# Final Year B.Tech

# Mechanical

# SEM-I & II Syllabus

# AY 2023-24

(DAC UG)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

## AY 2023-24

### Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME455 |
| **Course Name** | H-3 Project Management |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | - | **LA1** | **LA2** | **Lab ESE** | **Total** |
| **Interaction** | 1 Hour/week | 15 | 15 | 20 | 50 |
| | | **Credits: 1** | | | |

### Course Objectives

| | |
|---|---|
| **1** | To prepare the students to manage projects by exploring both technical and managerial challenges and preparing the budget. |
| **2** | To make aware the students about leadership and ethical qualities in dealing with real life project |
| **3** | To induce qualities for working in interdisciplinary and cross functional teams with effective communication skills, economical and managerial challenges and commercial management. |

### Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Grasp and perceive the project activities with respect to resources required and the constraint for feasibility or completion within time | II | Understanding |
| **CO2** | Estimate and prepare budget for project completion, Understand commercial management | IV | Analyzing |
| **CO3** | Figure out and schedule the project and assess for controlling critical path networks | V | Evaluating |

### Contents

| Module | Module content | Hours |
|---|---|---|
| 1 | Introduction to Project Management. | 2 |
| 2 | Project Cost, Planning, feasibility, risk. | 2 |
| 3 | Critical Path Networks - Principles of Resource Scheduling. | 2 |
| 4 | Executing and Controlling. | 2 |

| | | |
|---|---|---|
| 5 | Commercial Management and various regulations. | 2 |
| 6. | Study and use of software related to Project Management System. | 3 |

| Text Books | |
|---|---|
| 1 | Dennis Lock , Project Management - Gower Publishing Limited, 2013 |
| 2 | Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, Project Management in Practice - JOHN WILEY & SONS, INC., 2011 |
| 3 | B.C. Punmia and Khandelwal, Project Planning and Control with PERT and CPM, Lakshmi Publications Pvt. Ltd., 2001 |
| 4 | HoraldKerzner, Project Management: A systems approach to planning, scheduling and controlling, John Wiley & Sons Inc., 2009 |
| 5 | The factories act 1948 – Government of India 6. Meri Williams , The Principles of Project Management By – SitepointPvt Ltd., 2008 |
| | |
| **References** | |
| 1 | K. Nagarajan, Project Management, New Age Int., 2nd ed. 2004. |
| 2 | B.M.Naik, Project Management-Scheduling and Monitoring by PERT/CPM, 1984 |
| 3 | William R Duncan, A guide to the project management body of knowledge, PMI Publications, 1996 |
| | |
| **Useful Links** | |
| 1 | https://www.apm.org.uk/resources/what-is-project-management/ |
| 2 | https://www.projectmanager.com/project-management |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | | | | 1 | | | | | 1 | 1 |
| **CO2** | | | | | | | | | 2 | | | | | 2 |
| **CO3** | | | | | | | 1 | | | | | | 2 | |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

## AY 2023-24

### Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME403 |
| **Course Name** | H-4 Legal, IPR, Safety |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 1 Hrs/Week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 15 | 10 | 25 | 50 |
| | | **Credits: 1** | | | |

### Course Objectives

| | |
|---|---|
| **1** | To introduce the students about Legal, IPR, Safety laws. |
| **2** | To disseminate knowledge on patents, patent regime in India and abroad and registration aspects. |
| **3** | To be aware about current trends in IPR and Govt. steps in fostering IPR. |

### Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Understand about Indian industry Legal, IPR, Safety laws | II | Understanding |
| **CO2** | Interpret patent and copyright in innovative research work. | III | Applying |
| **CO3** | Illustrate the importance of Indian industry Legal, IPR, Safety laws. | IV | Analyzing |

### Contents

| Module | Module Contents | Hours |
|---|---|---|
| 1 | Overview of Bureau of Indian Standards Act of 1986 | 2 |
| 2 | The Right to Information Act of 2005, In order to promote public education and public safety | 2 |
| 3 | Intellectual Property, Patents, Copyrights, Trademarks, | 3 |

| | | |
|---|---|---|
| 4 | Other forms of IP, Current Contour, | 3 |
| 5 | The Factories Act, 1948, The Mines Act, 1952, | 2 |
| 6 | The Dock Workers (Safety, Health & Welfare) Act, 1986. | 1 |

| **Text Books** | |
|---|---|
| 1 | Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited. |
| 2 | D.S. S. Ganguly and C S Changeriya Labor & Industrial Acts & Laws (Safety Management) |
| | |
| **References** | |
| 1 | Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis. |
| | |
| **Useful Links** | |
| 1 | Cell for IPR Promotion and Management (http://cipam.gov.in/) |
| 2 | https://law.resource.org/pub/in/bis/manifest.med.html |
| 3 | World Intellectual Property Organization (https://www.wipo.int/about-ip/en/) |
| 4 | Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/) |
| 5 | https://labour.gov.in/industrial-safety-health |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | | | | 1 | | | | | 1 | 1 |
| **CO2** | | | | | | | | | 2 | | | | | 2 |
| **CO3** | | | | | | | 1 | | | | | | 2 | |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment (for Theory Course)**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem. VII |
| **Course Code** | 5OE429 |
| **Course Name** | Industrial Automation |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To train the students in the area of instrumentation, automation and control. |
| **2** | To get the basic knowledge and practical experience in instrumentation, automation and control area and to work more effectively in manufacturing, process and automation industries |
| **3** | To get the knowledge of various elements of industrial automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Identify different types automation, technological and economic issues involved in automatic manufacturing of products | III | Apply |
| **CO2** | Interpret basic concepts of sensors and transducers into real world applications. | V | Evaluate |
| **CO3** | Classify the major components used in automation such as commonly used sensors and analyze common techniques for sensor interfacing and protection circuits | IV | Analyze |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to Automation**<br>Introduction: Reason of automation, Current trends, classification and types of automation, Application of automation, Goals of automation, Low cost automation, Current emphases in automation, Issues for automation in factory operation, Ten strategies for automation. | 6 |
| II | **NC and CNC**<br>Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centres, NC and NC part | 6 |

| | | |
|---|---|---|
| | programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing. | |
| III | **Computer Aided design**<br>Computer Aided Design: Fundamentals of CAD - Hardware in CAD- Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, CNC Adaptive Control | 7 |
| IV | **Automation Elements**<br>Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies. | 7 |
| V | **Sensors and Processors**<br>Introduction, Sensor and transducers, Sensor technology, Selection of Transducers, Classification of sensors and transducers, History of Microprocessor, Programmable logic controller, Working of PLC. | 7 |
| VI | **Modelling and Simulation**<br>Introduction to Modelling and Simulation: Product design, process route modelling, Optimization techniques, Case studies & industrial applications | 6 |

| **Text Books** | |
|---|---|
| 1 | Mikell P. Groover, "Automation, Production systems and computer integrated manufacturing", Prentice Hall, 5th edition, 2019. |
| 2 | Serope Kalpakjain and Steven R. Schmid, "Manufacturing Engineering and Technology", 7th edition, Pearson, 2014. |
| 3 | Ibrahim Zeid, CAD/CAM : Theory & Practice, 6th edition, 25 June 2009. |

| **References** | |
|---|---|
| 1 | Yoram Koren, "Computer control of manufacturing system", McGraw Hill, 1st edition, 2017 |
| 2 | Webb and Reis, "Programmable Logic Controller – Principles and Applications", Prentice Hall of India, 5th Edition, 2002 |
| 3 | Kolk R.A. and Shetty Devdas, "Mechatronics System Design", Thomson Learning, 2007, 3rd Edition |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/103/112103293/ |
| 2 | https://onlinecourses.nptel.ac.in/noc20_me58/preview |
| 3 | https://nptel.ac.in/courses/112/104/112104288/ |
| 4 | https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-me58/ |

**Civil**

| **CO-PO Mapping** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **CO1** | 2 | | | | 1 | 1 | | | | | | | | | |
| **CO2** | 2 | 1 | | | 2 | | 1 | | 1 | | | 1 | | | |
| **CO3** | 2 | 1 | 2 | | 1 | | | | | | | 1 | | | |
| The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High | | | | | | | | | | | | | | | |

**Electronics**

| CO-PO Mapping | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **CO1** | 2 | | 1 | | 1 | | | | | | | | | | |
| **CO2** | 2 | 2 | | | 2 | | | | | | | 1 | | | |
| **CO3** | 2 | 2 | 1 | | 1 | | 1 | | | | | 1 | | | |
| The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High | | | | | | | | | | | | | | | |

**Electrical**

| CO-PO Mapping | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **CO1** | 2 | | 1 | 1 | | | | | | | | | | | |
| **CO2** | 2 | 1 | | | 1 | | 1 | | | | | 1 | | | |
| **CO3** | 2 | 1 | 2 | | 1 | | | | | | | 1 | | | |
| The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High | | | | | | | | | | | | | | | |

**Computer Science**

| CO-PO Mapping | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **CO1** | 2 | 1 | | | 1 | 1 | | | | | | | | | |
| **CO2** | 2 | 1 | | | 2 | | | | 2 | | | 1 | | | |
| **CO3** | 2 | 2 | 2 | | 1 | | | | | | | 1 | | | |
| The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High | | | | | | | | | | | | | | | |

**Information Technology**

| CO-PO Mapping | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | |
| **CO1** | 2 | | | | | | | | | | | | | | |
| **CO2** | 2 | 1 | | 1 | 1 | | | | 1 | | | 1 | | | |
| **CO3** | 2 | 1 | 2 | | 1 | | | | 1 | | | 1 | | | |
| The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High | | | | | | | | | | | | | | | |

| Assessment |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on |

modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME451 |
| **Course Name** | Mechanical Vibrations Lab |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | - | **LA1** | **LA2** | **Lab ESE** | **Total** |
| **Interaction** | - | 30 | 30 | 40 | 100 |
| | | **Credits: 1** | | | |

## Course Objectives

| | |
|---|---|
| **1** | To be aware about causes and effects of the vibration on mechanical systems. |
| **2** | To demonstrate mechanical vibration measuring instruments |
| **3** | To analyze types of vibrations namely un-damped, damped, free and forced vibrations. |
| **4** | To determine the transmission of force and motion due to vibration. |

## Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Demonstrate the concept of vibration, causes and basic elements and its measurement | II | Understanding |
| **CO2** | Determine natural frequency and corresponding mode shapes of systems | III | Applying |
| **CO3** | Measure force and motion transmissibility of given system | IV | Analyzing |

## List of Experiments / Lab Activities

List of Experiments:
Course Contents:
Any ten experiments/lab sessions from the list given below
List of experiments (study type)

1. Study of natural frequency of two degree of freedom spring mass system.
2. Study of natural frequency of double pendulum system.
3. Study of critical speed of shaft.

