments. Electronic Controlled Management (ECM) Systems, Automobile wiring. Sensors used in automobile.

Unit 6 Performance & Recent TrendsinAutomobiles **[06]**

Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Gradability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, (Numerical on Vehicle Resistance), Cruise Control, Adaptive Cruise Control (ACC), Electronic Stability Program (ESP), Traction Control System (TCS).

Term Work:

Minimum eight experiments from Group A and all experiments from Group B are to be performed.

Group A.

1. Study and demonstration of four wheeler chassis layout and vehicle body parts and itsmaterials.
2. Study and Demonstration of working of single plate automobile clutch and clutch plate lining materials.
3. Study and demonstration of synchromesh gearbox. (necessity, interlocking mechanism, gear shifting mechanism(Troubleshooting)
4. Study and demonstration of final drive and differential. (Types of final drive gear, Troubleshooting)
5. Study and demonstration of front wheel steering geometry and steering mechanism. (Troubleshooting)
6. Study and demonstration of suspension system of a four-wheeler. (Any one suspension system from conventional or independent, trouble shooting)
7. Study and demonstration of working Hydraulic braking system. (Air bleeding of hydraulic brake, Trouble shooting)
8. Study and demonstration of Lead acid Battery.(Troubleshooting)
9. Study and demonstration of electricalcharging system. (Troubleshooting)
10. Study and demonstration of electrical starting system.(Troubleshooting)
11. Study and demonstrationof

a) D. C. Electric Horn b) Electric Fuel Gauge c) Flasher Unit. d) Wiper Circuit

12. Study of automobile air conditioningsystem.

Group B.

1 Experiment on wheel balancing and front wheelalignment.

2 Visit to servicing station for study of vehicle maintenance, repairs and report.

OR

2. Visit to Automobile manufacturing industry.

Text Books:

1. "Automobile Engineering",Dr. Kirpal Singh (Vol. I and II) Standard Publishers, NewDelhi.
2. "Automobile Mechanics",N KGiri.
3. "Automobile Engineering", G.B.S. Narang., KhannaPublication ,3rdEdition.
4. "Automotive Technology", H.M. Sethi. Tata McGraw-Hill Education,(2001).
5. "Automobile Engineering", Banga andSingh.
6. "Automotive Mechanics", Joseph Heitner, Affiliated Eastern Law House, 2ndEdition.,(1967).
7. "Motor Vehicle Technology and Practical Work",Dolan. J.A., ELBS,(1978).
8. "Automobile ElectricalEquipment",P.L.Kohali,TechnicalEducationSeries,1st Edition.
9. "Automobile Engineering", R.B.Gupta, SatyaPrakasan, 9thEdition.
10. "Automotive Excellence Volume 1 and 2", Gelncoe, Tata McGraw-HillPublication.

Reference Books:

1. “Motor Vehicles”,Newton andSteed
2. “Motor Manuals (Vol I to VII)”, A.W. Judge., Chapman and HallPublication.
3. “Automobile Mechanics”,W.H. Crouse.,Tata McGraw Hill PublishingCo.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

COMPUTATIONAL FLUID DYNAMICS (Elective I)

SUBJECT CODE: PCE ME 404

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Fluid Mechanics, Heat and Mass Transfer, Applied NumericalMethods

Course Objectives:

The course aims to:

1. Provide Fundamental fluid dynamic principles and their applications.
2. Carry out research in the area of Computational Fluid Dynamics.
3. Provide students with the necessary skills to use commercial Computational Fluid Dynamics packages
4. Introduce the student to widely used techniques in the numerical solution of fluid equations, issues that arise in the solution of such equations, and modern trends in CFD.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Understand of the basic theory of Computational Fluid Dynamics, including discretisation, accuracy and stability.
2. Capable of writing a simple solver and using a sophisticated commercial CFD package.
3. Develop programming skills to solve some specific CFD problems.
4. Ability to assess fluid mechanics problems commonly encountered in industrial and environmental settings, construct and apply computational models, determine critical control parameters and relate them to desired outcomes and writereports.

Unit 1 Introduction to Computational Fluid Dynamics and Principles of Conservation [08]

Computational Fluid Dynamics: What, When, and Why? CFD Applications, Numerical vs. Analytical vs. Experimental, Modeling vs. Experimentation, typical problems, Problem Solving with CFD — Methodology, The Governing Equations of Fluid Dynamics and Heat transfer, Models of the flow- Control Volume, Fluid Element, Substantial Derivative, Divergence of Velocity, Continuity Equation Different Models and their Equivalence, Integral versus Differential Form of the Equations, The Momentum Equation, The Energy Equation, Summary Equations for Viscous Flow (the Navier-Stokes Equations) Equations for Inviscid Flow (the Euler Equations) Forms of the Governing Equations Particularly Suited forCFD

Unit 2 Basic of Discretization and Grid Generation [06]

Basic aspects of discretization - Discretization techniques Finite difference - Finite volume and Finite element method Comparison of discretization by the three methods, Transformation of non-uniform grids to uniform grids - General transformation of the equations -Form of the governing equations suitable for CFD - Compressed grids - Boundary fitted co-ordinate systems Elliptic grid generation - Adaptive grids - Modern developments in gridgeneration.

Unit 3 Finite Difference Method [06]

Finite Difference Formulations: Introductory remarks, Taylor Series Expansions,. Finite difference equations, Central Forward, Backward Numerical error, Explicit, Implicit, Semi-implicit(Crank- Nicholson method), Solution methods Direct, Iterative, Thomas algorithm, Gauss- Jacobi, Gauss- seidal method, Alternate Directional Implicit, Applications. 1-D examples, 2-Dexamples.

Unit 4 Finite Volume Method [08]

i. For Diffusion

Introduction, FVM for 1D steady state Diffusion, FVM for 2 D Diffusion

i. For Convection Diffusion

Introduction, Steady 1-D Convection and Diffusion, Central Differencing, Upwind Differencing, Hybrid Differencing, Power Law Scheme, QUICK scheme.

Unit 5 Introduction to Solution Algorithms for Pressure Velocity Coupling in Steady Flows and Turbulence and Multiphase Modeling(IntroductoryTreatment) [06]

Introduction, staggered grid, introduction to SIMPLE, SIMLEC, SIMPLER, PISO algorithms, Modeling of multiphase problems, Level set methods, VOF method. Coupled LS+VOF.

Unit 6 Introduction to Turbulence anditsModeling [06]

What is turbulence?; Transition from laminar to turbulent flow; Effect of turbulence on time averaged Navier -Stokes equations; Characteristics of simple turbulent flows; Introduction to Turbulent Models like Mixing length Model, k-epsilon model, Reynolds stress equation models,Algebraicstressequationmodels;SomerecentAdvances,introductiontoLES,DNS.

Term Work:

1. Simulate and solve two problems, each 2-d and 3-d steady and unsteady flows using any commercial CFD package like Ansys-FLUENT, STAR CCM, FLUIDYNE, Ansys-CFX, Open Sourceetc.
2. Write codes using C, C++, SciLab for at least one each, 1-d and 2-d steady flows and do the post processing to verify with analyticalresults.

Text Books:-

1. "Computational Fluid Mechanics the Basics with Applications",Anderson J. D. Jr,Tata McGraw Hill Education Pvt.Ltd.
2. "An Introduction to Computational Fluid Dynamics the Finite Volume Method" H. K.Versteeg and W. Malalasekera, Pearson Publication.
3. "Numerical Heat Transfer Fluid Flow",Suhas V. Patankar ,Taylor andFrancis.
4. "Introduction to Computational Fluid Dynamics", PradipNiyogi, S. K. Chakrabarthy,M. K. Laha , Pearson Publication.
5. "IntroductiontoComputationalFluidDynamics:Development,ApplicationandAnalysis", Atul Sharma,Wiley

Reference Books:-

1. "Computational Fluid Dynamics: A Practical Approach",JiyuanTu, Guan HengYeoh, Chaoqun Liu, Butterworth –Heinemann.
2. "Computational Fluid Dynamics", T. J. Chung, Cambridge UniversityPress.
3. "Introduction to Computational Fluid Dynamics",AnilW. Date, Cambridge University Press.
4. "Convective Heat and Mass Transfer",S. MostafaGhiaasiaan, Cambridge University Press.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

Process Equipment Design (Elective- I)

SUBJECT CODE: PCE ME 404

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/ Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Heat and Mass Transfer.

Course Objectives:

1. Acquaint several design codes used in the designprocess.
2. Studydesignofprocessequipmentsuchaspressurevessel,storagetank,heatexchanger etc.

Course Outcomes:

1. Illustrate understanding of process designparameters.
2. Design and develop pressurevessels.
3. Demonstrate capabilities developed for designing storage tank,agitators.

Unit 01 **(6)**

Process Design Parameters

Basic concepts in process design, block diagrams for flow of processes, material flow balance. Importance of codes and standards and their applications. Pand ID, Process Data Sheet, PFD and other documents used for designing. Review of Design pressures, temperatures, design stresses, factor of safety, minimum shell thickness and corrosion allowance, weld joints efficiency, design loading, stress concentration and thermal stresses, failure criteria. Selection of material for process equipment's using ASME Codes.

Unit 02

Design of Pressure Vessels **(8)**

Types of pressure vessels, selection of various parameters for their design Pressure vessel subjected to Internal Pressure: Complete design as per ASME code of Cylindrical andspherical

shells. Design of various end closures such as: Flat, Hemispherical, Torrispherical, Elliptical and Conical.
Design of openings: nozzles and manholes. Design of Flanged joints; Gasket selection and design of supports for process vessels.Pressure vessel subjected to External Pressure: Design of shell, heads, nozzles, flanged joints and stiffening rings.

Unit 03 **(6)**

Design of Tall Vessels and Large Storage Tanks

(a) Determination of equivalent stress under combined loadings including seismic and wind loads application of it to vertical equipment like distillation column.
(b) Design of Storage Tanks:
Study of various types of storage vessels and applications.Atmospheric vessels, vessels for storing volatile and non-volatile liquids. Various types of roofs used in storage vessels. Manholes, nozzles and mounting design. Design of Rectangular tanks.

Unit 04 **(6)**

Vessel Supports

Introduction and classification of supports.Design of skirt support considering stresses due to dead weight, wind load, seismic load and periodic vibration.Design of base plate, skirt bearing plate, anchor bolts.Design of Lug and bracket support.

Unit05 **(6)**

Process Piping Design

Flow diagrams and pipe work symbols, design of layout of water, steam and compressed airpipes work, pipe fitting, linings and flanged connections. Types of valves used on pipe line. Fabrication of pipe lines, expansion joints and pipesupports.

Unit06 **(6)**

Heat Exchangers

Heat exchangers: Design of vessels, Design of Shell and Tube Heat Exchanger, Study and design of various types of jackets like plain half coil, channel, limpet coil.

Agitator

Study of various types of agitators and their applications. Baffling, Power requirement of agitation. General design of agitator including blades, shaft, blade assembly.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1) Design of Pressure vessels and largetanks.
2) Design of Heat exchangers used inindustries.
3) Design and development of equipment useful to process industries such as sugar, cement, chemical industries.
4) Preparing flow diagrams of processes, piping layout,etc.
5) Report based on visit to industries such as sugar, cement, chemicalindustries.

TEXT BOOKS:

1) "Process Equipment Design", Dr. M.V. Joshi, Mc-Millan Publication.
2) "Process Equipment Design", Browell and Young, Wiley India.
3) "Chemical Equipment Design", B.C.Bhattacharya.

REFERENCE BOOKS:

1) "Plant Design and Economics", Max and TimasulausKalus , Tata McGrawHill.
2) "Industrial Instrumentation Servicing Hand Book", Cannel Grady, Tata McGrawHill.
3) "Handbook of Instrumentation and Control", KellenHeward, Tata McGrawHill.
4) "Chemical Engineering Handbook", Perry John, Tata McGrawHill.
5) "Industrial Pipe Work", D.N.W. Kentish, Tata McGrawHill.
6) "Chemical Engineering", J.M. Coulson, Richardson, Sinnott,Maxwell, McMillan. Publication.
7) "Pressure Vessel Design Hand Book," H.Bedna.
8) "Dryden's Outlines of Chemical Technology" ,RoaM. Gopala, Sitting M., East West Press Pvt. Ltd., NewDelhi.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

ADVANCED FOUNDRY TECHNOLOGY (Elective I)

SUBJECT CODE: PCE ME 404

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/ Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Course Prerequisites:

1. Manufacturingprocesses,
2. Thermodynamics
3. Machinedrawing,
4. MachineDesign

Course Objectives:

1. To acquaint students with the basic concepts of foundry processes
2. To impart knowledge of Ferrous and Non Ferrous Metal Processing
3. To study casting design process
4. To analyze the casting process

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

1. Understand the basic casting design procedure.
2. Understand fundamental knowledge of Ferrous and Non-Ferrous Metal.
3. Design of the castings for different application.
4. Understand the need of castability.

Unit 1: Metalcasting–overview **(6)**

Applicationsandproduction,historicalperspective,castingprocess,sandcasting,characteristicsofsand castingprocesses,Classification,,metalmoldcastingprocessesandcastingprocessesusingother mould/corematerials,Patternmaterials,typesofpatterns,Mouldandcoremakingmaterialsandtheircharacter istics, investment casting, die casting, ferrous casting, nonferrous castings, new casting development

Unit 2: Solid modelingof casting **(8)**

ElementaryaspectsofpatternandmoulddesignusingCADsoftware.Resinbondedmouldandcore makingprocessesandmachines.Specialcastingprocessesandtheirapplications-lowpressuredie casting,investmentcasting,squeezecasting,

Casting features, modeling techniques, graphical user interface, model representation, model exchange format, model verifications.

Unit 3: Pattern mold andcoredesign **(8)**

Mouldproduction-equipmentformoulding,mouldingtechnique-patternutilization,handand machinecompaction,machinemoulding,moulddryingandhardening.Coresandcoremaking-core boxes,compaction,corehardening,closingofmould.

Orientationandparting,mouldpartinganalysis,patterndesign,coredfeatures,coreprintdesignand analysis,Mouldcavitylayout

Unit 4: Feeder and Gating designandanalysis **(8)**

Castingsolidification,solidificationtimeandrate,feederlocationandshape,feederandneckdesign, feedaiddesign,solidificationanalysis,vectorelementmethod,optimizationandvalidation,examples basedonfeedingdesign

Mouldfilling,gatingsystemandtypes,gettingchannellayout,optimalfillingtime,gatingelement design,mouldfillinganalysis,numericalsimulation,optimizationandvalidation,examplesbasedon gatingdesign

Unit 5: Process planningandcosting **(6)**

Castingprocessselection,processshapesandparameters,toolingcostestimation,materialcost estimation,conversioncostestimationproductdesignforcastability,castabilityanalysis

Unit 6: Quality controlinfoundry **(6)**

Meltingandqualitycontrolofvarioussteelsandnon-ferrousalloys-castingdefects-fettling,inspection andtestingofcastings.Predictionofcastingdefects-porosity,segregation,shrinkageandhottearing.Castingdefects,theircausesandremedies. Shop floor quality control tests such as composition control, Wedge test, fluidity,temperature measurement.CastingModificationbydifferentmethodslikeFrictionstirprocessing.

TERMWORK

1. Designofpatternlayoutforagivencomponent

2. Designofgatingsystemforagivencomponent(ferrous/nonferrous)

3. Designofrise ringsystemforagivencomponent(ferrous/nonferrous)

4. Diedesignforpressurediecasting/centrifugalcasting

5. StudyofTS/ISO/QSnormsforfoundryindustry

6. Industrialvisittoamodernfoundryanditsreport

(Useofcomputerindesignsisessential)

Text Books

1) Metalcasting:computeraideddesignandanalysis,B.Ravi,prenticehallIndia.

2) PrinciplesofMetalCastings-Heine,LoperandRosenthal(TMH)

3) PrinciplesofFoundryTechnology-P.L.Jain(TMH)

REFERENCE BOOKS

1) Indian Institution of Foundry men-Foundry Journal

2) Advanced Pattern Making–CoxI.I. (TheTechnical Press, London.)

3) ASM Handbook–Vol.15Castings.(McGrawHill)

4) Metal Castings–Principles & Practice-T.V.RamanaRao.(NewAgePublishers.)

5) AFS and Control handbook–AFS.

6) Mechanization of Foundry Shops–Machine Construction-P.N.Aeksenov (MIR)

7) Fundamentals of Metal Casting Technology-P.C.Mukherjee (Oxford,IBH)

8) Foundry Engineering–Taylor, Fleming & Wulff (JohnWiley)

9) The Foseco Foundry man's Handbook,-Foseco, CBS Publishers & Distributors

10) The New Metallurgy of Cast Metals Castings–Campbell, CBS Publishers & Distributors,

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

IntroductiontoAircraftSystem(Elective-I)

SUBJECT CODE: PCE ME 404

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hours/ week	ESE: 70 marks
Practical: 2 Hours/ week	CIE : 30 marks
Credit: 4	Term work: 25 marks

Pre- requisites: Fluid Mechanics, Materials Science, Hydraulics and Pneumatics, I. C. Engines.

Course Objectives:

1. To identify components and design configurations of Aircraft.
2. To understand basics of aerodynamics and structure of Aircraft.
3. To impart the knowledge about various systems of Aircraft.
4. To study different materials of Aircraft.