List of experiments (Trial / Demonstration type)

1. Determination of stiffness of spring from static deflection.
2. Determination of natural frequency of single degree of freedom spring mass system.
3. Determination of radius of gyration of compound pendulum
4. Measurement of torsional vibrations.

5. Determination of torsional vibrations of single/two rotor system.
6. Demonstration of plot response curve of system under forced vibration.
7. Determination of damping effect on a system under forced vibration with viscous damping.
8. Determination of optimal frequency for dynamic vibration absorber.
9. Measurement of various parameters of vibrations.
10. Verification of Dunkerley's rule transverse vibrations.
11. Determination of mode shapes of beam with various boundary conditions.

| **Text Books** | |
|---|---|
| 1 | G. K. Grover, "Mechanical Vibration" Nemchand and Brothers, Roorkee, Third Edition, 2006 |
| 2 | Dr. V. P. Singh, "Mechanical Vibrations", S. Chand and Sons New Delhi, Second Edition, 2004 |
| 3 | J. S. Rao "Introductory Course On Theory And Practice Of Mechanical Vibrations", New Age International Publishers, Second Edition, 1999 |

| **References** | |
|---|---|
| 1 | Austin Church, "Mechanical Vibrations", Wiley Eastern. First Edition, 1963 |
| 2 | Cyril M. Harris, Charles E. Crede, "Shock and vibration handbook", McGraw-Hill, 1976 |
| 3 | S. S. Rao, "Mechanical Vibrations", Fourth Edition, 2006 |

| **Useful Links** | |
|---|---|
| 1 | Virtual Labs (vlabs.ac.in) |
| 2 | Hartnell Governor Practical Detailed - YouTube |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | 1 | | | | | 3 | |
| **CO2** | | | 3 | | | | | | | | 2 | | 2 | 2 |
| **CO3** | | 3 | | 2 | | | | | | | 1 | | | 1 |

**Assessment**

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing (min 40 %), LA1+LA2 should be min 40%

| **Assessment** | **Based on** | **Conducted by** | **Typical Schedule (for 26-week Sem)** | **Marks** |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External Examiner as applicable | During Week 18 to Week 19<br>Marks Submission at the end of Week 19 | 40 |

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing

experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME441 |
| **Course Name** | Mini Project 5 |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | 2 Hrs./Week | **LA1** | **LA2** | **Lab ESE** | **Total** |
| **Interaction** | - | 30 | 30 | 40 | 100 |
| | | **Credits: 01** | | | |

## Course Objectives

| | |
|---|---|
| **1** | To acquaint with the process of identifying the needs and converting it into the problem. |
| **2** | To familiarize the process of solving the problem in a group. |
| **3** | To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. |
| **4** | To inculcate the process of self-learning and research. |

## Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Apply Knowledge and skill to solve academic / industrial / societal problems in a group. | III | Applying |
| **CO2** | Develop interpersonal skills to work as member of a group or leader. | III | Applying |
| **CO3** | Draw the proper inferences from available results through theoretical / experimental / simulation work. | V | Evaluating |

## Course contents

**Guidelines for Mini Project 5:**

1. Students are required to work in a group of maximum five students, and this group shall be the same as the project batch for the final year project.
2. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor.
3. Students need to choose different topic for mini project than their final year B. Tech project.
4. Students shall submit implementation plan in the form of Gantt / PERT / CPM chart, which will cover weekly activity of mini project.
5. A log book is to be prepared by each group, wherein group can record weekly work progress,
6. Faculty advisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7. Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

8. Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
9. The solution to be validated with proper justification and report to be compiled in standard format as defined by the department.
10. The project work can be any of the form given below **but not limited to** :
    a. Making physical working models, prototypes, and scaled models, of a concept machine.
    b. Making virtual / CAD models of a sufficiently complex machines / concepts.
    c. Making study, modeling, analysis, programming and simulation of a system / machine / operation / process.
    d. Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
    e. Any other project work in mechanical or multidisciplinary area in consultation with the faculty in charge.
11. Students can use workshop facility, different laboratory facilities, software, mathematical tools, simulation / animation tools etc. available or online freeware tools.
12. With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that the mini project of appropriate level and quality to be carried out.
13. Students need to ensure that mini project is not repeated from previous three years.
14. Students may complete mini project as an industry sponsored project, in consultation with the faculty advisor.
15. The students group can be allowed to work on the extension of the Mini Project 3 /4 with suitable improvements / modifications or a completely new project idea. This policy can be adopted on case by case basis.

**Guidelines for Assessment of Mini Project Practical / Oral Examination:**

- Report should be prepared as per the guidelines issued by the department.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to faculty advisor.
- Students shall be motivated to publish a paper based on the work in student competitions / Conferences / journals.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Fluency in written and oral communication
9. Quality of project report

| **Text Books** | |
|---|---|
| 1 | Suitable books and e books on design engineering, manufacturing processes, thermal engineering, design of experiments, optimization techniques suitable for selected project domain. |
| | |
| **References** | |
| 1 | Suitable user manuals of software tools and research papers from reputed national and international journals and conferences. |
| | |
| **Useful Links** | |

| | |
|---|---|
| 1 | Any online resources suitable for project domain. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | | | 3 | | | 3 | 2 | |
| **CO2** | 2 | 3 | 3 | | | | | | 3 | | | 2 | 2 | 1 |
| **CO3** | | | | 3 | | 2 | | 3 | 2 | 2 | 3 | 3 | | 1 |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO, and preferably to only one PO. | | | | | | | | | | | | | | |

| Assessment | | | | |
|---|---|---|---|---|
| There are three components of lab assessment, LA1, LA2 and Lab ESE.<br>IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40% | | | | |
| **Assessment** | **Based on** | **Conducted by** | **Typical Schedule (for 26-week Sem)** | **Marks** |
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External Examiner as applicable | During Week 18 to Week 19<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME454 |
| **Course Name** | Project I |
| **Desired Requisites:** | Basic and advanced concepts and principles in mechanical engineering, graduate level courses. Latest developments in mechanical engineering field. |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | 6 Hrs/Week | **LA1** | **LA2** | **ESE** | **Total** |
| **Interaction** | - | 30 | 30 | 40 | 100 |
| | | **Credits: 03** | | | |

## Course Objectives

| | |
|---|---|
| **1** | Provide an opportunity to students to do 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 and limitations. |
| **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 making process. |
| **3** | To enable students to for technical report writing and effective presentations. |

## Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Will be able to understand the importance of team work and will be able to work in a team for achieving group goals / will be prepared to assume a leadership role in any team. | III | Apply |
| **CO2** | Will have ability to explain various concepts and tools used in their project.<br>Will be able to analyze and give solutions for a specific problem statement related to their project. | IV | Analyze |
| **CO3** | Will be able to prepare and present a detailed report based on project work spread over two semesters. | V | Evaluate |

## Course contents

**Project Definition:-**

- Creation of product, apparatus, small equipment, test setup, experimental set up, prototype based on new idea.
- Innovation of existing product.
- Energy audit/ conservation-studies of department/ section / plant /organization / machine etc.

- Making of machine and renovation of machine.
- Experimental set up to verify and confirm scientific concepts.
- Experimental verification of principles of mechanical engineering, analysis or simulation of a process.
- Multidisciplinary projects.
- Projects using modern electronic / computer based tools, software etc. in consultation with faculty in-charge.

**Industry sponsored projects:**
Students may carry out sponsored project fulfilling the requirements mentioned above.

The project contents should be such that it is to be carried out over entire academic year by the group.

**Synopsis:-**
Synopsis should contain:-
a. Need of project- How you are inspired of particular project.
b. Aim and objective of project topic.
c. Idea/ideas used in the project work.
d. How will you execute the proposed idea
e. Various steps that will be followed (sequential) in the project work.
f. Schedule to be followed for completion of project work.
g. Cost estimate for the project including material / financial assistance expected from the department.
h. Classification of the project such as In-house, Sponsored, Lab development, software based etc.

**Work diary:**
Each project group shall maintain the record about project work details containing following points:
• Searching suitable project work
• Brief report preferably on journals/ research or conference papers/ books or literature surveyed to select and bring out the project.
• Brief report of feasibility studies carried to implement the conclusion.
• Rough Sketches/ Design Calculations, etc.

**Students are encouraged to publish a technical paper in conference / reputed peer reviewed journals based on their project work.**

**Project shall be assessed based on following points;**
1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Fluency in written and oral communication
9. Quality of project report

| | |
|---|---|
| | **Text Books** |
| 1 | Suitable books based on the contents of the project selected. |
| | |
| | **References** |
| 1 | Suitable books based on the contents of the project selected and research papers from reputed national and international journals and conferences. |

| Useful Links | |
|---|---|
| 1 | As per the need of the project. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | | | 3 | | | 3 | 3 | |
| **CO2** | | 3 | 3 | 3 | 3 | | 2 | | 3 | | 3 | | 2 | 1 |
| **CO3** | | 3 | | | | | | 3 | | 3 | 3 | | | 1 |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO, and preferably to only one PO. | | | | | | | | | | | | | | |

| Assessment | | | | |
|---|---|---|---|---|
| There are three components of lab assessment, LA1, LA2 and Lab ESE.<br>IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40% | | | | |
| **Assessment** | **Based on** | **Conducted by** | **Typical Schedule (for 26-week Sem)** | **Marks** |
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External Examiner as applicable | During Week 18 to Week 19<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME452 |
| **Course Name** | Refrigeration & Air Conditioning Lab |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | 2Hrs/Week | **LA1** | **LA2** | **LA ESE** | **Total** |
| **Interaction** | - | 30 | 30 | 40 | 100 |
| | | **Credits: 1** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering. |
| **2** | To prepare students to use modern tools & techniques. |
| **3** | To train students with effective communication skill to demonstrate refrigeration/air conditioning theories. |
| **4** | To develop skills to fulfill industrial needs. |
| **5** | To develop a professional approach to lifelong learning in the refrigeration/ air conditioning /cryogenics. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Performance the experiments in refrigeration and air-conditioning as per given objectives. | III | Applying |
| **CO2** | Analyze different refrigeration, air conditioning and cryogenic systems with their applications. | IV | Analyzing |
| **CO3** | Measure the performance of different systems under different condition | V | Evaluating |

**List of Experiments / Lab Activities**

**List of Experiments:**

**Course Contents:**

Following practical's should be considered for ISE and ESE evaluation

**Experiments**

1 Trial on vapour compression refrigeration system.
2 Trial on Heat Pump.
3 Trial on ice plant.
4 Trial on Cascade system.
5 Trial on air conditioning system.

**Demonstration / Study**

1. Study and demonstration of refrigeration system for house hold refrigerator, water cooler, ice plant and cold storage.(Industrial Visit is desirable)

2. Study and demonstration of controls in refrigeration
3. Study and demonstration on window, split & central air conditioner.
4. Study of dehydration, charging leak testing and testing of refrigeration system.
5. Study and demonstration of absorption system.
6. Study of method for star rating and EER for domestic appliances like house hold refrigerator.
7. Study of heat pump. / Vortex tube /pulse tube refrigeration.
8. Study/ Trial on multi stage compression refrigeration system.
9. Study/ trial on air washer.
10. Study/ trial on multi evaporator refrigeration system.

In case of mini-projects, drawing, presentations etc., write the relevant details of the same.

| Text Books | |
|---|---|
| 1 | Dossat "Refrigeration", Pearson, fourth edition, 2007. |
| 2 | C. P. Arora ,"Refrigeration and Air conditioning", Tata McGraw Hill Education Private Limited , third edition,2008 |

| References | |
|---|---|
| 1 | Stocker. ,"Refrigeration and Air Conditioning", McGraw-Hill Publishing , 2nd Edition,2008 |
| 2 | W. P. Jones, "Air Conditioning Engineering", Rutledge, 5th Revised Edition, 2001. |
| 3 | Willis H. Carrier, "Carrier Hand Book "Jonathan Castro, 2013 |

| Useful Links | |
|---|---|
| 1 | https://www.youtube.com/watch?v=4HmA3sT0C1Y&t=11s |
| 2 | https://www.youtube.com/watch?v=5dgRgBuWDZw&t=2s |
| 3 | https://www.youtube.com/watch?v=MjZahESS-48 |
| 4 | https://www.youtube.com/watch?v=14-kyt-a1DU |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | 2 | | 1 | | | | |
| **CO2** | 2 | 2 | | | 1 | | | | | | | | | |
| **CO3** | 2 | | | | | | | | | 1 | 1 | | | |

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

**Assessment**

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

| Assessment | Based on | Conducted by | Typical Schedule (for 26-week Sem) | Marks |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External | During Week 18 to Week 19<br>Marks Submission at the end of Week | 40 |

| | | | | |
|---|---|---|---|---|
| | | Examiner as applicable | 19 | |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME453 |
| **Course Name** | Techno Socio Activity |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | - | **LA1** | **LA2** | **Lab ESE** | **Total** |
| **Interaction** | 1 Hrs./Week | 15 | 15 | 20 | 50 |
| | | **Credits: 1** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | In this course the student performance in co-curricular and extra-curricular activities over four years will be considered. |
| **2** | The institute, state, national and international level activities are like technical events, Sports, Cultural, Social, and Students Club etc. These activities help the students to develop leadership skills, team integrity, coordination skills, Time management, Communications skills, Interviewing skills etc. These activities help the students to know his or her intelligence. The evaluation will be done by the mentor who is mentoring the student during graduation period. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Notice an improvement in his/her understanding and presentation skills. | III | Applying |

| | | | |
|---|---|---|---|
| **CO2** | Understand and value the importance of working in a diversified team/areas. | IV | Analyzing |
| **CO3** | Demonstrate the soft skills like presentation skills, technical report writing etc. | V | Evaluating |

**List of Experiments / Lab Activities**

The proctor faculty will be mentoring a given student batch for the duration of four years. The students shall submit proof of their achievements in various extra and co-curricular activities from First year to Final year. The faculty will evaluate the students' performance at the end of 8th semester, based on the

Rubrics provided by the department from time to time.

**Text Books**

| | |
|---|---|
| 1 | Not applicable. |

**References**

| | |
|---|---|
| 1 | Not applicable. |

**Useful Links**

| | |
|---|---|
| 1 | Not applicable. |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | | | | 1 | | | | | 1 | 1 |
| **CO2** | | | | | | | | | 2 | | | | | 2 |
| **CO3** | | | | | | | 1 | | | | | | 2 | |

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High

Each CO of the course must map to at least one PO, and preferably to only one PO.

**Assessment**

There are three components of lab assessment, LA1, LA2 and Lab ESE.

IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

| Assessment | Based on | Conducted | Typical Schedule (for 26-week Sem) | Marks |
|---|---|---|---|---|

| | | by | | |
|---|---|---|---|---|
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External Examiner as applicable | During Week 18 to Week 19<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME401 |
| **Course Name** | Mechanical Vibrations |
| **Desired Prerequisites:** | Engineering Mathematics, Engineering Mechanics |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

## Course Objectives

| | |
|---|---|
| **1** | To make students aware about causes and effects of the vibration on mechanical systems. |
| **2** | To discuss types of vibrations namely un-damped, damped, free and forced. |
| **3** | To elaborate the process of transmission of force and motion due to vibration. |
| **4** | To demonstrate mechanical vibration measuring instruments |

## Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Explain the basics of vibration, causes and basic elements and its measurement | II | Understanding |
| CO2 | Apply numerical methods in finding natural frequency and corresponding mode shapes of systems | III | Applying |
| CO3 | Analyze linear and torsional systems with single and two degree of freedom under free and forced vibrations, for their natural frequency and response to excitations | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Importance and scope, Concepts and terms used, SHM, vector method of representing harmonic motions, Complex method of representing vibration, Fourier series and harmonic analysis, stiffness of springs in combinations. | 7 |
| II | **Single degree free and forced vibration: Damped and undamped**<br>(a) Undamped free vibrations, derivation of differential equation with solution, energy method, types of damping, free vibrations with viscous damping, logarithmic decrement, coulomb damping, and damping materials.<br>(b) Forced Vibrations: Types of excitation, forced excitation, forced vibrations with constant harmonic excitation, steady state vibration, excitation due to unbalance in machines, support excitation, response due to above types of excitations, transmissibility, force transmissibility and | 8 |

| | | |
|---|---|---|
| | motion transmissibility, vibration isolators, commercial isolation materials and shock mounts | |
| III | **Two degree free and forced vibration**<br>(a) Free un-damped vibrations – Principal modes and natural frequencies, co-ordinate coupling and principal co-ordinates. (b) Forced vibrations (Un damped) – Harmonic excitation, vibration, dampers and absorbers, dynamic vibration absorber – tuned and Un tuned type | 7 |
| IV | **Torsional Vibration**<br>Natural frequency of free torsional vibrations, effect of inertia of the constraint on torsional vibrations, free torsional vibrations of a single rotor system, two rotor system and three rotor system. Torsionally equivalent shaft, free torsional vibrations of a geared system. | 6 |
| V | **Vibration Measuring Instruments**<br>Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, introduction of X – Y plotter, spectral analyzers, FFT analyzer.<br>**Introduction to Numerical Methods in Vibration**<br>Holzer method, Releigh's method, matrix iteration method, introduction to F. E. M., Analysis techniques used in vibration (Eigen value analysis) | 6 |
| VI | **Critical Speed of Shaft**<br>Critical speed of a light shaft having a single disc with and without damping, Critical speeds of a shaft having multiple discs, secondary critical speeds | 6 |

| **Text Books** | |
|---|---|
| 1 | G. K. Grover, "Mechanical Vibration" Nemchand and Brothers, Roorkee, Third Edition, 2006 |
| 2 | Dr. V. P. Singh, "Mechanical Vibrations", S. Chand and Sons New Delhi, Second Edition, 2004 |
| 3 | J. S. Rao "Introductory Course On Theory And Practice Of Mechanical Vibrations", New Age International Publishers, Second Edition, 1999 |