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

1. Describe the basic components and various types of aircraftconfigurations.
2. Discuss the basics of aerodynamics andstructure.
3. Outline the working of various power plants used inaircraft.
4. Discuss the principles and working of various systems involved inaircraft.
5. Describe the significance and suitability of different aircraft materials.

UNIT I

Introduction to Aircraft: **[6]**

Types of Aircrafts-Lighter than Air/Heavier than Air aircrafts Conventional Design configurations based on power plant location, Wing vertical location, intake location, tail unit arrangements, landing gear

arrangements. Unconventional configurations- Biplane, variable sweep, canard layout, twin boom layouts, span loaders, blended body wing layout, STOL and STOVL Aircraft, stealth Aircraft. Advantages and disadvantages of these configurations.

UNIT II

Basics of Aerodynamics and Structures: [8]

Aerofoil Nomenclature, Types of Aerofoil, Wing section- Aerodynamic Center, Aspect Ratio, Effects of lift, drag speed, air density on drag. Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift, Drag, Pitching Moments, Types of Drag, Lift curve, Drag Curve, Lift/ Drag Ration Curve, Factors affecting lift and drag, Center of pressure and its effects. Basic components of an Aircraft, structural members, Aircraft Axis system, Aircraft Motions, Control surfaces and high lift devices.

UNIT III

Introduction to Propulsion System: [6]

Principles of aircraft propulsion, Types of power plants, basic components in power plants - inlet, compressor, combustion chamber, turbine and nozzle.Types of fuel - Illustration of working of air breathing engines.

UNIT IV

Aircraft Mechanical, Electrical and Electronic Systems: [8]

Types of Mechanical Systems, Environmental control systems (ECS), Pneumatic systems, hydraulic systems, Fuel systems, Landing gear systems, Engine Control systems, Ice and rain protection systems, Cabin pressurization and air conditioning systems, steering and brakes systems auxiliary power unit, avionics, Flight controls, Autopilot and Flight management systems, Navigation systems, Communication, Information systems Rader system**.** fire protection systems, de- icing and anti -icing system.

UNITV [6]

Aircraft Fuel and Hydraulic Systems:

Characteristics of aircraft fuel system. Gravity feed and pressure. A generalized fuel system. Fuel pumps-classification. Fuel control unit. Engine starting sequence. Starting and Ignition systems. Engine oils and a typical lubricating system. Hydraulic fluid.Hydraulic system and components.Study of typical workable system.Power packs. Hydraulic actuators. Pneumatic system and components. Use of bleed air. Emergency lowering of landing gear and braking.Shock absorbers - Retractionmechanism.

UNIT VI

Introduction to Aircraft Materials: [6]

General properties of materials, Definition of terms, Requirements of aircraft materials, Testing of aircraft materials, Inspection methods, Application and trends in usage in aircraft structures and engines, Introduction to smart materials and nanomaterials; Selection of materials for use in aircraft.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Assignment on Study of basic components and design configurations ofAircraft.
2. Assignment on Study of Aerodynamics and structures ofAircraft.
3. Assignment on Study of Mechanical systems ofAircraft.
4. Assignment on Study of Electrical and Electronic systems ofAircraft.
5. Assignment on Study of Fuel supply system and Hydraulic, Pneumatic systems ofAircraft.
6. Assignment on Study of different Aircraftmaterials.
7. Two reports on Industrial Exposure orVisit.

Practical Exposure:

With an intent to get some exposure on Aerospace and related industries, the colleges can arrange

- Industry visits to some of the Industries in Aerospace like HAL (Hindustan Aeronautics Ltd.), NAL (National Aerospace Ltd.), ISRO (Indian Space Research Organization) and students need to submit a report on the learning from thevisits.
  (**OR**)
- Visits to AerospaceMuseums
  (**OR**)
- Building Miniature models of Aircraft/ Gliders etc. as Hands on Exercises conducted as competitions.

TEXT BOOKS:

1. Fundamentals of Flight, Shevell, Pearson Education, 2nd Edition.
2. Mechanics of Flight by A.C Kermode, Pearson Education, 5thEdition
3. Ian Moirand Allan Sea bridge, Aircraft Systems: Mechanical, Electrical and Avionics-Subsystem Integration,,, AIAA Educational Series,2001.
4. Aircraft Material and Processes, Titterton G F, English Book Store NewDelhi, 1998

REFERENCE BOOKS:

1. Flight without Formulae by A.C Kermode, Pearson Education, 10 thEdition
2. Introduction to Flight by DaveAnderson
3. Treager, S., "Gas Turbine Technology", McGraw Hill1997.
4. William A Neese, Aircraft Hydraulic Systems, Himalayan Books;2007.
5. S R Maunder, Pneumatic Systems,,, Tata McGraw Hill Publishing Co.;1995.
6. Advanced Aerospace Material, H Buhl, Spring Berlin1992
7. 'Aircraft Maintenance and Repair', Frank Delp, Michael J. Kroesand William A. Watkins, Glencoe and McGraw- Hill , 6th Edition,(1993).

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

TOTAL QUALITY MANAGEMENT (Elective–II)

SUBJECT CODE:PCE ME 405

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs.perweek	ESE: 70Marks
Practical- 2 Hrs. per week	CIE: 30Marks
Credit: 04	Term Work: 25 Marks
	Practical/Oral : 00 Marks

Pre-requisites:

Course Objectives:

1. Know the concept of total quality and role of quality assurance.
2. Understand planning and controlling techniques for quality
3. Understand the key issues and some popular approaches to TQM implementation
4. Know the reliability approach for quality
5. Understand the current trends in TQM

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

1. Understand the concepts of total quality and quality assurance approaches.
2. They will identify and solve issues in quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques,
3. Understand vendor rating and select suitable vendor

4 Interpret various quality attributes and discuss the various quality approaches.

5 Calculate reliability of system

6 They will identify and solve issues in industries using the various techniques of TQM such as 5S, JIT, TPM, Reliability Engineering, Quality Circle etc.

Unit 1 **Quality Assurance System:** [6]

Concept of total quality ,role and objectives of Q.A. Q.A. cycle, process approach to Q.A. (input-process-output), Information feedback, Significance of feedback and field complaints analysis in Q.A., Significance of internal customer approach, Defect prevention programs for Q.A.

Unit 2 **Planning and Controlling Techniques for Quality** [7]

Planning for quality – The dimensions of Quality(quality of Design, conformance, performance and service) Quality planning with vendors, Vendor control procedures, Vendor-rating.
Controlling techniques for quality – Seven statistical tools, Process capability analysis, Problem solving new management tools, Why-why analysis, Six sigma-Concept, Need, Implementation.

Unit 3 **Robust and Reliable Product Approach for Quality** [7]

Product and system reliability: Basic concepts, Prediction and evaluation of parallel, Series and combined system reliability, Reliability tests (life testing, burn - intest, accelerated life testing),

FMEA; and FTA, Taguchi's quality Philosophy, System design, Parameter design,

Tolerance design, Orthogonal arrays, S/N ration, Loss functions.

Unit 4 **Principles and Approaches to TQM:** [6]

Basic concepts: definition of TQM, TQM and traditional management approach, Principles, characteristics, and benefits of TQM. Approaches to TQM: Deming's approach, Juran's triology, Crosby and quality improvement, Ishikawa's CWQC.

Unit 5 **The Essentials of TQM:** [7]

CustomerFocus,-Customerperceptionofquality,Qualitypolicydeployment,Quality function deployment, Voice of customer, Customer satisfaction, Kano's modelof satisfaction, Customerretention.

TQM Leadership- Role and commitment and accountability of leadership, Quality policy and objectives, Organizational structure for TQM, Role of HR in TQM, Training for TQM, Developing quality culture.

Tools and Techniques for TQM:5-Scampaign, TEI, quality circles, QFD, poka-yoke, KAIZEN

Unit 6 **Current Trends in TQM:** [7]

TQM in service sector: Definition and meaning and service, problems in defining service quality, attributes of service quality, SERVQUAL model, Implementing TQM in service industries, Measurement system for service quality.

Quality Management Systems: ISO9001:2008 Series Standards–Clauses, contents, interpretation and implementation, audit Sector Specific Standards–AS9100, ISO/ TS 16949,TL9000,

Quality Awards: National and International quality awards, Criteria and case studies.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Term Work: case studies through industrial visits on:

1. Tools and techniques ofTQM
2. TQM implementation in manufacturingsector
3. TQM implementation in ServiceSector
4. ISO 9001-2008implantation.

(Presentation is preferable for case studies)

Content Assessment Tool

1. case studies on abovetopic
2. case studies on above topic
3. case studies on abovetopic
4. case studies on above topic.
5. Four assignments based on thesyllabus

TEXT BOOKS:

1 "Practical Reliability Engineering",Patrick D.T. O'connor, , Wiley India, (ISBN 978-81-265- 1642-1), 4th Edition.

2 "TotalQualityManagement–Textandcases",JankiramanandGopal,PrenticeHallIndia Publication. (ISBN978-81-203-2995-9).

3 "Total Quality Management" Dr. Suri and Dr. Sharma, Wiley Publication, (ISBN 978-93- 5004-317-2).

4 "Total Quality Management",Dr. Rajaram, Wiley Publication, (ISBN 978-81-7722-63-2).

REFERENCE BOOKS:

1 "TotalQualityManagement",DaleH.Besterfiled,et.al.,PearsonEducation,Asia(ISBN 978-81-317-3227-4).

2 "TotalQualityManagement",Dr.PoornimaCharantimathPearsonEducation,Asia(ISBN 978-81-317-3262-5) ,2ndEdition.

3 "Quality Planning and Analysis",Juran J.M and Gryna.

4 "HandbookofTotalQualityManagement"Dr.R.P.Mohanti,R.R.LakheJaicoPublishingHouse , (ISBN 81-7224-833-44).

5 "Inspection,QualityControlandReliability",SharmaS.C.,KhannaPublishers(ISBN81- 7409-022-3).

6 "GlobalManagementSolutionsDemystified",DineshSeth,SubhashC.Rastogi,CeneageEducation (FormerThomsonAsiaPvt.Ltd.)(ISBN981-265-142-X).

7 "ManagingQuality",BarrieGDale,WileyIndiaPvt.Ltd.(ISBN978-81-265-2246-0), 5thEdition..

8 "Total Quality Control", Feigenban, Tata McGraw Hill Book Company, New York.

9 "FundamentalsofQualityControlandImprovement",AmitavaMitraPearsonEducation ,Asia.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

Industrial Product Design (Elective- II)

SUBJECT CODE:PCE-ME-405

TeachingScheme:	**Examination Scheme:**
Lectures: 3Hrs/ Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Machine Design, Manufacturing Engineering.

Course Objectives:
The course aims to:
1. Studythe various parameters in product design and developmentlike
- Finding CustomerNeed
- Doing Market Research in various parameters forproduct
- Product Specificationscriteria
- Product Architecture andPrototyping
- Cost and ValueEngineering
- Design for Manufacturing andAssembly
- Standards in Ergonomics and IndustrialSafety

2. Practice exposure to Case Studies and CAD Software with a productcase.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Find the Customer Needs for a Quality Product through Market Research in product development process, Concept Generation, Selection andTesting.
2. Describe basics of Product Architecture, Prototyping and Cost and Value Engineering. Select the Standard Ergonomics and Industry Safety parameters in Product Design.

Unit01 [06]

Introduction
Challenges of product development, Identify customer needs, Successful product development, Quality aspect of product design, Market Research, Survey.

Unit02 [07]

Product Development Process and Planning

Innovation and Creativity in Product Design, Product Planning Processes, Product specifications: Process of setting specifications. (Concept Generation–Selection–Testing)

Unit03 [07]

Product Architecture

Product Architecture: Implication of architecture, Establishing the architecture, Related system level design issue, Product Data Management, Use of Computerized Data Management and `Process, Industrial Design: Overview.

Unit04 [07]

Design for Manufacturing and Assembly

Tolerance, Design of Gauges, Design for Environment, Prototyping, Engineering Materials, Concurrent Engineering, Product Costing, Value engineering.

Unit05 [08]

Aesthetics:

Aesthetic Considerations, Visual Effects of Form and Color in Product Design.

Ergonomics:

Ergonomics and product design and automated systems, Anthropomorphic data and its applications in ergonomic design, Limitations of Anthropomorphic data, General approach to the Man-Machine Relationship - Work station Design and environment (working position and posture).

Control and Displays:

Configurations and sizes of various controls and displays, Design of controls in automobiles, machine tools etc., Design of instruments and controls.

Unit06 [05]

Industrial Safety:

An approach to Industrial Design - Elements of Design Structure for Industrial Design in engineering applications in manufacturing systems.Personal protective Equipment and Environment Control Prevention and specific safety measures for manufacturing and processing industry and chemical industry.

Term Work:

1. CaseStudyonanyTWO(byagroup,agroupofMin.02andMax.04studentstobe presented in front of all students) covering followingpoints,
    a. Product Development Process /Planning.
    b. ProductArchitecture.
    c. Design forManufacturing.
    d. Design forAssembly.
    e. Aesthetic and Ergonomic considerations in ProductDesign.
    f. Industrial Safety in Machine and EquipmentHandling.
    g. Health Safety in ProductDesign.
    h. Environmental Safety and ISO 14000Systems.
2. DevelopmentofanyProductusinghighendCADsoftwareconsidering followingpoints.

a) Need of Customer, Methodology ofMarket Survey.
b) Invention / Innovation of a product with modificationsrequired.
c) Aesthetics (Form and Color) and Ergonomics consideration indesign.
d) Preparation of various Views ofthe product.
e) Design for Assembly Procedures.
f) Product and MaintenanceManual.
g) Product Database Management.

A report should be prepared with details, drawing sheet, Bill of Material, Assembly–Disassembly Procedure, Maintenance Manual and Cost Estimation (if required) Presentation of the productdesigned.

Text Books:

1. "Product Design and Development",KarlT.Ulrich,StevenG.Eppinger;Irwin TataMcGrawHill, 3rdEdition.
2. "Product Design and Manufacturing", A.C.ChitaleandR.C.Gupta,PrenticeHall ofIndia, 3rdEdition.
3. "Product Design", Otto and Wood, Pearsoneducation.
4. "Human Factor Engineering", L P Singh ,Galgotia Publication Pvt.Ltd,1st Edition.

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Reference Books:

1. "New Product Development", Tim Jones, Butterworth, Heinemann, Oxford,(1997).
2. "AssemblyAutomationandProductDesign",GeoffreyBoothroyd,MarcelDekker,CRC Press.
3. "Industrial Product Design", C WFlureshem.
4. "Industrial Design for Engineers",MayallW.H, London,HiffeebooksLtd.
5. "Introduction to Ergonomics",R.C. Bridger,TataMcGrawHillPublicatio

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

ADVANCED FORMING PROCESSES (Elective-II)

SUBJECT CODE:PCE-ME-405

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Course objectives:

The course aims to:

1. Understand the fundamentals of various traditional, nontraditional and advanced metalforming processes
2. Study different types of traditional, nontraditional and advanced metal working processes,their advantages, limitations and applications
3. Understand how the processes are carried out in industry

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Solve for strain rates, temperatures and metallurgical states in forming problems usingconstitutive relations
2. Develop process maps for metal forming processes using plasticity principles
3. Estimate formability limits for bulk metals and sheets
4. Evaluate high energy rate deformation process parameters.

Unit 1 Introduction and Fundamentals of Forming Processes: [05]

Importance of manufacturing technology, Classification of manufacturing processes, Selection of materials and manufacturing processes. Study of various forming processes their significance and comparison of various manufacturing processes on different criteria. Need for near net shape manufacturing.

Theory of elasticity, Simple Stress and Strains- Elastic stresses and strains, Plastic stresses and strains, Poisson's ratio, True stress and True strain, Empirical relations for the stress strain curve, Idealized stress strain curve. Two and three dimensional stresses and strains- Principal stresses and strains, Mean (Hydrostatic) stress and stress deviators, Principal strains, Equilibrium in Cartesian, cylindrical and spherical coordinates

Unit 2 Theory of Plasticity [07]

Theory of dislocations, Slip line field theory, Slab method and lower and upper bond methods for load , their significance in investigating and modeling of metal working operations. Plastic work.Yield criteria-Tresca and Von-mises yield criteria, General plastic stress-strain relations (Theory of plasticity). Effect of Temperature on plastic deformation, Cold forming- and effect of annealing on cold formed materials-recovery, Recrystallization and grain growth, warm forming and hot forming. Effect of strain rate on plastic deformation and super plasticity.Effect of friction and lubrication in metal forming. Classification of forming processes on various criteria

Unit 3 Bulk Forming of Metallic Materials [08]

Forging Processes: Introduction to types of forging and forging equipment's, Modeling of forging process, Calculation of forging loads in closed die forging, Effect of forging variables on properties, forging die design, Design principles, Pre form design considerations and die materials, Forging Defects.

Rolling Process: Introduction to types of rolling and rolling mills, Forces and geometrical relationships in rolling, Simplified analyses of rolling load , Variables, Torque and power, Roll pass design, Rolling mill control, Theories of cold rolling, hot rolling, transverse rolling, Rolling of bars and shapes. Rolling defects

Extrusion: Classification and applications, Extrusion equipment. Hot and cold extrusion, hydrostatic extrusion. Patterns of metal deformation in extrusion, Analyses of extrusion process, Extrusion Defects.

Rod, Wire and Tube Drawing: Classification of drawing processes. Rod Drawing, Wire Drawing, Tube Drawing. The Drawing Die.Modeling of Drawing Process.

Unit 4 Sheet Metal Forming Processes: Introduction and Classification [07]

Shearing Processes: Classification and applications, Open Contour Shearing, Closed Contour Shearing. Shearing mechanism.

Bending Processes: Applications, Bending Parameters, Spring back in Bending, Residual stresses in bending. Bending equipment, Press Brake, Roll Bending Machines and Contour Roll forming.

Stretch Forming: Applications, Stretch forming machines and accessories.

Deep Drawing: Applications. Deformation zones in deep drawing, Blank holding pressure. Ironing. Deep Drawing force. Limiting Drawing Ratio.Effect of Anisotropy.Redrawing.

Unit 5 High Velocity Forming and High Energy Rate Forming [06]

Introduction and Classification.Characteristics of HVF and HERF Processes.

High Velocity Forming Machines: Pneumatic (Compressed air) Hammer, Compressed Gas Forming Hammer, Gas Combustion High Speed Hammers,

High Energy Rate Forming Processes: Explosive Forming, Principles and Types of Explosives. Classification of Explosive Forming Methods, Process variables, Failure of Formed products, Advantages and limitations,

Electro Magnetic Forming: Principles of the process, Basic Methods of Electromagnetic Forming, Pressure required in EMF, Advantages and Limitations of EMF. Safety Considerations.

Electro Hydraulic Forming: Principles of the Process, Energy requirements, Process variables, Advantages and Limitations, Future of HVF and HERF.

Unit 6 Recent Trends in Forming: [07]

Thixo-forging, isothermal forging, super plastic forming technology, forming of super conductors, forming of ceramics and glasses, Forming of plastics and composite materials- Extrusion, Form moulding, Thermo forming, Cold forming and Solid phase forming, Design and economic considerations.

Rubber Pad Forming (Flexible – Die Forming) and **Hydro forming** (Fluid forming Processes).

Spinning: Conventional spinning, Flow Turning (Shear spinning), Tube spinning,

Super Plastic Forming of Sheets: Blow Forming and Vacuum Forming, Thermo forming Methods, Super Plastic Forming/ Diffusion Bonding Process. Sheet Metal Formability, Testing of Formability, Forming Limit Diagrams.

Term Work:

1. One exercises each on i. Rolling ii. Forging iii. Extrusion, iv. Wire and deep drawing forming processes
2. Four exercises on High velocity and high energy rate forming
3. Industrial visits to observe bulk metal, sheet metal and High velocity and high energy rate forming processes

Text Books:

1. “Modern Manufacturing”, MikellGroover, Wiley publication.
2. “Mechanical Metallurgy”, George E. Dieter, Tata McGraw Hill Education (India) Pvt. Ltd. 3rd Edition, (ISBN 978-1-25-906479-1), (2013).
3. “Manufacturing Technology – Materials, Processes and Equipments”, Helmi A. Youssef, Hassan A. El- Hofy, Mahmoud H. Ahmad, CRC Press, Taylor and Francis Group, ISBN 978- 1-4398-1085-9.
4. “Production Technology”,R.K. Jain, Khanna Publishers (ISBN :81-7409-099-1)
5. “Manufacturing Processes and Systems”,Phillip F Ostwald, J. Munoz, Wiley Student Edition, ISBN 978-81-26518944.

Reference Books:

1. “Metal Forming Handbook” Schuler, Springer-Verlag, Berlin Heidelberg New York ISBN 3-540-61185-1 (2008).
2. “Forging Design and Practice”,R. Sharan, S.N. Prasad Chand, (1982).
3. “Forging Equipment, Material and Processes”,J. Altan, F. W. Boulger- Metals Cewramic Information Centre Columbus ,(1973).
4. “Roll Forming Handbook”, Geotge T. Halmos ,(CRC Press, Taylor and Francis)- ISBN 0-8247-9563-6, (2006).
5. “Metal Forming Fundamentals and Applications”,Altan T, American Society of Metals, Metal Park, (1983).
6. “ASM Hand Book”, Forming and Forging, Vol. 14, 9th Edition, (1998).
7. “Manufacturing Engineering and Technology”, SeropeKalpakjain, Steven R. Schmid, Pearson Education Asia, 4thEdition (ISBN 978-81-7758-170-6).
8. “Fundamentals of Metal Forming Processes”, B.L. Juneja New Age International Publishers, (ISBN 978-81-224-3089-9). 2nd Edition.
9. “Roll Forming Handbook”, Geotge T. Halmos CRC Press, Taylor and Francis(ISBN :0-8247-9563-6) ,(2006).

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBSE PATTERN Semester VII**

DESIGN OF THERMAL SYSTEM(Elective-II)

SUBJECT CODE:PCE ME 405

TeachingScheme:	**ExaminationScheme:**
Lectures:3Hrs/Week	ESE: 70Marks
Practical:2Hrs/Week/Batch	CIE:30 Marks
Credits:4	TermWork:25Marks

Pre-requisites: Applied Thermodynamics, Heat and Mass Transfer.

Courseobjectives:
The course aimsto:
1. Learn Thermal system designmethodology.
2. Understand real life situations and be able to decide an approach for problemsolving.
3. Design simple thermal systems with advanced tools where in integration of more than one component is required.

Course Outcomes:
Upon successful completion of this course, the student will be able to:
1. Understand the thermal system designmethodology.
2. Decide an approach to solve real life thermal system designproblems.
3. Design simple thermal systems with advanced computer aidedsystems.
4. Gain confidence in problemsolving.

Unit 1
Introduction to ThermalSystemDesign **[06]**
Classification of design, Optimal and nearly optimal design, Methodology of design, Aspects of thermal system design, Assessment concept and creation, Component modeling.

Unit 2
Design ofRefrigerationSystem **[07]**
Design of basic components of refrigeration system, Design of refrigeration systems: vapour compression system- Household refrigerator, Ice plant, Vapour absorption systems using waste heat and solar energy.

Unit 3
Heat Transfer and Design Analysis of AirConditioningSystem **[07]**
Design of Air conditioning systems: Design considerations, Load calculations, Single unit room air conditioners, Central air conditioning plant, Industrial drying systems, Component selection and Computer Aided PipingDesign.

Unit 4

Design ofSolarSystem [07]

Design of solar assisted water heating systems, Preliminary specifications, Concepts development, detailed design for feasibility study, Component design.

Unit 5

Design of AdvancedCooling Systems [06]

Design of advanced heat exchanger networks, Design of electronic miniature cooling systems, Utilization of Nano- Fluids for cooling systems.

Unit 6

Design and Economic Analysis of Waste HeatRecovery Systems [07]

Designofwasteheatrecoverysystems,Designspecifications, Conceptdevelopment,Detailed specifications and component design, Thermo Economic Evaluation and additional costing Considerations.

Term Work:

Any six assignments to be completed

1. Design of water chillingplant
2. Design of cold storageplant
3. Design and optimization offins
4. Designofwasteheatrecoverysystemfor dieselpowerplant
5. DesignofDehumidificationplantusedforindustrialdrying.
6. Design of gas turbinesystem
7. Design of shell and tube heatexchangers

***(Designing of any one basic component with CAE software like ANSYS, HYPERWORKS)**

Text Books:

1. "HVAC System Design Handbook"ASHRAE.
2. "Design and Optimization of Thermal Systems", Yogesh Jalurkar, CRCPress.
3. "Design and Simulation of Thermal Systems", N.V.Suryanarayana, OnerArici,TataMcGraw HillInc.
4. "Thermal System Design",Stoecker, Tata McGrew Hill Publication,3rd Edition.

Reference Books:

1. "Essentials of Thermal System Design", C. Balaji, CRCPress.
2. "Design of Fluid Thermal Systems", Janna W.S., Cengage Learning, 4thEdition.
3. Online Tutorials and ANSYS User Guide.

Shivaji University Kolhapur

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERNSemester VII**

SMART MATERIALS (Elective-II)

SUBJECT CODE:PCE ME 405

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 Hrs/ Week	**ESE: 70 Marks**
Practical: 2 Hrs/ Week	**CIE: 30 Marks**
Credits: 4	**Term Work: 25 Marks**

Pre-requisites: Mechatronics, Testing and Measurement.

Course Objectives: The course aims to:

1. The course is designed to give an insight into the latest development regarding, Smart materials & their types.
2. Study HBLS and LBHS based smart materials.
3. Study use of actuators and sensors in forming a smart system and its applications.
4. To know advances in smart structures and materials
5. To understand smart composites.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

1. Classify smart materials and explain their functions.
2. Explain the smart materials and their uses
3. Use of different sensors and actuators
4. Should suggest suitable material for actuators
5. Ability to interpret emerging technical literature related to smart materials and structures and demonstratesknowledge in a project.

Unit 1 Overview of Smart Materials **[06]**

Introduction, Components of smart systems – Sensors, actuators, Transducers, MEMS, Introduction to piezoelectric materials, Magnetostrictive smart materials, Active smart polymers, Shape memory alloys

Unit 2 Types of Smart Materials **[06]**

Introduction to HBLS (high bandwidth low strain) generating smart materials- Piezoelectric and Magnetostrictive materials, LBHS (low bandwidth high strain) generating smart materials- Shape memory alloys and electro-active polymers.

Unit 3 Actuators Based on Smart Materials **[08]**

HBLS based actuators- Piezoelectric actuators- Induced strain actuation model, Unimorph and bimorph actuators, Actuators embedded in composite laminate. Magnetostrictive actuators - Mini actuators, Thermal instabilities, Magnetorstrictive composites, MEMS based actuators. LBHS based actuators: Shape memory alloy based actuators, Electro-active polymer.

Unit 4 Sensors Based on Smart Materials **[06]**

Sensors based on HBLS smart materials- Piezoelectric sensors, Magnetostrictive sensors, MEMS sensors, Sensors based on LBHS smart materials- Shape memory alloy based encoders, EAP based sensors.

Unit 5 Integration of Smart Sensors and Actuators **[08]**

Case studies to advanced smart materials - Active fiber composites, Energy harvesting Actuators, energy Scavenging sensors, Self-healing smart materials

Unit 6 Applications of Smart Material **[06]**

Structural applications of smart materials, Structural acoustic control, and vibration control applications. Aerospace and transportation applications

Term work:

Any eight assignments based on above syllabus.

Text Books:

1. “Smart Materials and Structures”, Gandhi, Thompson and Gandhi, ChapmannandHall London.
2. “Smart Structures and Materials”, Bryan Culshaw, ARtech House, (1996).

Reference Books:

1. “Smart Material Systems and MEMS”, Vardhan, Vinoy, Gopalkrishanan, Willey India Edition.

2. Smart Structures, Gauenzi, P., Wiley, 2009, Dover Publication.

Shivaji University Kolhapur

Final Year B.Tech (Mechanical Engineering) **CBCS PATTERN Semester VII**

DESIGNFORSUSTAINABILITY(Elective-II)**SUBJECT**

CODE:PCE ME 405

Teaching Scheme:	**Examination Scheme:**
Lectures :03 Hrs. per week	ESE : 70Marks
Practical : 02 Hrs. per week	CIE : 30Marks
Credit : 04	TermWork : 25Marks

Pre-requisites:

Course Objectives:

1 Enable student to design products and equipment for sustainability

2 Use appropriate methodology to analyze and improve product design in terms of sustainability issues.

3 Know contextual factors impacting the engineering discipline.

4 Apply systematic engineering synthesis and design processes.

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

1 Explain the role of sustainability in the design process

2 Describe principles of materials selection based on sustainable principles

3 Apply a systematic approach to system redesign in terms of energy efficiency, water efficiency and transport efficiency

4 Give examples of engineering innovation including sustainable design

5 Explain and Apply principles of disposal and recycling

6 Design the products that are environmental friendly.

Unit 1 INTRODUCTION TO SUSTAINABILITY [06]

Definition and Language of sustainability in engineering design, natural resource terminology,carryingcapacity,strategiesusedduringsustainabledesignscopeand significance

Unit 2 TOOLS AND TECHNIQUES [08]

Lifecycleanalysis,carbonfootprint,lifecycleassessment(LCA)anditstypes& sustainableproductdesign,lightweightandmaterialreduction,wholesystem design, design for durability, repairs &upgrade,disassembly&recycling,reducing energylosses.

Unit 3 FOUNDATIONAL CONCEPTS & PRINCIPLES [09]

Infrastructure for managing flows of materials, energy and activities;sustainable value creation approaches for all stakeholders, environmental design characteristics; design changes & continual improvement; inclusive sustainable designprinciples, crowd sourcing, multiple-objective designs; infrastructures that support system thinking;knowledgemanagementforsustainabledesign,learningsystemsand experimentation;smartdatasystems,understandingvariation

Unit 4 CONSIDERATION DURING SUSTAINABLE DESIGN [06]

IndustrialEcology,MultipleLifecycleDesign,GreenEngineering,Bio-mimicry,Design for environment, Design for Flexibility

Unit 5 HUMAN DESIGN [07]

Preservationfornaturalconditions,UrbandesignandIndustrialsitesplanningwith humanandenvironmentalcomfort,simplecasestudyofsustainabilitydesign consideration in the Automobile components, Components used in Industries and societal routineuse.

Unit 6 ECONOMICAL ASPECTS AND CONSERVATION [04]

Economical aspects of sustainable design, energy conservation, water conservation, material conservation, bio-degradability of materials.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Minimum Six Assignments based on the abovesyllabus.

Note: Assignments should include case study of live example.

TEXT BOOKS:

1 "DesignforSustainability:Apracticalapproachfordevelopingeconomics",M.R.M.Cruland J.C. Diehi, Delf , University of Technology, USA.

2 "Introduction to Sustainability", Jong Jin Kim; National Polution Prevention center for higher education.

3 "Design for Sustainability a Practical Approach", Tracy Bhamra; Gower Publication.

REFERENCE BOOKS:

1 "Integral Sustainable Design: Transformative Perspectives", Mark Dekay Earth Scan animprint of Tailor and Francis Group.

2 "Sustainable Energy Systems and Applications",Ibrahim Dincer; Calin Zamfirescu Springer Publications.

3. Clarke,Abigail&JohnK.Gershenson2006.DesignfortheLifeCycle.Life-cycleEngineering Laboratory, Department of Mechanical Engineering-Engineering Mechanics, Michigan TechnologicalUniversity.

4 Ramaswamy,Rohit,1996.DesignandManagementofServiceProcesses:Keeping Customers for Life, Prentice Hall.

5 Finster, Mark P., 2013. Sustainable Perspectives to Design and Innovation.

6 Schmitt, Brent, Customer Experience Management, Wiley and Sons, 2003.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

Flexible Manufacturing Systems (Elective II)

SUBJECT CODE: PCE ME405

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Manufacturing Processes, Computer Integrated Manufacturing Systems.

Course Objectives:

1. To study fundamental concepts of flexible manufacturingsystems
2. To familiarize students to various components ofFMS.
3. To impart knowledge of flexible assemblysystems.

Course Outcomes: At the end of this course Students are able to

1. Understand meaning of flexible manufacturing system
2. Know about activities in modern PPCsystem.
3. Explain the concept of group technology, and how it relates to cellular manufacturing.
4. Explore primary capabilities of flexibility in theFMS.
5. Explore automated inspectiontechniques.
6. Know about different types of FMS with components.

Unit 1: Introduction and control structure of FMS: [07]

Flexible and rigid manufacturing, F.M. Cell and F.M. System concept, Types and components of FMS, Tests of flexibility, Group Technology and FMS, unmanned factories, Economic and Social aspects of FMS. Architecture of typical FMS, Automated work piece flow, Control system architecture – Factory level, Cell level; hierarchical control system for FMS, transmission medium, signaling, network topology, Manufacturing Automation Protocol; communication interfaces, Structure and functions of manufacturing cell, Distributed Numerical Control (DNC), FMS Diagnostics, conceptual DBMS, relevance of DBMS inFMS

Unit 2: Production planning and control in FMS: [07]

Activities in modern PPC system, process planning, computer aided process planning systems-retrieval and generative, material requirement planning, and shop floor control, scheduling algorithms, heuristic approach and optimized production technology approach to scheduling , automated scheduling systems, inventory control in FMS, MRP-II or ERP

Unit 3: Tooling and Fixturing in FMS: [08]

Modern cutting tools and tool materials, tool holders, modular tooling, tool monitoring, presetting and offsets, wear and radius compensation, tool magazines, automatic tool changers, robotized tool assembly, tool management systemPart holding on Pallets, standard fixtures, pallet changers, pallet pool, flexible fixturing – principles and methodologies, modular fixturing system: Tslot based, dowel pin based, fixturing components, computer aided fixture design – locating and clamping, use of GT in fixture design, fixture database

Unit 4 : Group Technology and material handling in FMS: [09]

GT concepts, Advantages of GT, Part family formation-coding and classification systems; Part machine group analysis, Methods for cell formation, Cellular vs. FMS production. Material Handling in FMS: Functions of an integrated material handling system in FMS, Flexibilities in material handling, Industrial robots for load / unload applications, Robotic cell layouts and FMS layouts, Automatically Guided Vehicles (AGVs) – types, features, guidance technologies and applications; Automated warehousing - AS/RS, storage and retrieval machines in AS/RS.