| **References** | |
|---|---|
| 1 | Austin Church, "Mechanical Vibrations", Wiley Eastern. First Edition, 1963 |
| 2 | Cyril M. Harris, Charles E. Crede, "Shock and vibration handbook", McGraw-Hill, 1976 |
| 3 | S. S. Rao, "Mechanical Vibrations", Fourth Edition, 2006 |

| **Useful Links** | |
|---|---|
| 1 | Module 1 - Lecture 1 - Rigid Body Motion - YouTube |
| 2 | Introduction_old - YouTube |
| 3 | Mod-1 Lec-1 Overview of the Course, Practical and Research Trends - YouTube |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | 3 | | | | | 3 | |
| **CO2** | | | 1 | | | | | | | | | 2 | 2 | 2 |
| **CO3** | | 1 | | 2 | | | | | | | | 3 | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

| Assessment (for Theory Course) |
| --- |
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME402 |
| **Course Name** | Refrigeration and Air Conditioning |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 2Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 2** | | | |

| **Course Objectives** | |
|---|---|
| **1** | To enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering. |
| **2** | To prepare students to use modern tools, techniques. |
| **3** | To practice effective communication skill to demonstrate refrigeration/air conditioning theories. |
| **4** | To develop skills in the analysis of refrigeration/air conditioning/cryogenics systems in research or design & industrial needs. |
| **5** | To develop a professional approach to lifelong learning in the refrigeration/air conditioning/cryogenics to include the awareness of social and environment issues. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Apply knowledge of mathematics, science, and engineering for the needs in refrigeration, air conditioning and cryogenic | III | Applying |
| CO2 | Analyze different refrigeration, air conditioning and cryogenic systems with their applications. | IV | Analyzing |
| CO3 | Evaluate refrigeration & air-conditioning systems under different conditions | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Review of Thermodynamics:** Laws, General equations, Processes, Equations applied to processes. Applications of refrigeration. **Basic Refrigeration Cycles:** Carnot cycle, Reversed Carnot cycle, Simple Vapor compression cycle, effect of sub-cooling, suction vapor superheating, Liquid to suction vapor heat exchanger, , Calculations and performance of above cycles, Actual vapor compression cycle, Bell Coleman - Reversed Bryton cycle, Air cycles for aircrafts (Descriptive Treatment). | 5 |
| II | **Multi pressure System and Refrigerants:** | 4 |

| | | |
|---|---|---|
| | **Multi pressure System**<br>Removal of flash gas, Flash inter-cooling, Water-cooling, Multistage, Multi-evaporator and Cascade System.<br>**Refrigerants:**<br>Classification, Desirable Properties like Thermodynamic, physical, & chemical. Comparison among commonly used refrigerants, Selection of Refrigerants,<br>Effect on Ozone depletion and global warming, Alternative Refrigerants. | |
| III | **Cryogenics and Vapor Absorption System:**<br>**Cryogenics:**<br>Introduction to cryogenic engineering and application, liquefier and cryocoolers.<br>**Vapor Absorption System:**<br>Aqua Ammonia system, Enthalpy-Concentration chart. analysis of system<br>Lithium Bromide -water vapor absorption system, Coefficient of Performance, Comparison with Vapor Compression cycle. (Descriptive treatment only). | 5 |
| IV | **Refrigeration Equipments**<br>Types of Compressor, Condenser, Evaporator, Expansion devices, & selection, use of insulation, its types & applications... | 3 |
| V | **Psychrometry**<br>Moist air as a working substance, Psychrometric properties of air, Use of Psychrometric tables and charts, Processes, Combinations and Calculations, ADP, Coil Condition line, Sensible heat factor, Bypass factor, Air washer and it's applications.<br>**Comfort:**<br>Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements | 5 |
| VI | **Heating and Cooling Load Calculation:**<br>Representation of actual air conditioning process by layouts and on Psychrometric charts, load analysis, RSHF, GSHF, ESHF, Enumeration and brief explanation of the factors forming the load on refrigeration and air conditioning systems, Energy requirements of different types of air conditioning systems, Energy conservation in air conditioning. | 4 |

| **Text Books** | |
|---|---|
| 1 | C. P. Arora ,"Refrigeration and Air conditioning", Tata McGraw Hill Education Private Limited , third edition, 2008 |
| 2 | Roy J. Dossat "Principle of Refrigeration", Pearson, fourth edition, 2007. |

| **References** | |
|---|---|
| 1 | Wilbert F. Stoecker, Industrial refrigeration handbook, 1st edition, McGraw-Hill Professional Publishing,1998 |
| 2 | Wilbert F. Stoecker, Jerold W Jones ,"Refrigeration and Air Conditioning", McGraw-Hill Publishing , 2nd edition ,2008 |
| 3 | Shan K. Wang, "Handbook of air conditioning and refrigeration" McGraw-Hill international second edition. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/107/112107208/ |
| 2 | https://nptel.ac.in/courses/112/105/112105128/ |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | | | 3 | |
| **CO2** | 2 | 2 | | | | | | | | | | 1 | 2 | 2 |
| **CO3** | 2 | | | 2 | | | | | | | | 1 | | 2 |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | |

| Assessment |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME411 |
| **Course Name** | Finite Element Method |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To explain the general steps in finite element method. |
| **2** | To solve various field problems using finite element method. |
| **3** | To apply variational formulation method to solve mechanical engineering problems. |
| **4** | To use modern software to simulate structural, thermal and fluid problems. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Explain the use of mathematical modeling and FEM. | III | Applying |
| CO2 | Use modern tools, software, and equipments to analyze and solve the problems and interpret the data | IV | Analyzing |
| CO3 | Analyze mechanical components, systems and projects required for industry by using FEM. | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction to FEM**<br>Basic concepts of FEM – Historical background, relevance and scope for FEM – need for approximation, applications of FEM in various fields, advantages and limitations of FEM. | 6 |
| II | Introduction Discretization, interpolation, shape function, formulation of element characteristics matrices, assembly and solution. | 7 |
| III | Introduction, Geometrical approximations, Simplification through symmetry, Basic element shapes and behaviour, Choice of element type, Size and number of elements, Element shape and distortion, Location of nodes, Node and element numbering. | 7 |
| IV | Types of elements, order of element. Formulation of element characteristic matrices and vectors for elasticity problems: One dimensional elasticity – two dimensional elasticity, axi-symmetric elasticity. Formulation procedures, the variational formulation, the | 7 |

| | | |
|---|---|---|
| | weighted residual method. Thermal problems, one dimensional heat transfer, two dimensional heat transfer, Torsional problems, Fluid flow problems. | |
| V | Introduction, co- ordinate transformations, assembly of element equations, incorporation of the boundary conditions, solution of the equations, matrix operations, elimination method, penalty method | 6 |
| VI | Model validity and accuracy, mesh design and refinement, element distortions, result processing, model checking. | 7 |

| | |
|---|---|
| **Text Books** | |
| 1 | S. S. Rao, "Finite Element Method in Engineering", Elsevier Publication, 4th Edition, 2004 |
| 2 | P. Seshu, "Textbook of Finite Element Analysis",1st Edition. 2008. |
| | M. J Fagan, "Finite Element Analysis- Theory and Practice"; Longman Scientific & Technical, 1st Edition, 1992 |
| | |
| **References** | |
| 1 | J. N. Reddy, "An Introduction to Finite Element Method", Tata McGraw Hill publication co. 2nd Edition, 1993 |
| 2 | Logan D. L. "A first course in Finite Element Method", Cengage learning, 4th Edition, 2008. |
| 3 | O. C, Zienkiewicz "The Finite Element Method – Basic Concepts and Linear Applications", Tata McGraw Hill publication co., 5th Edition, 2000 |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/112/106/112106135/ |
| 2 | https://nptel.ac.in/courses/112/104/112104115/ |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | | 3 | 3 | |
| **CO2** | | | 1 | 2 | | | | 2 | | | | | 2 | 2 |
| **CO3** | | 2 | | | | | | 2 | | | | 2 | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME412 |
| **Course Name** | Industrial Engineering |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | - | **Credits: 03** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To make the students to aware about processes, methods for effective planning, controlling, and implementing projects. |
| **2** | To utilize the tools and techniques for solving industrial engineering problems. |
| **3** | To apply project management related tools in the industry. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Explain methods, processes, and their types in industrial engineering. | III | Applying |
| CO2 | Illustrate the basic concepts of industrial engineering in the manufacturing and service sector. | IV | Analyzing |
| CO3 | Examine various tools and techniques for solving the industrial engineering problems. | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction of I.E., Productivity and PPC**<br>Definitions, functions and status of I.E. department in Manufacturing organization and Service sector, Productivity – concept and objectives, factors affecting, tools and techniques, Value analysis. Production Planning and Control – Elements and functions of PPC, Sales forecasting and methods of Capacity requirement planning. | 6 |
| II | **Plant Layout and material handling**<br>Plant layout:-Site selection, principles and objectives, production types, tools and techniques used, maintenance, line balancing, layout planning. Material handling: - Objective, elements, functions, principles, types of material handling equipments, unit load concept, Economics of material handling. | 7 |
| III | **Method study**<br>Definitions, objectives, various recording techniques, methods improvement techniques, principles of motion economy, Therbligs, micro-motion study, MOST | 6 |

| | | |
|---|---|---|
| IV | **Work measurement**<br>Definitions, objectives, activity and elements, performance rating, rating methods, allowances, group timing techniques, work sampling, PMTS. | 7 |
| V | **Inventory Control**<br>Different Models of Inventory Systems, MRP, Make or Buy decision. | 7 |
| VI | **Network Techniques**<br>CPM and PERT, Construction, Time cost trade off. | 6 |

| **Text Books** | |
|---|---|
| 1 | Khanna O.P., "Industrial Engineering and Management", Dhanpat Rai Publications (P) Ltd, New Delhi. Year 2003 |
| 2 | Martand Telsang "Industrial Engineering and Production Management" S. Chand & Company Ltd., New Delhi Year 2003 |

| **References** | |
|---|---|
| 1 | Gavrial Salvendy" Handbook of Industrial engineering" John Wiley and sons, New York, 2007 |
| 2 | M. I. Khan "Industrial Engineering" New age international(P) Ltd, New Delhi, 2004 |
| 3 | International labour office, "Introduction to work study" Publisher International Labour office,1969, Digitalized edition, 2008 |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/107/112107142/ |
| 2 | https://www.myklassroom.com/Engineering-branches/28/Industrial-Engineering |
| 3 | https://www.youtube.com/watch?v=yhywrCChJBQ&feature=emb_imp_woyt |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | | **2** | | | | **3** | | | | 3 | |
| **CO2** | | | | **3** | **1** | **2** | | | | | | | 2 | 2 |
| **CO3** | | | | | **2** | | **2** | **3** | | | | | | 3 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment (for Theory Course)**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