Unit 5: Automated Inspection Systems: [05]

Online offline infection, automated inspection techniques, contact non-contact inspection, application of m/c vision system in inspection, CMM, study of inspection and post inspection software, FIS (flexible inspection system)

Unit 6: Flexible Assembly Systems: [05]

Basic Concepts, classification, planning and scheduling in FAS, loading and scheduling in F.A. cells. Lean & Agile Manufacturing: definition and principles of lean manufacturing, benefits, methodologies for transferring to lean manufacturing, definition, principles of agility, market forces and agility, reorganizing the production system for agility, managing relationships for agility.

TERM WORK:

Minimum eight assignments based on the following.

1. Develop a form code using any classification system for 3 parts.
2. Application of rank order clustering algorithm to identify logical part families and machines groups.
3. Exercise on any schedulingalgorithm.
4. Exercise on flexible Fixturing.
5. Simulation of FMS shop, using Simulation software package (like ARENA, OpenCIM/ OpenFMS or equivalent) using various modules like Arrive, Server, Depart, Simulate modules, Creating models of FMS shops and simulating the performance to obtain outputresults
6. Exercises on assessment of performance of batch production systems for the followingmeasures

a) Manufacturing lead time, b) Work - in – process, c) Machine utilization

TEXT BOOKS:

1. Flexible manufacturing systems in practice applications, design and simulation: by joseph talavageet. Al: publisher: Taylor and FranciesUS
2. Computer integrated design and manufacturing by Bedworth el.alMcGraw-Hill,1991
3. Performance modeling of automated manufacturing systems by N. Viswanadham, Y. Narhari-1992
4. Automation, production systems and computer integrated manufacturing by Groover- Pearson education
5. CAD/CAM by P.N. Rao, Tewari NK, Kundra TK, "Computer Aided Manufacturing", Tata McGraw HillPublications
6. FMS By H KShivanand
7. Hand book of CIMS Teicholds and Orre McGrawHill

REFERENCE BOOKS:

1. Ranky, Dr. Paul, (1984), "The Design & Operation ofFMS".
2. Groover, Mikell P. (2002), 2/e, " Automation, Production Systems & Computer Integrated Manufacturing", Pearson Education orPHI
3. Viswanadhan, N. &Narahari, Y. (1998), "Performance Modelling of Automated Manufacturing Systems",PHI
4. Pinedo, Michael & Chao, Xiuly(1999), "Operations Scheduling with Applications in Manufacturing & Services", McGraw Hill International Editions (with 2 Floppy Disks of LEKIN SchedulingSoftware)
5. Kelton, Sadowsky&Sadowsky, "Simulation with ARENA",2/e, McGraw Hill International Editions (with CD of ARENA SimulationSoftware)
6. Radhakrishnan, Subramanyan, "CAD / CAM / CIM", JohnWiley
7. Rong, Yeming; "Computer Aided Fixture Design", Marcel Dekker, ISBN0-8247-9961-5
8. Hobbs, "Lean Manufacturing Implementation", J. Ross Publishing, ISBN1-932150-14-2
9. Chowdiah, Gargesa& Kumar, "Agile Manufacturing",TMH
10. Automation, Production System & Computer Integrated Manufacturing by Groover , publication-Englewood
11. Design and Operation of SMS by Rankey, publication-IFS
12. Flexible Manufacturing System by Wernecks, publication-Spring-Verlag.
13. FMS in Practice by Bonetto, publication- Northox Ford
14. Flexible Manufacturing Cells and systems by W.W. Luggen, Publication-PHI
15. Performance Modeling of Automated Manufacturing Systems by Vishwanathan&Narahari, publication-Prentice Hall India

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBSE PATTERN Semester VII**

SEMINAR

SUBJECT CODE:PCC ME 406

Teaching Scheme:	**Examination Scheme:**
Practical: 02Hrs/week	Term Work: 25 Marks

Credit:1

Course Objectives:-

The course aims to:

1. Create awareness about latest technological aspects
2. Improve presentation and communication skills
3. Improve skills related to search on the internet
4. Motivate for research in respective area
5. Provide platform for interaction amongst students on advanced and/or emerging topics of technology.

Course Outcomes:-

Upon successful completion of this course, the student will be able to

1. Have and develop presentation skills.
2. Impart knowledge in different aspects of knowledge domains.
3. Make them aware of knowledge in industry perspective and new industry trends.
4. Build confidence and improve communication skills.
5. Collect ideas through literature survey about new innovations, analyze and present them.
6. Sharpen their personality and intelligence.

Schedule for the semester

1. **1st week:** Discussion of relevance, objectives and outcome expectations with students.
2. **2nd to 4th week:** Preliminary discussions, topic identification and synopsis submission, topic approval by guide.
3. **5th to 10th week:** Collecting detailed information, discussion with guide, preparation of Seminar report and PPT, approval from guide.
4. **11th to 14th week:** Seminar delivery by each student for 20 minutes followed by question answer session and discussion for 10 minutes. Each student should deliver seminar in front of other students from the batch, guide and another expert appointed by HOD

Topic selection

Individual student shall chose seminar topic from engineering/allied/applied field under the guidance of allotted guide. Student should collect information from reference books, handbooks, technical research journals, catalogues, etc. related with the topic and beyond the details covered in the curriculum of mechanical engineering undergraduate course.

Instructions for report writing and presentation

Prepare two hard copies of seminar report of 20 to 30 pages each (one for student and other for department). For standardization of the seminar reports the following format should be strictly followed. Student should also submit soft copy of the seminar report and presentation.

1. Page size: Trimmed A4
2. Top Margin: 1.00 Inches
3. Bottom Margin: 1.32 Inches
4. Left Margin: 1.5 Inches
5. Right Margin: 1.0 Inches
6. Para Text: Font - Times New Roman; 12 Point
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right aligned and in footer. Font Times New Roman; 12 Point
9. Headings: Times New Roman, 14 Point, Boldface
10. Certificate: All Students Should Attach Standard Format

The entire seminar should be documented as one chapter. The usual steps involved in writing report are: (a) logical analysis of the subject-matter; (b) preparation of the final outline; (c) preparation of the rough draft; (d) rewriting and polishing; (e) preparation of the final bibliography; and (f) writing the final draft. For more details about report writing and formats students and guide are advised to refer, "Kothari, C.R., *Research Methodology Methods and Techniques,* New Delhi, New Age International (P) Ltd., Publishers, 2nd Edition, 2004" Record of the referred literature should be submitted in either hard or soft form at the time of seminar presentation.

Seminar work load

1. 2 hours work load/practical batch/faculty

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech (Mechanical Engineering) **CBCS PATTERN Semester VII**

SUMMER INTERNSHIP

SUBJECT CODE: -SI ME 407

Teaching Scheme:

Credits: 01

Examination Scheme:
Term Work: 25 Marks

Course Objective:
The course aims to:

1. Familiar the students to realize an industrial work.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Comprehend the knowledge gained in the coursework
2. Create, select, learn and apply appropriate techniques, resources, and modern engineeringtools.

Industrial Training
The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Mechanical engineering during the semester break after Sixth semester and complete within 15 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.
It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, Process capability evaluation, Industrial automation, Process or machinery modification as identified.

Industrial Training Report Format:
Maximum fifteen students in one batch, involving three groups of maximum five students, shall work under one Faculty. The same group shall work for project under the same guide. However, each student should have different industrial training and its presentation.
The report should be of 20 to 30 pages. For standardization of the report the following format should be strictly followed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point. Font

7. Line Spacing: 1.5Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times New Roman
9. Headings: Times New Roman, 14 Point ., Bold Face
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student. Certificate should have signatures of Guide, Head of Department and Principal/Director.

The entire report should be documented as one chapter with details like

1. "Name of Industry with address along with completed training certificate"
2. Area in which Industrial training is completed

All Students have to present their reports individually.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VII**

PROJECT PHASE–I

SUBJECT CODE: PW ME408

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

Examination Scheme:
Term Work: 25Marks
Oral Exams: 25Marks

Course Objectives:
The course aims to:

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on their own to bring out the conclusion under the given circumstances of the curriculum period in the budget provided with the guidance of thefaculty.
2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision makingprocess.

Course Outcomes:
Upon successful completion of this course, the student will be able to:

1. Improve the professional competency and research aptitude in relevantarea.
2. Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and currentresearch.

Project Phase I Load:
A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed.

Project Phase I Definition:
The project phase I work can be a design project / experimental project and or computer simulation project on Mechanical engineering or any of the topics related with Mechanical engineering stream. The project phase I work is allotted in groups on different topics.
The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along withtimeframe.
The project phase I work is to be extended for project phase II at B. E. (Mech.) Sem. VIII with same group working under guidance of same Faculty member assigned for project phase I.

Project Phase I Term Work:
The term work under project submitted by students shall include
1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project groupfor

a. Searching suitable projectwork
b. Brief report preferably on journals/research or conference papers/books or literature surveyed to select and bring up theproject.

c. Day to day activities carried out related to project work for entiresemester.
d. Synopsis.

The group should submit the synopsis in following format

i. Title ofProject
ii. Names ofStudents
iii. Name ofGuide
iv. Relevance
v. Present Theory andPractices
vi. Proposedwork
vii. Expenditure
viii. References

2. The synopsis shall be signed by the each student in the group, approved by the guide and endorsed by the Head of theDepartment
3. Presentation: The group has to make a presentation in front of the Faculty members of department at the end ofsemester.

Project Phase I Report Format:

Project Phase I report should be of 25 to 30 pages (typed on A4 size sheets). For standardization of the project phase I reports the following format should be strictly followed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point.Font
7. Line Spacing: 1.5Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point. Times NewRoman
9. Headings: Times New Roman, 14 Point , BoldFace
10. References: References should have the following format

ForBooks: “Title of Book”, Authors, Publisher,Edition
ForPapers: “Title of Paper, Authors, Journal/Conference Details,Year

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Book referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creativethinking.
- The Diary along with Project Phase I Report shall be assessed at the time of oral examination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the projectgroup.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

Mechatronics

SUBJECT CODE:PCC ME 409

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	ESE : 70Marks
Practical : 02 Hrs. per week	CIE : 30 Marks
Credit :04	TermWork : 25Marks
	External Oral : 25 Marks

Pre-requisites:

Course Objectives:

1	To learn how to apply the principles of Mechatronics and automation for the development of system.
2	To learn the automation technology and industrial automation as applications of Mechatronics in manufacturing system.
3	To supply qualified personnel to meet the requirement of specialist in Mechatronics.
4	To prepare Mechanical Engineering students for advanced graduate studies in Mechatronics, Manufacturing engineering and related field.

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

1	DevelopasimulationmodelforsimplephysicalsystemsandexplainMechatronics design process.
2	Outline appropriate sensors and actuators for an engineering application
3	Write simple PLC programs
4	Explain various applications of design of Mechatronic systems

Unit 1 Introduction to Mechatronics **6**

Introduction to Mechatronics, Mechatronics systems, multi discipline scenario Transducers & Sensors, Position Sensors: Limit switch, photoelectric switches, proximity sensors, incremental & absolute encoders, decoders & relays. Displacement: Potentiometer sensors, capacitive displacement sensors. Velocity sensors: Tachogenerator, use of encoders, advances in sensors.

Unit 2 Signal Conditioning **6**

Signal conditioning process, Operational amplifier (inverting amplifier, non-inverting amplifier, summing, integrating amplifier, differtianting amplifier, logarithmic amplifier), protection, filtering, data acquisition, multiplexer, analog to digital converter (ADC), digital to analog converter (DAC). Sample and hold, demultiplexing. Polling and interrupts.

Unit 3 Digital circuits, Microprocessor and Microcontroller **8**

Introduction to Digital logic gates, Boolean algebra, application of logic gates, Combinational and sequential logic, flip flop, D flip flop, JK flip flop, Master slave flip flop.Comparison between microprocessor and micro controller, organization of a microprocessor and microcontroller system, architecture of PIC controller, instruction types and set,Introduction and applications of Arduino and Raspberry, Pi microcontroller, Applications of microcontroller.

Unit 4 Introduction to PLC **6**

Introduction, definition, PLC system and components of PLC input output module, PLC advantages and disadvantages. Ladder diagram & PLC programming fundamentals,machine control terminology, update – solve ladder – update, physical components Vs. program components.

Unit 5 Applications of PLC **8**

Internal relays, light control example, disagreement circuit, majority circuit, oscillator, holding (sealed or latches) contacts, always ON always OFF contacts, fail safe circuits, PLC timer and counter functions – Introduction and types.Industrial applications – Automatic liquid filling system, liquid mixture, traffic control.

Unit 6 Industrial control systems **6**

Introduction Human machine Interface (HMI), Difference between HMI and PLC, Introduction to SCADA and its industrial applications, motion controller, applications of RFID technology and machine vision, Introduction to DCS.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Trial on sensors (minimumfour)
2. Assignment on Microprocessor and Microcontroller.
3. PLC programming on Industrial Applications basedon Timers, Counters, internal relays (Minimum 4applications)
4. Fabrication of Simple Mechatronics working project by a group of 4/5 students using hardware and suitable software.
5. Assignment on HMI and SCADA
6. Industrial visit to study Mechatronics system application & submission of visitreport.

Note: Mechatronics Laboratory is expected to have a simple 8 input 8 output PLC

REFERENCE BOOKS:

1 Mechatronics – Mahalik, TATA McGraw Hill

2 Mechatronics – W. Bolton, Pearson education

3 Microprocessor 8085 – Gaokar

4 Introduction to PLC programming, NIIT

5 Programmable logical controller, Hackworth % Hackworth, Pearson Education

6 Programmable logical controller, Reis Webb, Prentice Hall

7 SCADA, Stuart A. Boyer, ISA Publication.

8 Mechatronics –AppuKuttam, Oxford publications

9 Human Machine Interface –Dhananjay R. Kalbande, PrashantKanade, Wiley Publications

10 Arduino - Richard Blum, Pearson education

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

ENERGY AND POWER ENGINEERING

SUBJECT CODE:PCC ME 410

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Basic mechanical Engineering, Thermodynamics, Heat and Mass Transfer, Fluid and Turbo Machinery.

Course Objectives:

1. Enable the student to estimate the potential of energy sources.
2. Acquire the knowledge of renewable sources of energy and utilization.
3. Understand the new trends in power and energy sectors.
4. Study various power stations, Performance and economic analysis.

Course Outcomes

1. Analyze the utilization of solar, wind energetic.
2. Demonstrate need of different energy sources and their importance.
3. Illustrate power plant economics.
4. Comprehend various equipment's /systems utilized in power plants

Unit 01

Solarenergy [07]

Introduction to Renewable Energy sources, Solar potential, Solar radiation spectrum, Solar radiation geometry, Solar radiation data, Solar Collectors - flat plate, evacuated tube, Cylindrical parabolic, Concentrating paraboloid, Graphical representation of efficiency of various Collectors, Modern thermal energy storage - Ultra capacitors / Super capacitors, Super conducting materials, New generation batteries.

Unit02

Solar photovoltaic system[08]

Operating Principle of Photovoltaic cell concepts, Photo-cell materials, Cell module array, Series and parallel connections, Maximum power point tracking, Study of standalone system with battery and AC or DC load, Hybrid systems (Diesel-PV, Wind-PV, Biomass-Diesel systems), Applications, Introduction, Principle and operation of fuel cells, classification and types of fuel cell, Fuel for fuel cells, Application of fuelcells.

Unit03

Wind energy [04]

Wind parameters and wind data, Power from wind, Site selection, Wind energy conversion systems and their classification, Construction and working of typical wind mill, Introduction to OTEC.

Unit04

I. Power plants [08]

Different types of power plants – Thermal, Hydro, IC Engine, Gas Turbine, Nuclear and their characteristics, Combined Cycle, Pumped storage, Compressed Air storage power plants and their characteristics, Comparison of Power plants with respect to various parameters, Issues in Power plants,

II. Power scenario in India

Power scenario in India and world, NTPC, NHPC and their role in Power development in India, Power generation in Private sector, Power distribution, Power grid corporation of India, State grids, Railway grids and International grids.

Unit05

I. Instrumentation [08]

Flow measurement of feed water, fuel, air, steam with correction factor for temperature, Speed measurement, Level recorders, Radiation detectors, Smoke density measurement, Dust monitor, Flue gas oxygen analyzer – Analysis of impurities in feed water and steam – Dissolved oxygen analyzer – Chromatography – PH meter – fuel analyzer – Pollution monitoring instruments, Integration of instrumentation system.

II. LoadCurves

Load Curves and Load duration curves (Numerical treatments), Performance and operational characteristics of power plants, Peak load, Intermediate load and Base load plants and their characteristics, Input output characteristics of power plants, Economic division of between Base load plant and peak load plants, Tariff methods.

Unit06

Energy Marketing and Management[05]

Energy Management, Energy Marketing: Selling and marketing in India, Creating supply chain in India, Successfully working with business and virtual teams in India, Navigating the financial, legal and accounting environment, Human Resources issues, India's business culture in energy sector, Conservation ofenergy.

Term Work

1. Study of performance of solarcollectors.
2. Demonstration and measurement of solar radiation usingpyranometer.
3. Study of power plantinstruments.
4. Study of combined cycle gas based and coal based Powerplant.
5. Study of load curves and selection of plants for powergeneration.
6. Study of Indian electricity gridcode.
7. Industrial visit to any power plant / Survey based / Project based industrialvisit.
8. Energy Audit - Case study of an organization andreport

Text Books

1. "Solar Energy", S.P.Sukhatme and J.K.Nayak, Tata McGraw-Hill, 3rd Edition,(2008).
2. "Non-Conventional Energy Sources", G.D.Rai.-Khanna Publisher, 4thEdition.
3. "Power Plant Technology", M.M.ElWakil, Tata McGraw-Hill. Int, 2nd Edition. Reprint, (2010).
4. "Power Plant Engineering", Domkundwar and Arora, Dhanpatrai andSons.
5. "Modern Power Engineering", John Weisman and L.E. Eckart, Prentice Hall of India, (1985).