## Course Information

| | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 5ME413 |
| **Course Name** | Solid Mechanics |
| **Desired Prerequisites:** | Advanced Strength of Materials |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

## Course Objectives

| | |
|---|---|
| **1** | To provide students a sound knowledge in stress analysis required to solve the problems in industry |
| **2** | To teach the mathematical and physical principles in understanding the linear continuum behavior of solids. |

## Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Discuss the different concepts in stress analysis. | II | Understanding |
| CO2 | Apply basic relations between stress and strains to solve complex problems in stress analysis. | III | Applying |
| CO3 | Analyse the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries. | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Analysis of Stress and Strain**<br>Introduction, Concepts in Stress and Strain analysis, Principal stresses, Governing equations in cartension and polar coordinates, Generalized Hooke's law | 7 |
| II | **Two Dimensional Problems in Elasticity**<br>Plane stress and plane strain problems. Stress function, stress function for plane stress and plane strain cases. Solution of two-dimensional problems with different loading conditions by the use of polynomials. | 6 |
| III | **Axisymmetric Loaded Members** | 6 |

| | | |
|---|---|---|
| | Governing equations, stress in thick walled cylinder under internal and external pressure, stresses in rotating flat solid disk, flat disk with central hole | |
| IV | **Torsion**<br>Torsion of prismatic bars of solid section, Membrane analogy, Torsion of thin walled of open cross section and multiple cell closed sections. | 7 |
| V | **Thermal Stresses**<br>Thermoelastic stress-strain relations, Equations of equilibrium, Strain-displacement relations, Thin Circular disk: Temperature symmetric about centre, Long Circular cylinder | 7 |
| VI | **Plasticity**<br>Theoretical concepts of plasticity, The flow curve, True stress and True strain, Yield criteria, Plastic stress strain relationship, Elastic plastic problems in bending. Some engineering applications of elasticity and plasticity | 6 |

| **Text Books** | |
|---|---|
| 1 | S.P. Timoshenko and J.N. Goodier, *"Theory of Elasticity"*, McGraw-Hill Publishing Co. Ltd., 3rd Edition, 1970. |
| 2 | Beer and Johnston, *"Mechanics of Materials"*, McGraw Hill, 6th Edition , 2012 |
| 3 | L.S. Srinath, "*Advanced Mechanics of Solids*", Tata McGraw-Hill Publishing Co. Ltd, 3rd Edition 2009. |

| **References** | |
|---|---|
| 1 | Shames, I.H. and Pitarresi, J.M, *"Introduction to solid Mechanics"*, PHI learning Pvt. Ltd, 3rd Edition, 2009 |
| 2 | Hulse, R and Cain J, *"Solid Mechanics"*, Palgrave publisher, 2nd Edition, 2004. |
| 3 | F.B Seely and Smith, *"Advanced Mechanics of Materials"*, John Wiley & Sons, 2nd Edition, 1978. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/101/112101095/ |
| 2 | https://nptel.ac.in/courses/105/105/105105177/ |
| 3 | https://nptel.ac.in/courses/112/107/112107146/ |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | **2** | | | | | | | | | | | | **2** | |
| **CO2** | | | **2** | | | | | | | | **3** | **3** | **2** | |
| **CO3** | **2** | | **2** | | | | | | | | | **3** | **2** | |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

| Assessment |
| --- |
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME491 |
| **Course Name** | Project 2 |
| **Desired Requisites:** | Basic and advanced concepts and principles in mechanical engineering, graduate level courses. Latest developments in manufacturing technology. |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Practical** | 12 Hrs./Week | **LA1** | **LA2** | **Lab ESE** | **Total** |
| **Interaction** | - | 30 | 30 | 40 | 100 |
| | | **Credits: 6** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To help students to identify real life needs and discuss project requirements. |
| **2** | To give technical solutions through the latest design & development tools. |
| **3** | To direct students to compare and analyze the IT platforms for efficient solutions. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Integrate project at each stage of the software development life cycle. | III | Applying |
| **CO2** | Recommend project plans that address real-world challenges. Develop successful software projects that support program's strategic goals and satisfies the customer needs. | IV | Analyzing |
| **CO3** | Integrate project at each stage of the software development life cycle. | V | Evaluating |

**List of Experiments / Lab Activities/Topics**

- Completion of manufacturing / processing-assembly / testing / analysis / simulation work of the project.
- Testing, result analysis etc.
- Demonstration of the working of the project
- Rectifications/ correction if required to be completed.

**Students are encouraged to publish a technical paper in conference / reputed peer reviewed journals based on their mini project work.**

**Project shall be assessed based on following points;**

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements

| |
|---|
| 5. Effective use of skill sets<br>6. Effective use of standard engineering norms<br>7. Contribution of an individual's as member or leader<br>8. Fluency in written and oral communication<br>9. Quality of project report |
| |

| **Text Books** | |
|---|---|
| 1 | Suitable books based on the contents of the project selected. |
| | |
| **References** | |
| 1 | Suitable books based on the contents of the project selected and research papers from reputed national and international journals and conferences. |
| | |
| **Useful Links** | |
| 1 | As per the need of the project. |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | | | | | | | | 3 | | | 3 | 3 | |
| **CO2** | | 3 | 3 | 3 | 3 | | 2 | | 3 | | 3 | | 2 | 1 |
| **CO3** | | 3 | | | | | | 3 | | 3 | 3 | | | 1 |
| The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO, and preferably to only one PO. | | | | | | | | | | | | | | |

| **Assessment** | | | | |
|---|---|---|---|---|
| There are three components of lab assessment, LA1, LA2 and Lab ESE.<br>IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40% | | | | |
| **Assessment** | **Based on** | **Conducted by** | **Typical Schedule** | **Marks** |
| LA1 | Lab activities, attendance, journal | Lab Course Faculty | During Week 1 to Week 8<br>Marks Submission at the end of Week 8 | 30 |
| LA2 | Lab activities, attendance, journal | Lab Course Faculty | During Week 9 to Week 16<br>Marks Submission at the end of Week 16 | 30 |
| Lab ESE | Lab activities, journal/ performance | Lab Course Faculty and External Examiner as applicable | During Week 18 to Week 19<br>Marks Submission at the end of Week 19 | 40 |
| Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any. | | | | |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME421 |
| **Course Name** | Automobile Engineering |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To make students familiar with various basic systems of a modern automobile. |
| **2** | To introduce the mathematical treatments required for vehicle performance and for some of important systems such as steering system and brake system. |
| **3** | To make students aware about latest trends in transportation towards a safe, pollution free and fully automatic vehicle. |
| **4** | To empower students to face the real life automotive usage with greater confidence. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Comprehend about various automotive systems and recent trends in automobile design, development, manufacturing and assembly. | II | Understanding |
| **CO2** | Relate concepts of vehicle dynamics with daily experiences. | III | Applying |
| **CO3** | Analyze acceleration, barking and steering performance of a vehicle in different driving conditions. | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction, classification and Automotive power plants**<br>Introduction, Broad classification of Automobiles. Major components and their functions. Types of vehicle layouts, Types of bodies. Requirements of automotive power plants, Comparison and suitability considerations.<br>Electric and Hybrid vehicles- Layout, advantages and limitations. | 4 |
| II | **Vehicle Performance**<br>Resistance to vehicle motion, Air, Rolling and Gradient resistance, Acceleration, Gradeability and draw bar pull, Traction and Tractive effort, Distribution of weight, Power required for vehicle propulsion, Selection of gear ratio, Rear axle ratio. | 7 |
| III | **Automobile Systems**<br>Transmission System : Function, requirement and types of following parts: Automobile clutch, Gearbox, Differential, final drive, rear axle, propeller shaft. | 9 |

| | | |
|---|---|---|
| | Suspension, Steering Braking and Electrical System:<br>Function, types, requirements of the above mentioned systems. Key concepts of each of the mentioned systems. (Numericals from suspension, steering and braking systems only. Theory part of electrical system) | |
| IV | **Introduction to Hybrid and Electric Vehicles**<br>Electric Vehicles: Architecture of an electric vehicle, essentials and performance of electric vehicles Traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, advantage and limitations.<br>Hybrid Vehicles: Hybrid electric drivetrains concepts, architecture, design, control strategies, merits and demerits. | 6 |
| V | **Electric Propulsion Systems & Energy storage devices**<br>Electric propulsion systems: DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives.<br>Energy Storage Devices: Electrochemical batteries, thermodynamic voltage, lead-acid batteries, nickel based batteries, lithium based batteries, flywheel and ultra-capacitors, Battery management systems, range calculation. | 7 |
| VI | **Vehicle Testing and Recent trends in Automotive Development**<br>Road Test, free acceleration test, down test, passer by noise test, road load data acquisition for vehicle.<br>Test tracks: Proving ground testing, high speed track, pavement track, corrugated track, mud track, steering pad, gradient and other related tests. NVH and crashworthiness of vehicles, Emission norms and control. Recent advances in automobiles. | 6 |

| **Text Books** | |
|---|---|
| 1 | Kripal Singh, “Automobile Engineering Vol. II”, Standard Publishers Distributors, Tenth Edition , 2007 |
| 2 | P S Gill, “Automobile Engineering II”, S K Kataria and Sons, Second Edition, 2012 |
| 3 | R K Rajput, “Automobile Engineering”, Laxmi Publications, First Edition, 2007 |
| 4 | Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011 |
| 5 | Mehrdad Ehsani, YiminGao, Sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009. |

| **References** | |
|---|---|
| 1 | Newton, Steeds and Garrett, “The Motor Vehicle”, Butterworths International Edition, 11th Edition, 1989 |
| 2 | Crouse and Anglin, “Automotive Mechanics”, McGrawhill Publication, Tenth Edition, 2007 |
| 3 | P W Kett, “ Motor Vehicle Science Part - 2, “ Chapman & Hall” , 2nd Edition, 1982 |
| 4 | James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003. |
| 5 | Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2000 |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/107/106/107106088/ |
| 2 | https://nptel.ac.in/courses/107/106/107106080/ |
| 3 | https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160_Journal_Complete_Notes.pdf |
| 4 | http://nptel.ac.in/courses/108103009/ |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **CO1** | | | **2** | | | | | | | **1** | | | 2 | | |
| **CO2** | | | | | | | | **3** | | | **2** | | | 2 | |
| **CO3** | | **1** | | **2** | | | | | | | | **2** | | 3 | |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | | |

| **Assessment** |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

**Walchand College of Engineering, Sangli**
*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME431 |
| **Course Name** | Computational Fluid Dynamics |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To familiarize the students about different prediction methods and the role of CFD. |
| **2** | To prepare the students to derive different forms of governing equations used in CFD and their significance. |
| **3** | To analyze N-S equations and the different numerical techniques used in CFD. |
| **4** | To train the students to select the appropriate conditions to solve the problem with CFD. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Summarize the prediction methods and basic methodology of CFD. | II | Understanding |
| **CO2** | Derive various governing equations in different forms. | III | Applying |
| **CO3** | Analyze the different numerical techniques for solving fluid flow problems. | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Prediction method, experimental techniques, analytical methods, CFD application, typical problems/ Problem Solving with CFD – Methodology. | 7 |
| II | **Conservation laws and the model equations**<br>Governing equations of fluid flow and heat transfer, Equations of the state, Navier-Stokes equations for a Newtonian fluid, Conservative form of the governing equations of fluid flow, Differential and integral forms of the general transport equations, Classification of physical behavior. | 6 |
| III | **Exact solution of the Navier-Stokes equations and boundary conditions**<br>Introduction, Transformation of the Governing Partial Differential Equations, Grid Generation Techniques.<br>Boundary conditions: introduction, types of boundary conditions, Potential pitfalls and final remarks. | 7 |
| IV | **Basic computational techniques:**<br>Finite Difference Formulations: Introductory remarks, Taylor Series Expansions, | 6 |

| | | |
|---|---|---|
| | Finite difference by Polynomials, Finite difference equations, Applications. Finite Volume Method: Introduction, Steady one-dimensional problem, the central discretization schemes, Properties of discretization schemes, Assessment of the central differencing scheme for convection-diffusion problems, 1-D examples, 2-D examples. | |
| V | **Solution methods**<br>This chapter deals with basic numerical discretization approaches discussed in earlier chapter and mold them into various techniques that will allow the numerical solution of flow problems. Lax- Wendroff Technique McCormack's Technique, Crank-Nicolson Technique ,Relaxation Technique, ADI Technique, Pressure correction Technique. | 7 |
| VI | **Post processing**<br>Results are usually reviewed in one of two ways. Graphically and Alpha numerically. Graphically: Vector plots, Contours, Iso-surfaces, Flow lines, Animation. Alpha numerical techniques. | 6 |

| **Text Books** | |
|---|---|
| 1 | Anderson, J.D., "Introduction to Computational fluid Dynamics", McGraw Hill Publication 2008 |
| 2 | Muralidhar K. and Sundararajan T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, 2nd edition, New Delhi 2011. |
| 3 | Hoffmann K. A "Computational Fluid Dynamics" Publication of engineering education system, 2000. |

| **References** | |
|---|---|
| 1 | Suhas V. Patankar, "Numerical heat transfer fluid flow", Hemisphere Publishing Corporation, 1980. |
| 2 | H. K. Versteeg and W Malalasekera, "Introduction to Computational Fluid Dynamics" Longman group, 1998. |
| 3 | Fletcher C.A.J., "Computational Techniques for Fluid Dynamics I," Fundamental and General Techniques, Springer-Verlag, 1987 |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/107/112107208/ |
| 2 | https://nptel.ac.in/courses/103/106/103106073/ |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | | | 3 | |
| **CO2** | | | 2 | | | | | | | | | 3 | 2 | 2 |
| **CO3** | | 2 | | | | | | | | | | | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment (for Theory Course)**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME433 |
| **Course Name** | Condition Monitoring of Machines and Signal Processing |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To make students aware of some methods and procedures applied for general Condition Monitoring. |
| **2** | To make students appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring, know the general stages of CM |
| **3** | To prepare students capable to apply some basic techniques for analysis of random and periodic signals |
| **4** | To prepare students aware of some basic instrumentation used for machinery and structural vibration-based monitoring |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Calculate the characteristic of problems related to vibrations | V | Evaluating |
| **CO2** | Apply knowledge for preventive maintenance | III | Applying |
| **CO3** | Investigate the data for troubleshooting vibration problems in the mechanical machines | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Types of Maintenance**<br>Types of maintenance, basic idea of health monitoring and condition monitoring of structures and machines. Critical speed of shafts, Some basic techniques. | 7 |
| II | **Signal Processing**<br>Study of periodic and random signals, probability distribution, statistical properties, power spectral density functions of commonly found systems, spectral analysis | 6 |
| III | **Fourier Transform**<br>Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals, resonant frequencies, modes of vibration | 6 |
| IV | **Vibration Based Fault Diagnosis**<br>Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments | 6 |
| V | **Applications of Condition Monitoring**<br>Typical applications of condition monitoring using vibration analysis to rotating machines, unbalance, misalignment, faulty gears and bearings, vibration problem related to the foundation. Transmissions of vibration and its isolation | 7 |
| VI | **Other Health Monitoring Techniques**<br>Other health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications | 6 |

| Text Books | |
|---|---|
| 1 | Adams M. L., Rotating Machinery Analysis - from Analysis to Troubleshooting, CRC Press, 2nd edition, 2009 |
| 2 | Cornelius S., Paresh G., Practical Machinery Vibration Analysis and Predictive Maintenance, Newnes, 1st edition, 2004 |
| 3 | Mohanty A. R., Machinery Condition Monitoring-Principles and Practices, CRC Press, 1st edition, 2015 |
| | |
| **References** | |
| 1 | William J. H., Davis N., Drake P. R., Condition Based Maintenance and Machine Diagnostics, Springer Netherlands , 2nd edition, 1994 |
| 2 | L.L. Faulkner, Handbook of Industrial Noise Control, Industrial press, 1st edition 1976 |
| 3 | Rao S. S., Mechanical Vibrations, Pearson education, 5th edition, 2010 |
| | |
| **Useful Links** | |
| 1 | https://www.youtube.com/watch?v=aKcDBg8c4hk |
| 2 | https://www.youtube.com/watch?v=6dFnpz_AEyA |
| 3 | https://nptel.ac.in/courses/112/105/112105232/ |
| 4 | https://nptel.ac.in/courses/112/105/112105048/ |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | | **2** | | | | | **1** | | | | 1 | |
| **CO2** | | | | | | | **2** | | | | **2** | | | 3 |
| **CO3** | **2** | | **3** | | | | | | | | | **2** | | 3 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME432 |
| **Course Name** | Total Quality Management |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

| **Course Objectives** | |
|---|---|
| **1** | To make the students to understand fundamental principles of total quality management. |
| **2** | To provide the students the knowledge of new concepts like customer focus, customer retention and associated costs. |
| **3** | To prepare the students for the analysis and use of various TQM tools. |
| | |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Understand on quality management philosophies and frameworks. | II | Understanding |
| **CO2** | Develop in-depth knowledge on various tools and techniques of quality management and their application. | III | Applying |
| **CO3** | Learn the applications of quality tools and techniques in both manufacturing and service industry. | IV | Analysing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Definitions of quality, need and evolution of quality, product quality and service quality, costs and value of quality, basic concepts of TQM, TQM framework, quality gurus and contributions, barriers to TQM, customer focus, customer satisfaction, customer complaints and customer retention | 7 |
| II | **TQM Principles**<br>Leadership, strategic quality planning, employee involvement and empowerment, teamwork, quality circles, recognition and reward, performance appraisal, continuous process improvement, supplier partnership, supplier rating and selection | 6 |
| III | **TQM Tools**<br>Control charts, process capability, six sigma- concepts, methodology, applications, bench marking process, FMEA- stages and types, PDCE cycle, 5S, Kaizen | 7 |

| | | |
|---|---|---|
| IV | **TQM Techniques**<br>Just in time (JIT), Quality Function Deployment (QFD), Taguchi quality loss function, TPM- concepts, improvement needs, performance measures | 7 |
| V | **Quality systems**<br>Need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits | 6 |
| VI | **TQM Implementation**<br>TQM implementation in manufacturing and service sectors, case studies of TQM implementation | 6 |