Reference Books

1. "Solar Photovoltaic Fundamentals, Technologies and Applications", Chetan Singh Solanki, Prentice Hall of IndiaPublications.
2. "Modern Power Station Practice", Vol.6, Instrumentation, Controls and Testing, by Pergamon Press, Oxford,(1971).
3. "Power System Analysis", Grainger John J, and Stevenson Jr.. W.D., Tata McGraw Hill, (2003).
4. "Economic Operation of Power Systems", L.K. Kirchmeyer, John Wiley and Sons,(1993).
5. "Power System Analysis", C.A. Gross, John Wiley and Sons, Inc.(1986).

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

Noise and Vibrations

SUBJECT CODE: **PCC ME 411**

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/ Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits: 4	Term Work: 25Marks
	Oral Exam: 25 marks

Pre-requisites: Engineering Mathematics, Theory of Machines.

Course Objectives:

The Course aims to

1. Study basic concepts of vibration analysis.
2. Acquaint with the principles of vibration measuring instruments.
3. Create awareness about principles of sound level measurement and noise.

Course Outcomes:

On Completion of the course, student will be able to

1. Understand relevance of noise in mechanical systems.
2. Carryout measurement of various vibration parameters.
3. Analyze vibratory response of mechanical element/system.
4. Estimate natural frequency of mechanical element/system.
5. Develop mathematical model to represent dynamic system

Unit 01

Introduction **(7) Hrs**

Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, Motion – periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, Static equilibrium position, Vibration classification, Steps involved in vibration analysis, Simple harmonic motion, Equivalent stiffness of spring combination, un-damped free vibration.

Unit 02

Single DoF System **(7) Hrs**

a) Damped free vibrations, Types of damping, Logarithmic decrement and damping materials.

b) Forced Vibrations: Types of excitation, Forced excitation, Transmissibility-Force transmissibility and motion transmissibility, Vibration isolators, commercial isolation materials and shock mounts.

Unit 03

Two DoF System **(6) Hrs**

a) Free undamped vibrations – Principal modes and natural frequencies, Co-ordinate coupling and principalco-ordinates.

b) Forced vibrations (Undamped) – Harmonic excitation, Vibration Dampers and absorbers.

Unit 04

Introduction to Multi DoF System **(7) Hrs**

a) Free vibrations of Multi DOF System-Flexibility and stiffness influence coefficient matrix, Equation of motion.

b) Rayleigh's method and Holzer method.

Unit 05

Vibration Measuring Instruments **(6) Hrs**

Instruments for measurement of displacement, velocity, acceleration and frequency of Vibration, Exciters FFT analyzer. Introduction to Condition Monitoring and Fault Diagnosis.

Unit 06

Introduction to Noise **(7) Hrs**

Frequency dependent human response to sound, Sound pressure dependent human response, Decibel scale, Relation among sound power, Sound intensity and sound pressure level, Non auditory effects of noise on people, Auditory effects of noise, Noise standards and limits, Ambient emission noise standards in INDIA.

TERM WORK:

Minimum Eight Experiments out of following list. (Any 8 out of 1 to 9)

1. Experiment on equivalent spring mass system.
2. Experiment on study of forced vibration characteristics
3. Determination of logarithmic decrement for single DOF damped system
4. Experiment on torsional vibration of two rotors without damping
5. Experiment on torsional vibration of three rotors without damping
6. Use of different types of exciters for vibration analysis.
7. Measurement of vibration parameters using vibration measuring instruments
8. Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.
9. Measurement of Noise by using noise measuring instruments.

TEXT BOOKS:

1. “Mechanical Vibrations”, Singiresu S. Rao, Pearson Education, ISBM –81-297-0179-0- (2004).
2. “Mechanical Vibrations”, G. K. Grover, Published by Nemchand and Brothers,Roorkee.
3. “Mechanical Vibrations”, Dr. V. P. Singh, Published by S. Chand and Sons NewDelhi.
4. “Noise and Vibration Control”, Leo L. Bernack, Tata Mc- Graw HillPublication.
5. “Mechanical Vibration and Noise Engineering”,A. G. Ambekar, Prentice Hall ofIndia.
6. “Fundamentals of Vibrations”, Balchandran Magrab ,CengageLearning.
6. “Theory of Vibrations with Applications”, W. Thomson, Pearson Education,2nd Edition.
7. “Mechanical Vibration”, Dr Debabrata Nag, Wiley India Pvt. Ltd ,ISBN978-81-265-3090-8.

REFERENCE BOOKS:

1. “Mechanical Vibration", Austin Church, Wiely Eastern. 2nd Edition.
2. “Schaumm's Outline Series in Mechanical Vibration”, S. Graham Kelly, 6th Edition.
3. “Kinematics, Dynamics and Design of Machinery", Waldron, Willey India, 2nd Edition.
4. “Mechanical Vibrations ”,J.P.Den Hartog,Tata Mc Grawhill Book CompanyInc.,4th Edition.
5. “Introduction to Dynamics and Control”, Leonard Meirovitch, J. Wiley, New York.
6. “Elements of Vibration Analysis” Leonard Meirovitch, Tata Mc Graw-Hill, New York. 2nd Edition.
7. “Principles of Vibration”, Benson H. Tongue, Oxford University Press., 4th Edition.
8. “Vibrations and Noise for Engineers”, Kewal Pujara Dhanpat Rai and Sons,(1992).
9. “Mechanical Vibration”, William J Palm III Wiley India Pvt. Ltd.,ISBN978-81-265-3168-4, 1st Edition.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

INDUSTRIAL ENGINEERING (ELECTIVE-III)

SUBJECT CODE: PCE ME 412

TeachingScheme:	**ExaminationScheme:**
Lecturers: 3Hrs/Week	CSE: 70Marks
Practical:2Hrs/Week	CIE: 30 Marks
Credits: 4	Term Work: 25Marks

Pre-requisites: Industrial Management and Operation Research

Course Objectives:

1. To introduce students the concepts, principles and framework of Industrial Engineeringand various productivity enhancementtechniques.
2. To understand Method study and time studytechniques.
3. To acquaint the students with tools and technique of materialhandling.
4. To acquaint the students the concept of value analysis, job evaluation and meritrating.

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

1. Manage an dimplementdifferentconceptsinvolvedinmethods studyandunderstandingof workcontent in different situations.
2. Measure and estimate standard time for job.
3. Understand different types of plant layouts.
4. Interpret job evaluation and merit rating.

Unit 1: Introduction to Industrial Engineering Productivity [06]

(A) Introduction to Industrial Engineering–Definition,Scope,Responsibilities, Important contributors to I.E., Tools and techniques of industrialengineering. **(B)Productivity**–Concept,objectives,Factorsaffectingproductivity,Tools andtechniquestoimprove productivity, Productivity measurementmodels

Unit2: Method Study [08]

Historical background, role of work study in improving productivity, method study procedure, selection of jobs, information, collection and recording; Recording techniques, charts, diagrams, templates, models, critical analysis, development, installation, and maintaining bettermethod

Unit3: Motion Study & Human Factor Engineering (Ergonomics) [06]

A) Motion Study: Principles of motion economy, micro motion study, SIMO chart, MEMO motion study, cycle graph, chronocyclegraph

B) Human Factor Engineering (Ergonomics): Introduction, objectives definition, man machine system, physiological work measurement, design ofcontrols.

Unit 4: Work Measurement (TimeStudy) **[08]**

Definition, objectives, procedure, time study equipment, performance rating, allowances, concept of normal time and standard time, calculation of standard time, work sampling, predetermined motion time analysis.

Unit 5:Facility Design **[06]**

Plant site selection, factors influencing the selection, optimum decision on choice of site and analysis, types of plat layout, advantages and disadvantages of layout, principles and objectives of plant layout, tools and techniques of layout planning, material handling- Objective, elements, functions, principles, types of material handling equipments.

Unit 6: Value analysis & Job evaluation andmeritrating **[06]**

A] Value analysis: Definition, concept of approaches of value analysis and engineering,steps, evaluation, and applications of value analysis.

B] Job evaluation and merit rating: Definition, objectives, procedure of job evaluation, different schemes and their advantages anddisadvantages.

TERM WORK

Any Eight Assessments of the following:

1. Problems on productivity.
2. Case study on method study.
3. Man; Machine chart program.
4. Two handed process chart.
5. Stop watch time study for an operation.
6. Work sampling.
7. Plant site location analysis.
8. Case study on Value analysis concept.
9. Case study on job evaluation and merit rating.

TEXT BOOKS:

1. Introduction to Work Study, ILO, Geneva and Oxford and IBH Publi. Co. Pvt.Ltd.
2. M. Telsang, "Industrial Engineering and Production Management", S. ChandPublication.
3. L.C. Jhamb, "Industrial Engineering", Everest Publication,Pune.
4. O.P. Khanna, "Work Study" DhanpatRaiPubli. NewDelhi.
5. M Mahajan, Industrial Engineering and Production Management, DhanpatRai andCo.
6. Banga and Sharma, Industrial Organization & Engineering Economics, Khannapublication.

REFERENCE BOOKS:

1. R.M. Barnes, "Motion and time study design and measurement of work" John Willey &Sons Inc. 7th Edi.
2. H.B. Maynard and others, "Industrial Engg. Handbook" IVth Edi. McGraw HillPubli.
3. J.AdamEE,RJEbert"ProductionandOperationManagement",PrenticeHallEnglewoodCliff N.
4. David Sumanth, "Productivity Engg. And Management", Tata McGraw Hill, NewDelhi.
5. Gavrial Salvendy" Hand book of Industrial engineering" John Wiley andsons,New York,2007
6. M. I. Khan "Industrial engineering" New age international(P) ltd, NewDelhi,2004.
7. International labour office, "Introduction to work study" Publisher International labour office,1969.

Digitalized2008.
8. Introduction to Work Study by ILO, ISBN 978-81-204-1718-2, Oxford &IBH Publishing Company, New Delhi, Second Indian Adaptation,2008.
9. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRCPress,2002.

SHIVAJI UNIVERSITY, KOLHAPUR

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

PRODUCTION MANAGEMENT (ELECTIVE-III)

SUBJECT CODE: PCE ME 412

TeachingScheme:
Lectures: 3Hrs/Week
Practical:2Hrs/Week
Credits:4

ExaminationScheme:
ESE: 70Marks
CIE: 30Marks
Term Work: 25Marks

Pre-requisites: Mathematics, Production Engineering.

Course Objectives:
The course aims to:

1. Get acquainted with basic aspects of Productionmanagement
2. Study various important planning, organizing and controlling aspects of Operations management
3. Study different operational issues in manufacturing and serviceorganizations.

Course Outcomes:
Upon successful completion of this course, the student will be able to

1. The students will have fair understanding of the role of Production / Operations Management played in businessprocesses.
2. Emphasis on both familiarization of various production processes and service systems and quantitative analysis of problems arising in the management ofoperations.

Unit 1 Introduction to Production Management [07]

Production types, Objectives and scope of Production Management(1), Production Planning and Control (PPC)- Definition and elements and activities of production planning and production control Relevance(2), Strategy formulation process(3), Order qualifiers and order winners(4), Strategic options for Operations- Product – Process Matrix(5), Product portfolio, Process technology(6), WCMpractices(7).

Unit 2 Product and Process Design [06]

Determinants of process characteristics- Volume, Variety, Flow, Types of processes(1), Choice of Process, Equipment selection(2), Use of BEP in selection process- Product matrix(3). Estimation of Demand- Time series Analysis and causal forecasting techniques, Least square method, Moving average and exponential smoothing forecasting method(4) Role of Product Development in competitiveness(5), Product Life Cycle (PLC),Product Development Process (6).

Unit 3 Capacity and Scheduling of Operations [07]

Capacity- Definition, Measure of Capacity(1), Capacity strategies,Estimation of number of machines(2), Overcapacity and under capacity factors, Aggregate Planning, Aggregate Planning

Strategies(3), Use of transportation model approach to aggregate planning Loading, schedulingand sequencing(4), Priority sequencing rules(5). Sequencing problems, n job 2 machines, n Job '3' machines(6). Forward and backward scheduling, Critical ratio scheduling, Production Control Activities(7)

Unit 4 Supply Chain Management and Advanced Manufacturing Techniques [08]

Concept of supply chain and supply chain management(1), Manufacturing supply chain, SCM activities, Supply chain strategies, Managing supply chain, Measuring supply chain performance(2),JIT Philosophy, Origin and core logic of JIT, Elements of JIT(3), Kanban System- Design of Kanban containers(4), JIT.Implementation issues and performance(5), Lean Manufacturing- Pillars(6), features and process comparison with Traditional Manufacturing(7-8).

Unit 5 Total Productive Maintenance and Replacement [06]

Introduction, Definition, Six big losses, Stages of maintenance(1), Pillars stages of TPM Development(2), Overall Equipment Effectiveness (OEE) (3) Computation Replacement - need, Replacement of items whose maintenance cost increases with time(4) (with and without considering time value of money), Replacement of items that fail suddenly(5-6)

Unit 6 Production Economics [06]

Demand and supply, Demand curve and supply curve(1), Equilibrium of supply and demand(2), Elasticity of demand Production function, Factors of production, Isoquants(3), Review - Time value of money, Cash flows(4), Evaluation criteria for capital projects(5) (investment) Payback period, IRR and BCR(6)

Term Work:

1. Presentation on Case study on "Interdepartmental relationship in a businessorganization"
2. Presentation on Case study on "Design for Manufacturing andAssembly".
3. Assignment on DemandForecasting.
4. Problems on Job sequencing- Single Machine Scheduling, Priority Sequence and Johnson'sAlgorithm.
5. Presentation on Case study on "Implementation of JIT in a small/ mediumcompany".
6. Problems on Estimate OEE and ReplacementAnalysis.
7. Exercises on Analyzing tools in Projectpreparation.
8. Presentation on World Class Manufacturing Practices like Toyoto Mfg. system,etc.

Text Books:

1. "Industrial Engineering and Production Management", Martand Telsang, S Chand and Company New Delhi,(2009).
2. "Productions and Operations Management", KanishkaBedi, Oxford Higher Education., 3rdEdition.
3. "Production and Operation Management", Tripathi, ,ScitechPublications.
4. "ProductionandOperationManagement",S.N.Chary,TataMcgGrawHill,5thEdition.

ReferenceBooks:

1. "Production and Operations Management", Buffa. Elwood modern Wiley India,8thEdition.
2. "Operation Management, Process and Value Chain", Krajewski and Ritzman, MalhotraPearsonEducation.

3. “Production and Operations Management”, Ashwathappa, Bhat , HimalayaPublishing
4. “Techniques of Value Analysis and Engineering”, MilesLawrence.
5. “Operation Management Theory and Practice”, Mahadevan B PearsonEducation,(2007)
6. “Operations Management” Kaitherand Frazer, CengagePublication
7. “Production and Operation Management”, Everett E. Adam and Ebert, PHI Publication, ISBN no.9788120308381.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

Fracture Mechanics (Elective- III)

SUBJECT CODE:PCE ME 412

TeachingScheme:	**Examination Scheme:**
Lectures: 3Hrs/ Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits: 4	Term Work: 25Marks

Pre-requisites: Advanced strength of materials or theory of elasticity

Course Objectives:

1. Develop basic fundamental understanding of the effects of crack-likedefects.
2. Identify and formulate the stress intensity factor ((k) for typical crackconfigurations
3. Identify and formulate the strain energy release rate(g).
4. Identify and formulate j - integral and the stress and strain fields around a crack tip for nonlinear and elasto-plasticmaterials.
5. Define fracture toughness of materials using kc, gc andjc.
6. Employ the standard and nonstandard fracture mechanics tests to determine the fracture toughness ofmaterials.
7. Predict the fatigue life of structures using fracture mechanicsapproaches.

Course Outcomes:

1. Understand and account for the theoretical background of linear and nonlinear fracture mechanics.
2. Carry out fracture mechanics analysis and design, using handbooks, of simple crack problems in linear and nonlinearmaterials.
3. Determine the loading applied on acrack.
4. Evaluate fracture mechanicstesting.
5. Carry out analyses of crackgrowth
6. Determine whether or not stable crack growth can becomeunstable.
7. Apply the knowledge from the course on practical cases where linear fracture mechanics issufficient

Unit01 **[07]**

Fracture mechanics principles: Introduction and historical review, Mechanisms of Fracture, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Griffith's energy balance approach. Fracture mechanics approach to design- strengths, stiffness and toughness. Stress intensity approach

Unit02 **[07]**

Linear elastic fracture mechanics, Crack tip stress and deformations, Relation between stress intensity factor and fracture toughness, Stress intensity factor. Dislocation theories of brittle fracture, ductile fracture, Notch effects, Fracture under combined stresses.

Fatigue Failure: Stress cycle, S-N curve, Description of fatigue fractured parts, Phases of fatigue fracture, Fatigue crack propagation, Effects of metallurgical variables, Temperature, Stress concentration, Size and surface factors, Fatigue under combined stresses.

Unit03 **[06]**

Elasto plastic fracture mechanics introduction, Elasto–plastic factor criteria, Crack-opening displacement (COD) and crack tip opening displacement (CTOD), J- Integral to solve energy of crack formation, the crack resistance (R-curves).

Unit04 **[07]**

Creep Failure: Creep curve, Structural changes and mechanisms during creep, Activation energy for steady-state creep, Fracture at elevated temperature.

Brittle Fracture: Transition temperature curves, Fracture analysis diagrams, various types of embitterment, Fracture under very rapid loading.

Unit05 **[06]**

Ductile Fracture: Condition for necking, Dislocation and void formation activities, Types of fractured parts.

Assessment of Types of Fractures by Observation: Comparison between different fractured parts undergoing various type of fracture.

Unit06 **[07]**

Design Application of the Knowledge of Failure: Design considering fatigue-Geber's parabola, Soderberg equation, Lubricating optimally to combat bearing failures. Selection of materials to prevent seizure, galling, etc. Wear reduction techniques, Fracture toughness consideration in design.

TERM WORK:

Minimum eight assignments from the following

1. The Evaluation of Fracture toughness by Numerical Methods of finite elements.
2. Methods for Evaluating Fracture toughness by Numerical Methods of Finite Differences (FD).
3. Evaluating Fracture toughness by Numerical Methods of Boundary Integral Equations.
4. The Evaluation of Fracture toughness by ExperimentalMethods.
5. Study of the Methods for Evaluating Fracture toughness by ComplianceMethod.
6. The Evaluation of Fracture toughness by Photoelasticity.
7. The Evaluation of Fracture toughness by Interferometery and Holography.
8. The Experimental evaluation of Fracture toughnessby
    a. Plane strain fracture toughness method
    b. JIntegral
9. Comparison between computer modeling and Experimental verification of Fatigue propertiesof S-N diagram, fatigue limit, fatigue crack growth rate, Parislaw.

TEXT BOOKS:

1. "Fracture Mechanics – Fundamentals and application", T.L. Anderson,CRCPress.
2. "Elements of Fracture Mechanics", Prashant Kumar, Tata McGraw –Hill, NewDelhi.

REFERENCE BOOKS:

1. "Metal Fatigue Design and Theory", Madoyag,F.
2. "Fatigue Design of Machine Components", Sors, L., PergamonPress.
3. "Fracture and Fatigue Control Structures", Rolfe, S.T. and Barson, J.M., Prentice Hall ofIndia.
4. "Elementary Engineering Fracture Mechanics", Broek, D.,Noordnoff.
5. "Mechanical Metallurgy", Dieter, G.E., Tata McGraw Hill Book Co., NewDelhi.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

Reliability Engineering (Elective- III)

SUBJECT CODE:PCE ME 412

TeachingScheme:	**ExaminationScheme:**
Lectures: 3Hrs/ Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits: 4	Term Work: 25Marks

Pre-requisites: Manufacturing Engineering, Mathematics.

Course Objectives:

1. Introduce principles of reliability in engineering design.
2. Develop understanding of concepts of failures, maintainability and availability of the intended products/systems and services.
3. Develop an ability to analyze field failure data in order to evaluate system reliability.
4. Develop an ability to apply various reliability techniques to solve interdisciplinary reliability problems.

Course Outcomes:

1. Explain basics of reliability, maintain ability and availability and differentiate among them.
2. Apply fundamentals of reliability to estimate reliability of mechanical systems, electronic devices, software's andhuman.
3. Analyze field failure data for reliabilityanalysis.
4. Evaluate system reliability using varioustechniques.

Unit 01

Fundamentals of Reliability anditsMeasures **[07]**

Brief history of reliability, Concepts, Terms and definitions, System safety, Quality and reliability, Lifecyclecostofaproductorsystem, Systemeffectiveness, Conceptoffailure, Laws of probability, Random variables, Discrete and continuous probabilitydistributions.

Measures: Reliability function, Hazard rate function, CDF, PDF, MTTF, MTBF, Median time to Failure, Mean, Mode, Median, Skewness, Kurtosis, Variance and standard deviation, Typical forms of hazard rate function, Bathtub curve.

Unit 02

ReliabilityDistributions [06]

Basic reliability distribution, Conditional reliability, Constant Failure Rate (CFR) model, Binomial distribution, Normal, Poisson, Lognormal, Rayleigh, Weibull etc., Fitting probability distributions graphically and estimation of distribution parameters, Calculation of R(t), F(t), f(t), λ(t), MTTF, tmed, tmode for above distributions.

Unit 03

Reliability Evaluation of Systems [07]

System Reliability block diagram- Series configuration, Parallel configuration, Mixed configurations, Redundant systems, Standby redundant, Load sharing systems etc. High level versus low level redundancy, k-out-of-n redundancy, Network reduction and decomposition methods, Cut and tie set approach for reliability evaluation. Fault tree analysis (FTA), Success tree method, Failure mode and effect analysis (FMEA), Failure modes effects and criticality analysis (FMECA), Morkov analysis, Monte Carlo simulation.

Unit 04

Maintainability and Availability [07]

Maintainability - Objectives of maintenance, Types of maintenance, Concept ofmaintainability, factors affecting maintainability, System downtime, Measures of maintainability, Mean time to repair (MTTR), Analysis of downtime, Repair time distributions, Stochastic point processes, Reliability centered maintenance(RCM).

Availability -Availability concepts and definitions, important availability measures, Inherent, achieved and operational availability.

Unit 05

Reliability Testing and Data Analysis [06]

Reliability Testing - Life testing, Burn-in testing, Acceptance testing, Accelerated life testing, highly accelerated life testing (HALT) and reliability growth testing.

Data Collection and Analysis - Data collection, Empirical methods, Estimation of performance measures for ungrouped compete data, Grouped complete data, Analysis of censored data, Pareto analysis, and Goodness-of-fit tests.

Unit 06

Interdisciplinary Approach and Life Cycle Cost (LCC) [07]

Electronics - Reliability of electronic components, Component types and failure mechanism.Software – Introduction, errors, Software testing, Hardware/ software interface.Human reliability analysis (HRA) - Introduction, human error in maintenance, Impact on system reliability. Reliability costs, effect of reliability on LCC, Categories of costs, Calculation of LCC.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Any Four Assignments out of following.

1. Theory of Reliability and Probability.
2. Fitting probability distributions graphically and estimation of distribution parameters.
3. Numerical based on Reliability Evaluation of Systems.
4. Maintainability andavailability
5. Reliability testing

TEXT BOOKS:

1. "Introduction to Probability Models", Sheldon M. Ross, Elsevier,9thEdition.
2. "An Introduction to Reliability and Maintainability Engineering", Charles E. Ebling, Tata McGraw Hill Education Private Limited, New Delhi(2004).
3. "Reliability Engineering", L. S. Srinath, East West Press, New Delhi(1991).
4. "Reliability Engineering", K. K. agarawal, Springer InternationalEdition.
5. "Reliability Engineering", E. Balagurusamy, Tata McGrawHill.
6. "Reliability Engineering: Theory and Practice", Alessandro Birolini, Springer(2010).
7. "Reliability Evaluation of Engineering Systems: Concepts and Techniques", Roy Billiton and Ronald Norman Allan,Springer(1992).
8. "PracticalReliabilityEngineering",PatrickD.T.O'Conner,DavidNewton,Richard Bromley, John Wiley andSons.(2002)
9. "Reliability Engineering: Probabilistic Models and Maintenance Methods", Joel A. Nachlas Taylor and Francis(2005).
10. "Reliability in Engineering Design", K. C. Kapur, L. R. Lamberson, John Wiley andSons.
11. "Reliability Theory with Application to Preventive Maintenance", I. Gertsbakh , Springer Inc.Edition.
12. "Reliability Engineering and Quality Management", Onkar N. Pandey, BhupeshAneja, Katson andSons.

REFERENCE BOOKS:

1. "Reliability Engineering and Risk Analysis – A practical Guide", Mohammad Modarres, Mark Kaminskiy, VasiliyKrivstov, CRC Press, Taylor and FrancisGroup.
2. "Life Cycle Reliability Engineering", Guangbin Yang, John Wiley and Sons(2007).
3. "Case studies in Reliability and Maintenance", W. R. Blischke, D.N.P. Murthy, John Wiley and Sons(2003).
4. "Maintenance, Replacement and Reliability: Theory and Applications", Andrew Kennedy, Skilling Jardine, Albert H. C. Tsang, CRC/Taylor and Francis(2006).
5. "Engineering Reliability–New Techniques and Applications", B.S.Dhillon, Chanan Singh, John Wiley and Sons(1981).
6. "Engineering Maintainability", B. S. Dhillon Prentice Hall ofIndia., (1999).

SHIVAJI UNIVERSITY, KOLHAPUR

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

ADVANCED I.C.ENGINE (Elective –III)

SUBJECT CODE:PCE ME 412

TeachingScheme:	**Examination Scheme:**
Lectures: 3Hrs/Week	ESE: 70 Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits: 4	Term work: 25Marks

Pre-requisites: I C Engine

Course Objectives:

The course aims to:

1) Understand modern fuel injectionsystems.
2) Understand thermodynamics of combustionphenomenon.
3) Understand cause of emission and itscontrol.
4) Understand alternative fuels for I Cengines.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1) Analyze fuel injection system of ICengines
2) Analyze the combustion in thermodynamic point ofview.
3) Know design aspects of combustionchamber.
4) Know new trends in ICengines.
5) Know the modification in engines for alternativefuels.
6) Know advanced emission controlmethods

Unit 1 SI Engines [06]

Review of SI engine, Over-expanded engine cycle, Fuel characteristics, Fuel rating.Modern Carburetor. Recent Spark Plug, Spark Timing. Multi-Point Fuel injection system and its components, Sensors and transducers, ECU. Feedback system, Airflow and fuel flow phenomenon, Fuel injection pumps.

Unit 2 CI Engines [06]

Review of CI engine, Electronic fuel injection system, ECU, sensors and transducers, Feedback system, Fuel spray behavior, recent fuel injector and injection timing, Advance turbo charging system.

Unit3 Combustion [08]

SI engine combustion phenomenon, Turbulence characteristics, Chamber optimization Strategy, Thermodynamic analysis of SI engine combustion (Combustion Analyzer)CI Engine combustion phenomena, Swirl, Swirl Measurement, Generation of Swirl during induction, Swirl within cylinder, Chamber optimization Strategy, Thermodynamic analysis of CI engine combustion (Combustion Analyzer)

Unit4 AlternateFuels [07]

Hydrogen and Fuel cells, Ethanol, Bio-Diesels, Alcohols, LPG- Engine Modification, Combustion and Emission characteristics of SI and CI Engine using alternative fuels.

Unit5 Engine Emission, Pollution AndItsControls [07]

Formation of HC, NOx, CO mechanism, Smoke and Particulates emission, Methods of Controlling Emissions, Measuring Equipment's and methods, International and National EmissionNorms

Unit 6 Trends in IC Engines [06]

Variable Valve Timing, Recent CRDI engine, Variable Turbo Geometry system, 3- Way Catalytic Converter, Homogeneous Charge Compression Ignition, Variable compression ratio engine , Low Heat Rejection Engine, Lean Burn Engine, Six- Stroke Engine, Gasoline Direct Injection System.

Term Work:

Seven assignments (One Assignment on each unit and two assignments on unit three) and One case Study.

Text Books:

1. "Internal Combustion Engines Fundamentals", E. F. Obert, Harper and Row Publication, New York.

2. "Internal Combustion Engines",J. B. Heywood, McGrawHill.

3. "Internal Combustion Engines", Maleev, CBS Publication andDistributors.

4. "Internal Combustion Engines", J.Ganesan.

Reference Books:

1. "Internal Combustion Engines", Gills andSmith.

2. "Diesel and High Compression Gas Engines",J. M.Kates.

3. "Engg. Fundamentals of the I.C. Engines" W.W.Pulkrabek, Pearson Education.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final Year B.Tech(Mechanical Engineering) **CBCS PATTERN Semester VIII**

MACHINE TOOL DESIGN (Elective III)

SUBJECT CODE:PCE ME 412

Teaching Scheme:	**Examination Scheme:**
Lectures:3Hrs. /Week	ESE: 70 Marks
Practical: 2Hrs./Week/Batch	CIE: 30Marks
Credits:4	Term Work: 25Marks

Course Objectives:

1. To understand core concepts of Machine Tool & ProductDesign.
2. To understand the basic approach for designing machine tool components and implement the appropriatemethod.
3. To compute the power requirements of various machinetools.
4. To learn to design quality based manufacturingsystem.
5. To learn to design a product using innovative concepts of 'ProductDesign'

Course Outcomes:

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

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

Unit-1

Introduction to Machine & Machine Tool **(06)**

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

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

Unit-2

a) Analysis offorces(2)

Forces affecting machine tool elements, determination of motive power for different operating conditions, useofhandbooks.

b) Design considerations and selection of standardcomponents(3)

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

Unit-3

Kinematics of Machine Tools(8)

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

Unit-4

a) Design of Spindle & SpindleSupport(3)

Functions of spindle unit and requirements, materials and construction, spindle ends, spindle support, design calculations, mounting arrangements of spindle bearings, spindlebearinglubrication

b) Selection of Machine ToolBearing (4)

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

Unit-5

a) Design of Machine ToolStructures(5)

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

b) Design of Guideways (5)

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

Unit-6

Recent Trends of Machine Tool Design(5)

Recent trends in machine tools, Design considerations for SPM, NC/CNC, Micro/Nano machining, Retrofitting, Autonomous machine tool, Installation, Calibration and Machine tool testing.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

DESIGNOFAIRCRAFTSYSTEMS(Elective–III)

SUBJECT CODE: PCE ME 412

TeachingScheme:	**ExaminationScheme:**
Lectures:3Hrs/Week	ESE: 70Marks
Practical:2Hrs/Week	CIE:30 Marks
Credits:4	TermWork:25Marks

Pre-requisites: Analysis of Mechanical Elements, Machine Design, Theory of elasticity.

Course Objectives:
The course aims to:
1. Study the fundamentals of aircraft design and structural analysis.
2. Study structural analysis of various components like plates, shells, beams.
3. Know about air worthiness.
4. Study aircraft structural repair.

Course Outcomes:
Upon successful completion of this course, the student will be able to
1. Understand the basics of aircraft systems and aircraft structures.
2. Know industry practices on design of aircraft structures and systems.
3. Understand the applicability of designaspects in aircraft design.
4. Relate the theoretical knowledge with the design of aircraft structures and systems.

Unit 01

Fundamentals of Aircraft Design and Structural Analysis (6)

Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies Review of Hooke' s Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, Conservation of Energy, Stress Transformation, Stress StrainRelations.

Unit 02

Aircraft Structures and Loads (7)

Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longeron, Splices, Sectional Properties of structural members and their loads, Types ofstructural

Joints, Type of Loads on structural joints Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, MiscellaneousLoads.

Unit 03

Structural Analysis of Aircraft Structures - I (7)

Theory of Beams- Stress distribution diagram for cantilever and simplysupported beam.Equation of Bending. Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams.

Unit 04

Structural Analysis of Aircraft Structures - II (7)

Theory of Plates -Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysisofstiffenedpanelsinbuckling,Rectangularplatebuckling,AnalysisofStiffenedpanels in Post buckling, Post buckling undershear

Unit 05

Structural Analysis of Aircraft Structures - III (7)

Theory of Shells-AnalysisofShellPanelsforBuckling,Compressionloading,ShearLoading/Shell Shear Factor, Circumferential Buckling Stress.

Theory of Torsion-Assumptions in theory of pure torsion, Torsion equation for solid and hollow circular shaft. Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections

Unit 06

Airworthiness and aircraft Structural Repair (6)

Airworthiness Regulations, Regulatory bodies, Type Certification, General Repair, Airframe Requirements, Landing Requirements, Fatigue and Failsafe Requirements. Types of Structural damage, Nonconformance, Rework, Repair, Allowable Damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and bestpractices

Term Work:

Eight Assignments based on the Syllabus.

Out of eight, two assignments should contain the following:

• Hands-on calculation on Exercises related to Fundamentals of Structural Analysis

• Hands-on Calculation on Exercises involving, plate theory, beam theory and shell theory, Panel buckling, Shear flow Exercises in AircraftStructures.

Industrial Visits

With an intent to get some exposure on Aerospace and related industries, arrange

• Industry Visits to some of the Industries in Aerospace like HAL (Hindustan Aeronautics Limited),NAL(National Aerospace Limited),ISRO(Indian Space Research Organization)OR

• Visits to Aerospace MuseumsOR

• Building miniature Models of Aircraft /Gliders etc as a Hands on Exercises conducted as competitions

Text Books:

1. "AircraftDesign-AConceptualApproach",DanielP.Raymer,AIAAeducationseries,6th Edition.
2. "Airframe Structural Design", Michael Niu, ConmilitPress, 2nd Edition (1988).
3. "Airframe Stress Analysis and Sizing",Michael Niu, ConmilitPress,3rd Edition (1999).