| **Text Books** | |
|---|---|
| 1 | Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006 |
| 2 | Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th edition, Cengage Learning, 2012 |
| 3 | Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006 |

| **References** | |
|---|---|
| 1 | Juran J.M. & Gryna , Quality Planning and Analysis |
| 2 | Feigenban, Total Quality Control, McGraw Hill Book Company |
| 3 | Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006 |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/110/104/110104080/ |
| 2 | https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-me26/ |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 1 | | | | | | | | | | | | 2 | |
| **CO2** | 2 | | 2 | | | | | 2 | | | 1 | | | |
| **CO3** | 1 | 3 | | | | | | 1 | | | | | | |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME435 |
| **Course Name** | Computer Integrated Manufacturing |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To expose the student to the various fundamentals of computer assisted manufacturing systems. |
| **2** | To make the students familiar with criteria for implementing systems associated with software and CAD/CAM database for design and manufacturing. |
| **3** | To explain students about Robotics and its allied interdisciplinary approach, component design, sensor technology, computer science and artificial intelligence. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Choose sensors, actuators and motion conversion devices in logical way. | III | Applying |
| **CO2** | Defend the working of Robot software/ hardware in CIM environment | V | Evaluating |
| **CO3** | Design of the modern information processing system through computers. | VI | Creating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Computer Integrated Manufacturing**<br>- Introduction, definition, importance, components, automation and evolution of CIM. Advantages, limitations, scope and globalization view.<br>- Product Development through CIM:<br>Introduction, product development cycle, sequential engineering, concurrent engineering, comparison between SE and CE, implementation of CE, CE and IT, soft and hard prototyping, characteristics of CE, success of CE, applications of CE. | 6 |
| II | **Automated Quality Control and CIM Implementation**<br>- In-process and post process methodologies, integrations of CNC machines, | 7 |

| | | |
|---|---|---|
| | robot in CIM environment.<br>- Communication, software/ Hardware:<br>Availability of software, network topologies for LAN, network interface card and protocols, Network operating systems.<br>- CIM models:<br>Introduction, ESPRIT- CIM OSA model, the NIST- AMRF hierarchical model, the Siemens model, digital equipment corporation model, IBM concept of CIM. | |
| III | **Computer Aided Process Planning**<br>Structure, information requirements, CAD based process planning, Group Technology, Coding structure, MICLASS system, Variant and generative process planning, Implementation considerations | 6 |
| IV | **Robotics in CIM**<br>Historical development, various terminologies, classification, degrees of freedom and degrees of motion, manipulation of robot components, joints and symbols, work volume, work envelope, accuracy and repeatability, configuration, Numerical examples. | 7 |
| V | **Robot Programming and Modular Components**<br>Methods, languages, advantages and limitations of robot, requirements for robot in an Industries, specifications of robot, operational capabilities level of robot, modular robot components, wrist mechanism, Numerical examples.<br>Robot Sensors, Actuators and Motion Conversion:<br>-Internal and external sensors, force sensors, thermocouples, performance characteristics, standard test signals, controllers, PLC and robotics.<br>-Robot actuators, micro grippers, motion conversion systems, harmonic drives, robot safety. | 8 |
| VI | **Advanced Systems**<br>Heuristics decision for robot, Fuzzy logic for robot control, Artificial Neural Network for robotics, Biped Robot, Biomimetic robotics, calibration.<br>Shop floor data collection, Automatic data collection, Data acquisition system | 5 |

| **Text Books** | |
|---|---|
| 1 | Groover M.P, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall International publication, 2004. |
| 2 | AppuKuttan K.K, "Robotics", I. K. International publication, 2007. |
| 3 | Groover M.P., Nagel R.N., Ordey N.G. "Industrial Robotics- Technology, Programming and Applications," McGraw Hill International, 2012. |

| **References** | |
|---|---|
| 1 | Richard M. Murrai, Zexiang Li, S Shankar Sastry, "Robotic Manipulation," CRC Press, 2001 |
| 2 | S.R. Deb, "Robotics Technology and Flexible Automation," Tata McGraw Hill, 2000 |
| 3 | Urich Rembold, "Computer Integrated Manufacturing Technology and System," 1995 |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/content/storage2/112/105/112105249/MP4/mod01lec01.mp4 |
| 2 | NPTEL Link: https://youtu.be/a6_fgnuuYfE |
| 3 | NPTEL Link: https://youtu.be/49RET0N-ITY |
| 4 | NPTEL Link: https://youtu.be/9fqygvj-O2s |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | | | 1 | | | 2 | | | | | | | 2 | 2 |
| CO2 | | | | | | 1 | | | | | | 2 | | 3 |
| CO3 | | | | | | | | | | | 2 | | | |
| The strength of mapping is to be written as 1: Low, 2: Medium, 3: High<br>Each CO of the course must map to at least one PO. | | | | | | | | | | | | | | |

| Assessment |
|---|
| The assessment is based on MSE, ISE and ESE.<br>MSE shall be typically on modules 1 to 3.<br>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.<br>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.<br>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing) |

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME436 |
| **Course Name** | Design of Transmission System |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

| **Course Objectives** | |
|---|---|
| **1** | To train students in the standard procedure available for design of transmission systems of machines. |
| **2** | To provide the students with knowledge of gear design. |
| **3** | To prepare the students to succeed as designer in industry/technical profession. |
| **4** | To provide students with a sound foundation in the use standard data and catalogues |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| CO1 | Describe the theory of power transmission and gear box design. | II | Understanding |
| CO2 | Utilize the given data tables to arrive at proper specifications of flexible power transmission element. | III | Applying |
| CO3 | Design the gear box as per the need of functioning of machine. | VI | Creating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Belt and Pulleys**<br>Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets | 6 |
| II | **Spur Gears**<br>Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears. | 8 |
| III | **Bevel and Worm Gears**<br>Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears. | 7 |
| IV | **Design of Gear Box**<br>Gear box- geometric progression, standard step ratio; Ray diagram, kinematics | 8 |

| | | |
|---|---|---|
| | layout; Design of sliding mesh gear box, Design of multi-seed gear box for machine tool applications; constant mesh gear box | |
| V | **Cam Design**<br>Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses | 5 |
| VI | **Clutch and Brake Design**<br>Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake. | 6 |

| **Text Books** | |
|---|---|
| 1 | Bhandari V.B., Design of Machine Elements, 3rd edition, Tata McGraw-Hill Book Co, 2018 |
| 2 | Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th edition, Tata McGraw Hill, 20104. |
| 3 | Mehta N.K., Machine Tool Design and Numerical Control, 3rd edition, Tata McGraw Hill, 2012 |

| **References** | |
|---|---|
| 1 | Norton R.L., Design of Machinery, McGraw Hill Publication, 3rd edition, 2013 |
| 2 | Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010. |
| 3 | Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd edition, Tata McGraw Hill, 2001 |
| 4 | PSG Design Data Book |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/106/112106137/ |
| 2 | https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-me16/ |
| 3 | https://www.digimat.in/nptel/courses/video/112105234/L35.html |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | | | **2** | | | | | | | **1** | | | 2 | |
| **CO2** | | | | | | | | **3** | | | **2** | | | 2 |
| **CO3** | | **1** | | **2** | | | | | | | | **2** | | 3 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

## AY 2023-24

### Course Information

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 5ME434 |
| **Course Name** | Gas Dynamics and Jet Propulsion |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

### Course Objectives

| | |
|---|---|
| **1** | To introduce students about the basic difference between incompressible and compressible flow |
| **2** | To provide knowledge related to phenomenon of shock waves and its effect on flow. |
| **3** | To prepare the students To gain some basic knowledge about jet propulsion and Rocket Propulsion. |

### Course Outcomes (CO) with Bloom's Taxonomy Level

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Interpret the basic difference between incompressible and compressible flow. | II | Understanding |
| **CO2** | Recognize phenomenon of shock waves and its effect on flow. | III | Applying |
| **CO3** | analyze gas dynamics principles in the Jet and Space Propulsion | IV | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Basic Concepts And Isentropic Flows**<br>Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers. | 7 |
| II | **Flow Through Ducts**<br>Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. | 7 |
| III | **Normal And Oblique Shocks**<br>Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications | 6 |
| IV | **Jet Propulsion**<br>Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines. | 7 |
| V | **Space Propulsion Gas Dynamics And Jet Propulsion**<br>Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion. | 6 |

| | | |
|---|---|---|
| VI | **Performance Study**<br>Performance study – Staging – Terminal and characteristic velocity – Applications – space flights. | 6 |

| | |
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| | |
| **Text Books** | |
| 1 | Anderson, J.D., "*Modern Compressible flow*", 3rd Edition, McGraw Hill, 2003. |
| 2 | Yahya, S.M. "*Fundamentals of Compressible Flow*", New Age International (P) Limited, New Delhi, 1996. |
| | |
| **References** | |
| 1 | Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980 |
| 2 | Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010. |
| 3 | Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953. |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/112/106/112106166/ |
| 2 | https://web.iitd.ac.in/~pmvs/course_mcl341.php |
| 3 | https://arc.aiaa.org/loi/jjp |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 2 | | | | | | | | | | | | 3 | |
| **CO2** | | | 2 | | | | | | | | | 3 | 2 | 2 |
| **CO3** | | 2 | | | | | | | | | | | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 5ME437 |
| **Course Name** | Combustion |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3 Hrs./week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

**Course Objectives**

| | |
|---|---|
| **1** | To learn about applications and scope of combustion. |
| **2** | To understand thermodynamics , chemistry and physics of combustion |
| **3** | To learn laminar premixed flame and flame stabilizations. |
| **4** | To learn about the compressors with and without intercooling. |
| **5** | To learn the spray and solid fuel combustion. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Understand applications and scope of combustion. | II | Understanding |
| **CO2** | Understand chemistry and physics of combustion. | II | Understanding |
| **CO3** | Analyze premixed flame and diffusion characteristics. | III | Analyzing |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction:** Introduction to combustion, Applications of combustion, Types of fuel and oxidizers, Characterization of fuel, Various combustion mode, Scope of combustion. | 6 |
| II | **Thermodynamics of Combustion:** Thermodynamics properties, Laws of thermodynamics, Stoichiometry, Thermochemistry, adiabatic temperature, chemical equilibrium. | 7 |
| III | **Chemistry of Combustion:** Basic Reaction Kinetics, Elementary reactions, Chain reactions, Multistep reactions, simplification of reaction mechanism, Global kinetics. | 6 |
| IV | **Physics of Combustion:** Fundamental laws of transport phenomena, Conservations Equations, Transport in Turbulent Flow. | 7 |
| V | **Premixed Flame:** One dimensional combustion wave, Laminar premixed flame, Burning velocity measurement methods, Effects of chemical and physical variables on Burning velocity, Flame extinction, Ignition, Flame stabilizations, Turbulent Premixed flame. | 6 |
| VI | **Diffusion Flame:** Gaseous Jet diffusion flame, Liquid fuel combustion, Atomization, Spray | 7 |

| | | |
|---|---|---|
| | Combustion, Solid fuel combustion. | |

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| | |
| **Text Books** | |
| 1 | D.P. Mishra, Fundamentals of Combustion, Prentice Hall of India, New Delhi, 2008. |
| | |
| **References** | |
| 1 | Kuo K.K. “Principles of Combustion” John Wiley and Sons, 2005. |
| 2 | Strehlow R A., “Fundamentals of combustion” McGraw Hill Book Company, 1984. |
| | |
| **Useful Links** | |
| 1 | https://nptel.ac.in/courses/112/105/112105123/ |
| 2 | https://nptel.ac.in/content/storage2/courses/112104117/ui/Course_home-lec6.htm |

**CO-PO Mapping**

| | Programme Outcomes (PO) | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| **CO1** | 3 | 3 | | | | | | | | | | 1 | 2 | 2 |
| **CO2** | 3 | 2 | 1 | 2 | 3 | | | 3 | 3 | 1 | 3 | | 2 | 2 |
| **CO3** | 3 | 2 | 1 | | 2 | 1 | 1 | | 3 | | | | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 5ME439 |
| **Course Name** | Mechanical System Design |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

| **Course Objectives** | |
|---|---|
| **1** | To prepare the students to succeed as designer in industry/technical profession. |
| **2** | To Provide students with a sound foundation in mechanical system design required to solve the problems in industry. |
| **3** | To train the students for safe and efficient design of structural parts of the mechanical system. |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Explain the theory of pressure vessels and gearbox design. | III | Applying |
| **CO2** | Use Johnson's method of optimum design to design mechanical components. | IV | Analyzing |
| **CO3** | Estimate the tolerances and reliability of mechanical components and systems. | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | Introduction to optimum design for mechanical elements, adequate and optimum design, Johnson's method of optimum design- simple problems in optimum design like axially loaded members, shafts subjected to torsional and bending moments, helical spring, levers. Optimum design with in Lagrange multipliers | 6 |
| II | (a) Statistics in design, probability, random variables- sample and populations, Normal distribution, Sampling distribution, Confidence intervals, population combinations (Introductory treatment, no questions to be asked in examinations on 5(a)<br>(b) Design for natural tolerances, Statistical analysis of tolerances. Introductions to reliability and its applications for selections of factor of safety, study of process capability for design. | 7 |
| III | System Approach to Design; Mathematical model; Lumped system; Dynamic response of lumped & distributed system; Modeling of masses, Elasticity, | 7 |

| | | |
|---|---|---|
| | Inertia, Damping and friction. | |
| IV | 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.Introdduction to design of pressure vessels as per IS Codes. Shell and end closures. Effect of opening & nozzles in shell & covers. Types of pressure vessel support | 7 |
| V | 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 | 6 |
| VI | Approach to industrial product based on idea generation and innovations to meet the creative process involved in idea marketing, designers, mind-criticism, design process, creation needs of the developing society. Design and development process of industrial products, various steps such as Ergonomics and aesthetic requirements of product design, quality and maintainability consideration in product design, Use of modeling technique, prototype designs, conceptual design | 7 |

| **Text Books** | |
|---|---|
| 1 | V. B. Bhandari , "Design of Machine Element", Tata Mc- Graw Hill Publication , 4th Edition, 2001 |
| 2 | Shigley and C. R. Miscke , "Mechanical Engineering Design", Tata Mc- Graw Hill Publication, 2001 |
| 3 | M. F. Spotts , "Mechanical design analysis", Prentice Hall publication, 1964 |
| 4 | Black P. H. and O. Eugene Adams , "Machine Design", Tata Mc- Graw Hill Publication, 3rd Edition, 1993 |
| 5 | W. H. Mayall ,"Industrial Design for Engineers", Illife, 1967 |

| **References** | |
|---|---|
| 1 | M. V. Joshi, " Process Equipment Design" , Macmillan Publication, 1976 |
| 2 | Robert L. Norton , "Machine Design", Tata Mc- Graw Hill Publication, 2001 |
| 3 | Anurag Dixit , "Mechanical System Design" , SCITECH publication, 2005 |
| 4 | Percy H. Hill "The Science of Engineering Design", Holt McDougal, 1970. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/112/105/112105124/ |
| 2 | https://onlinecourses.nptel.ac.in/noc20_ch17/preview |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 3 | | 2 | | | | | | | | | 3 | 3 | |
| CO2 | | | 2 | | | | | 2 | | | | 2 | 2 | 2 |
| CO3 | | 2 | 1 | 1 | | | | | | | | | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

# Walchand College of Engineering, Sangli

*(Government Aided Autonomous Institute)*

**AY 2023-24**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 5ME438 |
| **Course Name** | Product Lifecycle Management |
| **Desired Requisites:** | |

| **Teaching Scheme** | | **Examination Scheme (Marks)** | | | |
|---|---|---|---|---|---|
| **Lecture** | 3Hrs/week | **MSE** | **ISE** | **ESE** | **Total** |
| **Tutorial** | - | 30 | 20 | 50 | 100 |
| | | **Credits: 3** | | | |

| **Course Objectives** | |
|---|---|
| **1** | To provide the knowledge of different information systems used in an engineering enterprises |
| **2** | To impart the recent knowledge in the broader field of product development and various lifecycle aspects involved |
| **3** | To provide exposure to application of software tools for addressing problems in product design and development |

**Course Outcomes (CO) with Bloom's Taxonomy Level**

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

| **CO** | **Course Outcome Statement/s** | **Bloom's Taxonomy Level** | **Bloom's Taxonomy Description** |
|---|---|---|---|
| **CO1** | Explain various phases in product life cycle and its considerations in product development | III | Applying |
| **CO2** | Discuss PLM backend technologies and its implementation | IV | Analyzing |
| **CO3** | Apply DFX principles for product development | V | Evaluating |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Globalization and international business, Global competitiveness and manufacturing excellence, Operating environment, Business challenges, Emergence of information Age, Data and information management, Role of information systems. | 6 |
| II | **PLM evolution**<br>Pre-PLM era, Sequential engineering, Concurrent engineering, Integrated product process development (IPPD),DFX, Design for manufacturability, Design for assembly, Design for disassembly, Design for environment | 7 |
| III | **Product Lifecycle Management**<br>PLM Need, PLM overview, PLM system architecture, PLM functionalities, PLM systems and its benchmarking | 6 |
| IV | **Pillars of PLM systems** | 7 |

| | | |
|---|---|---|
| | Computer aided design (CAD), Product data management (PDM), Enterprise resource planning (ERP), Supply chain management (SCM), Customer relationship management (CRM), Knowledge management (KM) | |
| V | **PLM and Database Management System**<br>Database modeling (relational, object-oriented models, web models), Database systems (i.e., databases and rule management), Data warehousing, Databases and WWW, XML databases, Information retrieval, Distributed databases, Heterogeneous databases and data integration | 6 |
| VI | **PLM implementation**<br>PLM implementation, Challenges, Data Interpretability, Business Process Reengineering, PLM implementation case studies. | 7 |

| **Text Books** | |
|---|---|
| 1 | Stark John, Product Lifecycle Management - 21st Century Paradigm for Product Realization, Springer, 2005. |
| 2 | Hoffer J, Prescott M, McFadden F, Modern Database Management, Prentice Hall, 2007. |

| **References** | |
|---|---|
| 1 | Ramakrishnan R and Gehrke J, "Database Management Systems", McGraw-Hill Publisher, 2002. |
| 2 | Kusiak A, "Concurrent Engineering: Automation, Tools, and Techniques", John Wiley & Sons, 1993. |
| 3 | Magrab E, Gupta S, McClusky P, Sandborn P, "Integrated Product and Process Design and Development: The Product Realization Process", CRC Press, 2010. |

| **Useful Links** | |
|---|---|
| 1 | https://nptel.ac.in/courses/106/106/106106220/ |
| 2 | https://www.youtube.com/watch?v=LW8TMDwhc7w&list=PLeL2LKQLdbQvCnxVaL8WENwBPtQqTUTm4 |
| 3 | www.odoo.com/cloud/plm-software |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 |
| CO1 | 2 | | | | | 3 | | | 3 | | | 1 | 3 | |
| CO2 | 2 | | | 3 | | | | 3 | | | | | 2 | |
| CO3 | | | 2 | | 2 | | | | | | | | | 1 |

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

**Assessment**

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
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