Reference Books:

1. "Mechanics of flight", A.C. Kermode, Pearson Education, 5th Edition.
2. "The Elements of Aircraft Preliminary Design" , Roger D. Schaufele, Aries Publications (2000).
3. "Aircraft Structural Maintenance", Dale Hurst, Avotek publishers, 2nd Edition (2006).
4. "Aircraft Maintenance and Repair", Frank Delp, MichaelJ. Kroes and WilliamA.Watkins, Glencoe and McGraw-Hill,6th Edition (1993).
5. "Theory of Plates and Shells", S. S. Bhavikatti, New age International Publications, 3rd Edition(2017)

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

INDUSTRIAL AUTOMATION & ROBOTICS (Elective –IV)

SUBJECT CODE: PCE ME413

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	ESE : 70Marks
Practical : 02 Hrs. per week	CIE : 30Marks
Credit :04	TermWork : 25Marks

Pre-requisites:

1. Knowledge computer integrated manufacturing,FMS,

Course Objectives:

1. Introduce automation and basic elements of automated systems.
2. Get knowledge of advanced automated and levels of automations.
3. Introduce the industrial robotics and its applications.
4. Knowledge of programming associated with robo-control.

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

1 Design techniques for the analysis and control of discrete event system

2 Applyknowledgeofautomationtoolsandotherequipment'sformanufacturingandassembly components

3 Operate in research and development centre for automation

4 Identify efficiencies and limitation and provide in depth evaluation of robotic system for

Unit 1 **Introduction to Automation** [06]

Automated manufacturing systems, Fixed/programmable/flexible, Automation, Need of automation, Basic elements of automated systems- Power, program and control. Low cost automation, Economic and social aspects of automation, Advanced automation functions, Levels of automation.

Unit 2 **Industrial Control and Transfer Line** [08]

A. Industrial control systems in process and discrete manufacturing industries, Continuous and discrete control; Computer process control.

B. Fundamentals of transferlines, Configurations, Transfer mechanisms, Storag ebuffers, Control, Applications

Unit 3 **Assembly Automation** [06]

Assembly Automation: Types and configurations, Parts delivery at workstations, Various vibratory and non-vibratory devices for feeding and orientation, Product design for automated assembly.

Unit 4 **Fundamentals of Industrial Robots** [06]

Specifications and Characteristics, Criteria for selection, Robotic Control Systems: Drives, Robot Motions, Actuators, Power transmission systems, Robot controllers, Dynamic properties of robots-stability, Control resolution, Spatial resolution,Accuracy, Repeatability, Compliance,Workcellcontrol,Interlocks

Unit 5 **Robotic End Effectors and Sensors** [07]

Transducers and sensors-Sensorsinroboticsandtheirclassification,Touch(Tactile)sensors, Proximity and range sensors, Force and torque sensing, End Effectors-Types, grippers, Various process tools as end effectors; Robot End effectors interface, Active and passive compliance, Gripper selection and design,

Unit 6 Robot Teaching [07]

Introduction, Various teaching method, Task programming, Survey of Robot level programming languages, A Robot programs a Pathinspace, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching, Robot language structure, Various textual robot, Languages such as VALII, Typical programming examples such as palletizing, Loading a machine etc., Application of Robot.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Term Work:

1. A Case study on low cost automation
2. Study of part delivery system at work stations in automated assembly.
3. Study of robot end effectors and sensors
4. Two Programming exercises using various commands of VALII.
5. Demonstration of various robotic configurations.
6. One Industrial visit for Industrial automation and robotic application

TEXT BOOKS:

1 Automation, Production Systems and Computer Integrated Manufacturing", Groover, M.P., Pearson Education, ISBN: 81-7808-511-9 2nd Edition (2004).

2 "Industrial Robotics, Technology, Programming and Applications", Groover, M.P.; Weiss, M.; Nagel, R.N. and Odrey, N.G. , McGraw Hill Intl. Edition.,ISBN: 0-07-024989- X.

3 "Introduction to Robotics, Analysis, Control and Applications", Niku, Saeed B., Willey Publication, ISBN 9788126533121, 2nd Edition.

4 "Robotics-Control, Sensing, Vision and Intelligence", Fu, K.S.; Gonzalez, R.C. and Lee, C.S.G., McGraw Hill Intl. Ed., ISBN:0-07-100421-1.

REFERENCE BOOKS:

1. "Robot Technology Fundamentals", Keramas, James G, Thomson Learning–Delmar ISBN:981- 240-621-2,(1998).
2. Handbook of Robotics", Noff, Shimon Y., John Wiley and Sons.
3. "Introduction to Robotics, Analysis, Systems and Applications", Niku, SaeedB.(2002),Prentice Hall of India.
4. "Robotics for Engineers", Koren, Yoram, Tata McGraw Hill.,(2003)
5. "Fundamentals of Robotics, Analysis and Control", Schilling, R

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

CRYOGENICS (Elective- IV)

SUBJECT CODE: PCE ME413

TeachingScheme:	**ExaminationScheme:**
Lectures:3Hrs/Week	ESE: 70Marks
Practical:2Hrs/Week/Batch	CIE: 30Marks
Credits:4	TermWork:25Marks

Pre-Requisites: Applied Thermodynamics, Refrigeration

Course Objectives:

The course aims to:

1. Enable the students to analyze and solve cryogenics related problems by applying principles of mathematics, science and engineering.
2. Prepare students to use modern tools, techniques and skills to fulfill industrial needs related to low temperature systems.
3. Effective communication skill to demonstrate cryogenics theories.
4. Develop skills in the analysis of cryogenics systems in research or design.
5. Develop a professional approach to life long learning in the cryogenics to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Learn the concept of low temperature and its application.
2. Explain liquefaction systems and cryogenic heat exchangers.
3. Apply knowledge of mathematics, science, and engineering for the needs in Cryogenic.
4. Do the analysis the cryo-coolers
5. Design and analysis separation and distillation column.
6. Define and understand the cryogenic insulation and storage vessel.

Unit1 **[06]**

Introduction:

Cryogenics, Cryogenic Temperature scale, Historical Development of Cryogenics, Properties of cryogenic Fluids, Applications of cryogenics in different areas such as Space, Medical and Biological, Manufacturing processes.

Behavior of Structural Materials at Cryogenic Temperature:

Mechanical properties, Thermal properties.

Unit 2 **[07]**

Liquefaction of Cryogenic Gases:

Ideal cycle, System performance parameters, Production of low temperature methods in Cryogenics (Joule Thomson effect, Adiabatic expansion), Liquefaction systems; Simple Linde-Hampson system, Pre-cooled Linde-Hampson system, Cascade system, Claude system, Comparisonofabovesystems.

Unit 3 **[07]**

Liquefaction Systems for Neon, Hydrogen, Helium and Heat Exchanger:

Maximum Inversion temperature, Limitations of Linde -Hampson System for liquefaction of Neon,HydrogenandHelium,PrecooledLinde-HampsonsystemforNeonandHydrogen, ClaudesystemforHydrogen,CollinsHeliumLiquefactionsystem,Heatexchangerusedin liquefactionsystems

Unit 4 **[06]**

Cryogenic Refrigeration Systems:

Ideal refrigeration systems, Philips refrigerator,Vuilleumier refrigerator, Solvay refrigerator, Gifford-McMohan refrigerator, Pulse tube refrigerator.

Unit 5 **[07]**

Gas Separation and Purification:

Thermodynamic Ideal separation system, Temperature composition diagram, Principles of Gas separation, Principles of Rectifiers column, Air Separation Systems (Linde Single Column system, Linde double column system).

Unit 6 **[07]**

Insulation: Cryogenic fluid storage,Vacuum insulation, Fibrous materials, Solid foams, Gasfilled powder, Comparison.

VacuumTechnology: Importance,Pumpdowntime,Flowregimes,Componentsofvacuum systems,MechanicalVacuumpumps,andIonpumps

Term Work:

Any six experiments/ tutorial based on above syllabus

Text Books:

1. “CryogenicSystems”,BarronF.Randall,OxfordUniversityPress,NewYork.
2. "CryogenicEngineering”,ThomasM.Flynn,MarcelDekkcr.Inc,NewYork.
3. "CryogenicProcessEngineering”,KlausD.Timmerhaus,ThomasM.Flynn,PlenumPublishing Corporation (1989).
4. "AppliedCryogenicEngineering”,Vance,R.W,andDuke,Isted,W.M.,JohnWiley(1962).
5. “IntroductiontoCryogenics”B.S.Gawali,MahalaxumiPublication.

Reference Books:

1. "ExperimentalTechniquesinlowTemperaturePhysics",Guy,KWhite,ClaredonPress, Oxford,(1987).
2. "Cryogenic Research and Applications", Marshall Sitting and Stephen Kidd, D. Van Nostrand,IncUSA,(1963).
3. "Cryo-Cooler:FundamentalsPart-I",G.Walker,PlenumPress,NewYork.
4. "Cryo-Cooler:FundamentalsPart-II",G.Walker,PlenumPressNewYork.
5. "InternationalJournalofCryogenics",ElsevierPublication.
6. "Advanced Cryogenic Engineering", Proceedings of Cryogenic Engineering Conference, Vol.1-145,PlenumPress,NewYork(1968).

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

Enterprise Resource Planning (Elective-IV)

SUBJECT CODE: PCE ME 413

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	ESE : 70Marks
Practical : 02 Hrs. per week	CIE : 30Marks
Credit :04	TermWork : 25Marks

Pre-requisites:

Course Objectives:

1 Know the basics, evolution , importance of ERP
2 Correlate ERP and related technology
3 Understand manufacturing perspectives of ERP
4 Know business modules of ERP
5 Understandthekeyimplementationissuesandsomepopular products inERP
6 Understand implementation of ERP package

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

1 Understand the structure of an ERP system and know how process chains in materialsmanagement,production,controllingandsalesareimplementedinan ERPsystem Implementation and customize an ERP system using the appropriate modeling methods, that are Entity Relationship Modeling (ERM) and Event-Driven Process
2 Chains (EPC)
3 Understand the customization of an ERP system and customize essential parts of materials management, production, controlling and sales in SAP ECC
4 Understand software design issues in state-of-the-art business software and realize the importance of project management in an ERP implementation project
5 Understand what to expect, and not to expect, from a consultant implementing an ERP system
6 Understand the importance of IT governance in long-term relationships with a software vendor, such as SAP

Unit 1 Introduction to ERP [07]

Introduction, Evolution, Reasons for the growth of ERP market, Advantages, Benefits of ERP-Reduction of lead time, On time shipment, Reduction in cycle time, Improved resource utilization, Better customer satisfaction, Input supplier performance, Increasedflexibility.

Unit 2 ERP and Related Technologies [08]

Business Process Reengineering(BPR),Management Information System(MIS), Supply Chain Management (SCM), Decision Support System (DSS), Executive InformationSystem(EIS),Customerrelationshipmanagement(CRM)

Unit 3 ERP- A Manufacturing Perspective [05]

CAD/CAM,MRP,MRP II,Distribution Requirement Planning (DRP),Product DataManagement (PDM).

Unit 4 ERP Modules [07]

Introduction and study of Business modules like Finance, Mfg. and Production, Plant maintenance, Quality and Material Management, Sales and Distribution.

Unit 5 ERP Implementation Life Cycle [07]

Introduction, Pre-evaluation Screening, Package evaluation, Project planning, Gap Analysis, Reengineering, Configuration, Team training, Testing, End user training and Post-implementation phases, Enterprises application integration.

Unit 6 ERP Market and Case Studies [06]

Brief account of ERP market, various ERP packages like SAPAG, Oracle, People Soft, etc. Indian scenario for ERP implementation, Case studies based on implementation of ERP for various areas in mfg., Marketing and other businesses, E-commerce, cloud based ERP system.

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

1. Six assignments on each of above units.
2. Detailed study of implementation of ERP and its benefits for any suitable industry/organization

TEXT BOOKS:

1 "Enterprise Resource Planning", Alexis Leon,Tata McGrawHillPublication,ISBN0-07-463712-6.

2 "EnterpriseResourcePlanning",BretWagner,DelmarLearning,InternationalEdition,ISBN 10: 1439081085, ISBN–13: 978-1439081082.

3 "Enterprises Resource Planning", Venkateshswara, Scitech Publication.

4 "Entrepreneurship", Chris Boulton, Patric Turner, Willey India.

5 "Management Information System", S. Sadagopan, PHI, New Delhi, 2nd Edition.

REFERENCE BOOKS:

1 "ModernERP:SelectImplementandUse",MarianneBradford,HandMBooks,ISBN: 978-0-557-01291-6.

2 "Enterprises Resource Planning", E.F. Monk, B.J. Wagner, Cengage Learning.

3 "Enterprises Resource Planning", A. R Singla, Cengage Learning.

4 "Enterprises Resource Planning-Concepts and Practices", Vinod Kumar Garg andVenkitakrishnan N. K. , PHI, New Delhi.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS) (Elective IV)

SUBJECT CODE: PCE ME413

Teaching Scheme:	**Examination Scheme:**
Lectures : 03 Hrs. per week	**ESE : 70Marks**
Practical : 02 Hrs. per week	**CIE : 30Marks**
Credits :04	**TermWork : 25Marks**
	Practical/Oral: --

Pre-requisites: Fluid Mechanics Course Objectives:

Thecourseaimsto

1	Understand the concepts and context of MEMS
2	Understand various MEMS fabrication technologies
3	Understand MEMS-specific design issues, constraints and dynamics and modeling of Microsystems
4	Understand applications of micro sensors and micro actuators
5	Getting access to fabrication and testing in academia and industry

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

1	Gain a fundamental understanding of standard micro fabrication techniques and the issues surrounding them
2	Know the major classes, components, and applications of MEMS devices/systems and to
3	Demonstrate an understanding of the fundamental principles behind the operation of these devices/systems
4	Understand the unique requirements, environments, and applications of MEMS

5 Apply knowledge of micro fabrication techniques and applications to the design

6 Manufacturing of an MEMS device or a micro system

Unit 1 Introduction [06]

Introduction to Micromachining and MEMS, IC Fabrication, Essential technical background for lithography-based micromachining, Glimpses of Microsystems, Scaling effects, Distributed and lumped modeling approaches used in MEMS analysis andsimulations.

Unit 2 Micro sensors and Micro actuators [08]

Micro-sensors: Chemical sensors, Optical sensors, Pressure sensors, Thermal sensors – Thermopiles, Thermistors, Micro machined thermocouple probes, MEMS magnetic sensor, Microactuators: Capacitance, Piezo mechanics, Piezo-actuators as grippers, Micro grippers, Micro motors, Micro valves, Micro pumps, Micro accelerometers,Shape memory alloy based optical switch, Thermally activated MEMS relay, Micro spring thermal actuator.

Unit 3 Micro fabrication Processes [06]

Structure of silicon, Silicon wafer processing, Thin-film deposition, Lithography, Wet etching and Dry etching, Process integration, Bulk micromachining and Surface micromachining, Wafer-bonding, LIGA and other moulding techniques, Soft lithography. Thick-film processing, Low temperature co-fired ceramic processing.

Unit 4 Mechanics of Solids [08]

Stresses and deformation: Bars and beams, Micro device suspensions: Lumped modeling, Residual stress and stress gradients, Poisson effect, Anticlastic curvature, Examples of micromechanical structures, Thermal loading: Bimorph effect, Dealing with large displacements, In-plane and 3D elasticity equations, Vibrations of bars and beams.

Unit 5 Thermal, Fluid Flow in MEMS [06]

Thermal sensors and actuators and their analysis, Micro fluidics, Flow through micro channels, Miniature heat exchangers. Heat conduction in multilayered thin films,conduction in solids in sub micrometer scale.

Unit 6 Electronics and Packaging [06]

Semiconductor devices: Basics, Control and Microsystems, Vibration control of a beam, Integration of Microsystems and microelectronics, Packaging, Testing and reliability of Microsystems: Why and how?

TERM WORK /LIST OF EXPERIMENTS/ LIST OF ASSIGNMENTS:

Complete any 7 Assignments from below.

1. Case study of MEMS Sensors (Pressure sensor/ Accelerometer/Gyroscope).
2. Case-studyofMEMSActuators(Micro-pump/RFswitch).
3. Case-studyofSystemonchipe.g.,Drugdeliverysystem.
4. Visit to Micro fabricationfacility.
5. Visit to MEMS characterization and testing facility.
6. Lumped modeling of MEMS sensors/actuators in MATLABSimulink.
7. Introductory modeling of MEMS in multiphysics softwaree.g.ANSYSCOVENT
8. Study of Electrostatic Applications in MEMS like Electrostatic actuation (parallelplate),Electrostaticactuation(combdrive),Electrostaticsensing, Piezoelectric actuation, Piezoelectricsensing.
9. Study of:-
   i. Gyroscopic effect, Frequency response, Damping, Quality factor, Basic micro-flows for dampingcalculation.
   ii. Op-Amp and Op-Amp circuits, Signal conditioning for micro systemdevices.

REFERENCE BOOKS:

1 "MEMS and MICROSYSTEMS: Design and Manufacture", Hsu, Tai-Ran, TMH, ISBN:0-07-048709-X, (2003).

2 "MEMS", Mahalik, N. P., TMH, ISBN: 0-07-063445-9, (2007).

3 "MicromanufacturingandNanotechnology",Mahalik,N.P.,SpringerIndiaPvt. Ltd.,ISBN:978-81-8128-505-8(DistributedbyNewAgeInternational,NewDelhi) (Ed.),(2006)

4 "HandbookofMicrolithography,MicromachiningandMicrofabrication",P.Rai-Choudhury,SPIE,(1997).

5 "IntroductiontoMicroelectronicFabrication",RichardC.Jaeger,PrenticeHall, 2nd Edition,VolumeV,ISBN:0-201-44494-7,(2002).

6 "Nanosystems:MolecularMachinery,ManufacturingandComputation",KE Drexler,Wiley,ISBN0471575186,(1992).

7 "Microsystem Design", Stephen D. Senturia, Kluwer Academic Publishers, Boston, (2001).

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

ADVANCED REFRIGERATION(Elective IV)

SUBJECT CODE: PCE ME413

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30Marks
Credits:4	Term Work: 25Marks

Pre-requisites: Applied Thermodynamics, Refrigeration and Air Conditioning

Course Objectives

1. Understand the various methods ofRefrigeration.
2. Explain thermal analysis of vapour compressionsystem.
3. Understand the environmental aspect of refrigerants and alternaterefrigerants

Course Outcomes

1. Aware about market trends in the field of RAC and availability of various components in the market.
2. Update their knowledge in the subject and will bridge the gap between academics andindustry.
3. Improve utility of the students to RAC industry and will improve employment opportunity for the students.

Unit 01

Multistage Systems **[06]**

Multi-evaporator system; Multi expansion system; Cascade systems; Study of P-h; T-s; h-s and T-h charts for various refrigeration cycles, Heat Pump

Unit02 **[06]**

Vapour Absorption Refrigeration

Standard cycle and actual cycle, Thermodynamic analysis, Li-Br-water, NH_3-water systems, threefluid absorption systems, half effect, Single effect, Single-double effect, Double effect and triple effect system

Unit03 **[08]**

Modern Refrigerants & Non-Conventional Refrigeration System

Refrigerant recycling, Reclaim and charging, Alternative refrigerants, Refrigerant-lubricant mixture behavior, Synthetic Lubricants, Blending of refrigerants, Secondary refrigerants, Thermoelectric refrigeration, Thermo-acoustic refrigeration, Adsorption refrigeration, Steam jet refrigeration, Vortex tube refrigeration, and Magneticrefrigeration.

Unit04 **[05]**

Refrigeration Equipment's& Motor Selection

Study and Selection of Reciprocating, Screw, Scroll and Centrifugal Compressor based on applications, Selection of Single phase, Three phase, Starters, Constant speed and Variable speed Drive.

Unit05 **[10]**

Evaporators, Condenser, Control and Instrumentation

Design and Selection**,** Types, Thermal design, Effect of lubricants accumulation, Draining of lubricants, Selection and capacity control, Design and selection, Types, Thermal design, Purging, Selection and capacity Control, Selection of expansion devices, Design of refrigerant piping, Refrigeration system controls and safety devices, Solenoid valves, Suction and evaporator pressure regulators, Refrigeration system controller, High pressure receiver, Thermal design of low pressure receiver, Accumulator, Filters, Driers, Oil separators, Relief valves, Safety valves, High and low pressure cut out, Thermostats, Water regulators, System controller.

Unit06 **[05]**

Industrial refrigeration applications

Selection and design of various components for various Industrial refrigeration applications: Cold storage, ice plant, Process applications - Textile, Pharmaceuticals, Chemical, Transport, Food preservation, Dairy etc.Application and selection softwares of refrigeration system.

Term Work

1. Study and trial on cascade refrigerationsystem.
2. Study and trial on multi evaporatorsystem.
3. Study and Trial on multi compressorsystem.
4. Study and trial on nonconventional refrigerationsystem.
5. Component selection casestudy.
6. Industrial visit andreport.
7. Casestudyondesignofcommercialrefrigerationsystem.
8. Case study of coldroom.

Text Books

1. "Principles of refrigeration", R.J. Dossat, Pearson Education Asia Pearson Education,4th Edition.
2. "Refrigeration and Air-Conditioning", C.P. Arora, McGraw-Hill, 2ndEdition.
3. "Refrigeration and Air-conditioning", Stoecker andJones.
4. "Refrigeration", Manohar Prasad.

Reference Books

1. “Refrigeration and Air-conditioning”, Jordan andPriester.
2. “Refrigeration and Air-conditioning”, A.R. Trott,Butterworths.
3. “Thermal Environmental Engineering”, J.L. Threlkeld, Prentice Hall ofIndia.
4. “Industrial Refrigeration Handbook”, W.F. Stoecker,McGraw-Hill.
5. “Technician’s guide to Refrigeration Systems”,JohnA. Corinchock,McGraw-Hill.
6. “Industrial Refrigeration: Principles, Design and Applications”, P.C. Koelet,Mcmillan.
7. “ASHRAE Handbook”, (i) Fundamentals (ii) System iii)Applications.
8. “ISHRAEHandbooks”
9. “ARIStandards”
10. “Refrigeration Handbook”, Wang, McGraw Hill,Int.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

Tribology (Elective IV)

SUBJECT CODE: PCE ME413

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/ Week	ESE: 70Marks
Practical: 2Hrs/Week	CIE: 30 Marks
Credits: 4	Term Work: 25Marks

Pre-requisites: Physics, Chemistry, Mathematics, Fluid Mechanics, Theory of Machines, Machine Design.

Course Objectives:

1. Make student aware about Importance, scope and application of thissubject
2. Introduce the concepts of wear friction and lubrication and its application in design of tribologicalsystems.

Course Outcomes:

1. Awareness about the field ofTribology
2. Understand basis of friction, wear processes andlubrication
3. Aware about tribological issues in the design of machine components such as journal bearing, thrust bearing, and roller elementbearing
4. Familiarize with antifriction and anti-wear components of the material and the lubricants used therein
5. Design the tribological system from strength point ofview

Unit 01

IntroductiontoTribology **(6)**

Introduction Definition of tribology, Friction, wear and lubrication, Importance of the tribological studies. Properties of oils and equation of flow: Viscosity, Newton's Law of Viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, Classification properties and applications of lubricants. Regimes oflubrication,

Unit02 **(5)**

Friction and Wear

Friction: Introduction, laws of friction, Kinds of friction, Causes of friction, Friction measurement, Theories of friction, Effect of surface preparation.

Wear: Types of wear, various factors affecting wear, Measurement of wear, wear between solids and liquids, Theories of wear.

Unit03 **(9)**

Hydrodynamic Lubrication

Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, mechanism of pressure development in an oil film, Reynold's investigation and Reynold's equation in 2D. Numerical problems.

Introduction to idealized journal bearing, Load carrying capacity, Condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, End leakages in journal bearing, Numerical problems.

Unit04 **(6)**

Slider / Pad Bearing With a Fixed and Pivoted Shoe

Pressure distribution, Load carrying capacity, Coefficient of friction, Frictional resistance and loss of Power in a pivoted shoe bearing, Numerical examples.

Unit05 **(7)**

Hydrostatic Lubrication:

Introduction to hydrostatic lubrication, Hydrostatic step bearings, Load carrying capacity and oil flow through the Hydrostatic step bearing.Numerical Examples.

Unit 06

BearingMaterials: **(7)**

Commonly used bearings materials, Properties of typical bearing materials.Advantages and disadvantages of bearing materials.

Introduction to Surface engineering: Concept and scope of surface engineering. Surface modification – transformation hardening, surface melting, thermo chemical processes. Surface Coating – plating, fusion processes, vapor phase processes. Selection of coating for wear and corrosion resistance

TERM WORK :

(Any 5 out of 1 to 7)

1. Journal BearingApparatus
2. Tilting pad and thrust BearingApparatus
3. Study of lubricationsystems.
4. Friction in JournalBearings.
5. Four BallTester
6. Coefficient of friction using pin on disc type frictionmonitor
7. Industrial visit to study techniques of coating – casestudy.
8. Assignments based on topics in the syllabus. (Minimum5)

TEXT BOOKS:

1. “Introduction to Tribology Bearings”, Mujumdar B. C., S. Chand Company Pvt. Ltd(2008).
2. “Engineering Tribology” PrasantaSahoo, PHI,Estern EconomyEdition.
3. “Fundamentals of Tribology”, Basu S K., Sengupta A N., AhujaB.B., PHI(2006).
4. “Tribology in Industries”, Srivastava S., S Chand andCompany.
5. “Lubrication of Bearings – Theoretical Principles and Design”, Redzimovskay E I., Oxford Press Company(2000)
6. “Tribology”, Prof R B Patil, ISBN978-81-8492-812-9.

REFERENCE BOOKS:

1. " Engineering Tribology", G. W. Stachowiak and A. W. Batchelor, Butterworth-Heinemann (1992)
2. " Friction and Wear of Materials", Ernest Rabinowicz, John Wiley &Sons(1995)
3. "Basic Lubrication Theory", A. Cameron, Ellis Hardwoods Ltd.,UK
4. "Handbook of tribology: materials, coatings and surface treatments ", B.Bhushan, B.K.Gupta ,McGraw-Hill (1997)

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

PRECISION ENGINEERING (Elective IV)

SUBJECT CODE: PCE ME413

Teaching Scheme:	**Examination Scheme:**
Lectures: 3Hrs/Week	ESE: 70Marks
Practical:2Hrs/Week	CIE: 30 Marks
Credits:4	Term Work: 25Marks

Course objectives:

The course aims to:

1. Study the basics of precision engineering and different manufacturing technique in precision engineering
2. Get acquainted with various techniques of precision engineering like nano technology etc.
3. Understand importance of accuracy, influence of static stiffness, vibration accuracy etc.

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Specify what is meant by a precision engineering and list the basic components of an precision engineering
2. Explain how precision engineering can be specified.
3. Outline the Major issues of planning for the creation of precision engineering.
4. State points that arise from precision engineering quantitative analysis

Unit 1 Accuracy and Alignment Tests [08]

General concept of accuracy – Spindle rotation accuracy – Test methods- Displacement accuracy – Clamping errors - Setting errors -Location of rectangular prism, Cylinder-Basic type of tests – Measuring instruments used for testing machine tools - Alignment tests-Straightness, Flatness, Parallelism, Squareness, Circularity, Cylindricity.

Geometric Dimensioning and Tolerancing

Tolerance Zone Conversion-Surfaces, Features, Features of Size, Datum Features- Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums - Datum Feature of Representation Form Controls, Orientation Controls-Logical Approach to Tolerancing.

Unit 2 Precision Machining [06]

Introduction - Top down and bottom up approach - Development of Nanotechnology – Precision and micromachining -Diamond turning of parts to nanometer accuracy- Stereo microlithography Machining of micro-sized components-Mirror grinding of ceramics-Ultra precision block gauges.

Unit 3 Nano Measuring Systems [06]

In - process measurement of position of processing point - Post process and online measurementof dimensional features - Mechanical measuring systems - Optical measuring systems – Electronbeam measuring systems – Pattern recognition and inspection systems.

Unit 4 Lithography [06]

Nano Lithography – Photolithography - Electron beam lithography – Ion Beam lithography - Optical lithography - LIGA process- Dip pen lithography-Deep UV lithography, Nanocoatings.

Unit 5 Reliability Engineering [06]

Introduction to reliability, System reliability, Quantification of reliability: MTBF, MTTF,Analytical treatment based on series, Parallel and combination systems, Failure modes, FMECA, calculation of Risk Priority Number (RPN).

Unit 6 Tolerance Analysis[08]

Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects. Feature Tolerances, Geometric Tolerances. Surface Finish: Review of relationship between attainable tolerance grades and different machining process. Cumulative effect of Tolerances sure fit law, normal law and truncated normal law, tolerance stacking.

Term Work:

1. Various alignment test for sample component to check parallelism, circularity, straightness, flatness, surface finish and tolerance.
2. Understanding of fits with some practical hand on based on sample components and brief write up based on above.
3. Visit to suitable set up/industry/Research and Development Laboratory where nanotechnology is used.
4. Numericals based on system reliability for series, parallel and combination (Min. Two problems on each type)
5. Numericals on tolerance analysis for any sample component.
6. Assignment on tolerance stacking.

Text Books:

1. "Precision Engineering in Manufacturing", Murthy.R.L, New Age International, Delhi.
2. "Nanotechnology", Norio Taniguchi, Oxford University Press, Cambridge, (1996).
3. "Precision Engineering", Venkantesh V.C., Inzman S., Tata McGraw Hill, New Delhi, (2007).

Reference Books:

1. "Precision Motion Control Design and Implementation", Lee Tong Hong, Springer Verlag, U.K., (2001).
2. "Precision Machining of Advanced Materials", Liangchi Zhang, Trans Tech Publications Ltd., Switzerland, (2001).
3. "Principles of Precision Engineering", HiromuNakazawa, Oxford Uni. Press, (1994).
4. "Geometric Dimensioning and Tolerancing", James D. Meadows, Marcel Dekker Inc. (1995).
5. "Engineering Design – A systematic Approach", Matousek, Blackie and Sons Ltd. London.

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

online Certificate Course****

SUBJECT CODE: PCE ME414***

TeachingScheme:	**ExaminationScheme:**
	Term Work: 25 Marks
Credit: 2	

Course Objective –
To teach use of Moodle/Swayam/MOOC/NPTEL.etc. as a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environment.

Course outcome –
On successful completion of the course
Student should be able to Students will be able to choose course of their choice from Moodle/Swayam/MOOC/NPTEL. etc. and to be acquaintance with recent advance developments in Mechanical Engineering beyond syllabus.

The Student should register the online course with Moodle/Swayam/MOOC/NPTEL. etc. of his interest in Recent Advances in Mechanical Engineering at a Start of his/her final year (i.e. at Semester VII.) and Same is intimated to Head of Department. For Term Works Student has to Submit Completion Certificate of Course to the Department till end of Semester VIII. Term Work will be given at the end of Semester VIII.

The Student may choose**courses likes *****

1. **Design of Mechatronic Systems_**IIT Bombay
2. **Mechanics and Control of Robotic Manipulators_**IIT Palakkad
3. **Automation in Production Systems and Management,** IIT Kharagpur
4. **Toyota Production System,** IIT Roorkee
5. **Fundamentals of Artificial Intelligence,** IIT Guwahati
6. **Introduction to Airplane performance, IIT** Kanpur

***(These are Sample Courses given student has choice to select his own area)**

SHIVAJI UNIVERSITY, KOLHAPUR,

Final year B. Tech. (Mechanical Engineering) CBCS PATTERN Semester VIII

PROJECT PHASE–II

SUBJECT CODE: PWME 415

Teaching Scheme:
Practical:6Hrs/Week/Batch
Credit: 3Oral Exam: 25 Marks

Examination Scheme:
Term Work: 50 Marks

Course Objectives:
The course aims to:

1. Embed the skill in group of students to work independently on a topic/ problem/ experimentation selected by them and encourage them to think independently on theirown to bring out the conclusion under the given circumstances ofthe curriculum period inthe budget provided with the guidance of thefaculty.
2. Encourage creative thinking process to help them to get confidence by planning and carrying out the work plan of the project and to successfully complete the same, through observations, discussions and decision makingprocess.

Course Outcome:
Upon successful completion of this course, the student will be able to

1. Improve the professional competency and research aptitude in relevantarea.
2. Develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and currentresearch.

Project Phase II Load:
A batch of maximum three groups of four to five students per group, shall work under one Faculty member of department. The group of one student is strictly not allowed. Same groups of Seventh Semester shall work under same faculty member of department.

Project Phase II Definition:
Project phase-II is a continuation of project phase-I started in the seventh semester. Beforethe end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be externalevaluation.

Project Phase II Term Work:
The term work under project submitted by students shall include
1. Work Diary: Work Diary maintained by group and countersigned by the guide weekly. The contents of work diary shall reflect the efforts taken by project groupfor
a. Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring up theproject.
c. Brief report of feasibility studies carried to implement the conclusion.
d. Rough Sketches/ Design Calculations/ Testing reports/ Experimentation results.

Project Report:

Project report should be of 50 to 60 pages (typed on A4 size sheets). For standardization of the project reports the following format should be strictlyfollowed.

1. Page Size: TrimmedA4
2. Top Margin: 1.00Inch
3. Bottom Margin: 1.32Inches
4. Left Margin: 1.5Inches
5. Right Margin: 1.0Inch
6. Para Text: Times New Roman 12 Point.Font
7. Line Spacing: 1.5 Lines
8. Page Numbers: Right Aligned at Footer. Font 12 Point Times NewRoman
9. Headings: Times New Roman, 14 Point Boldface
10. Certificate: All students should attach standard format of Certificate as described by the department. Certificate should be awarded to batch and not to individual student.
Certificate should have signatures of Guide, Head of Department and Principal/Director
11. Index ofReport:

i) TitleSheet
ii) Certificate
iii) Acknowledgement
iv) Table ofContents.
v) List ofFigures
vi) List of Tables

1. Introduction
2. Literature Survey/Theory
3. Design/ Fabrication/ Production/ Actual work carried out for the same and Experimentation.
4. ObservationResults
5. Discussion on Result and Conclusion

12. References: References should have the followingformat

For Books: "Title of Book", Authors, Publisher, Edition

For Papers: "Title of Paper, Authors, Journal/Conference Details, Year

13. The Project report shall be signed by the each student in the group, approved by the guide and endorsed by the Head of theDepartment
14. Presentation: The group has to make a presentation in front of the faculty of department at the end ofsemester.

Important Notes:

- Project group should continue maintaining a diary for project and should write (a) Books referred (b) Company visited (c) Person contacted (d) Computer work done (e) Paper referred (f) Creativethinking.
- The Diary along with Project Report shall be assessed at the time of oralexamination
- One copy of the report should be submitted to Institute/ Department, One copy to Guide and one copy should remain with each student of the projectgroup.