*(Government Aided Autonomous Institute)*

**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME421 |
| **Course Name** | Automobile Engineering (PC) |
| **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 students with the fundamental systems of a modern automobile. |
| **2** | To introduce the mathematical concepts necessary for analyzing vehicle performance and critical systems, such as the steering and brake systems. |
| **3** | To raise student awareness about the latest trends in transportation, focusing on safety, pollution reduction, and automation. |
| **4** | To equip students with the confidence and skills needed to effectively handle real-world automotive challenges. |

**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 classification of automobiles, major components, their functions, and the requirements and suitability of automotive power plants, including electric and hybrid vehicles. | II | Understanding |
| **CO2** | **Apply** knowledge of vehicle dynamics and power systems to the design and development of automotive systems. | III | Applying |
| **CO3** | **Analyze** factors affecting vehicle performance, including resistance to motion, power for propulsion, and selection of gear and axle ratios. | IV | Analyzing |
| **CO4** | **Evaluate** the functions, types, and requirements of automobile systems (transmission, suspension, steering, braking, and electrical) and solve related numerical problems. | V | Evaluating |

| **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,<br>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.<br>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) | 9 |
| 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
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 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | |
| **Course Name** | Project 2 |
| **Desired Requisites:** | Basic and advanced concepts and principles in mechanical engineering, graduate level courses. Latest developments in engineering fields. |
| | |
| **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 | 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 | Applying |
| CO2 | Will have ability to explain various concepts and tools used in their project. | IV | Analyzing |
| CO3 | Will be able to analyze and give solutions for a specific problem statement related to their project. | V | Evaluating |
| CO4 | Will be able to prepare and present a detailed report based on project work spread over two semesters. | VI | Create |

**Course contents**

- Completion of manufacturing / processing-assembly / testing / analysis / simulation work of the project.
- Testing, result analysis etc.
- Demonstration of the working of the project set-up / model / software program as applicable.
- 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
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 |
| **CO4** | | | | | | | | 1 | | 1 | | 2 | 2 | 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 2024-25**

| Course Information | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem. VIII |
| **Course Code** | 6ME431 |
| **Course Name** | Renewable Energy Engineering (PE 6) |
| **Desired Requisites:** | |
| | |
| **Teaching Scheme** | **Examination Scheme (Marks)** |

| Lecture | 3 Hrs./week | ISE | MSE | ESE | Total |
|---|---|---|---|---|---|
| Tutorial | - | 20 | 30 | 50 | 100 |
| Practical | - | | | | |
| Interaction | - | Credits: 3 | | | |

| Course Objectives | |
|---|---|
| 1 | To provide students with a comprehensive understanding of non-conventional energy sources and their role in the global and Indian energy scenario. |
| 2 | To equip students with knowledge about solar energy, including solar radiation, energy collectors, and various applications. |
| 3 | To introduce students to wind energy conversion systems, including site selection, types of wind machines, and energy storage. |
| 4 | To familiarize students with bio-energy and fuel cells, including biogas generation and the principles and applications of fuel cells. |
| 5 | To explore the principles and applications of ocean energy, including OTEC and tidal energy. |
| 6 | To impart knowledge on energy economics and the environmental impacts of conventional energy use, as well as opportunities for energy conservation and co-generation systems. |

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

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

| | | |
|---|---|---|
| CO1 | **Describe** the global and Indian energy scenarios, including the consumption and demand of energy. | Remembering |
| CO2 | **Explain** the principles of solar, wind, bio-energy, fuel cells, and ocean energy technologies. | Understanding |
| CO3 | **Demonstrate** practical skills in calculating solar, wind, and tidal energy potentials, and in designing basic renewable energy systems. | Apply |
| CO4 | **Analyze** the design and operational parameters of renewable energy systems for specific applications. | Analyze |
| CO5 | **evaluate** the economic and environmental impacts of different energy systems, using life cycle costing and energy audit methods | Evaluate |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Introduction to Non-Conventional Energy Sources**<br>Introduction, Indian and global energy scenario, fossil fuels, India's energy production, consumption and demand of energy, solar energy and other non-conventional energy resources, role of alternate energy sources of worlds power generation in future | 7 |
| II | **Solar Energy**<br>Extra-terrestrial solar radiation, solar radiation on earth, beam and diffused radiation, global radiation on a surface, solar radiation geometry, solar energy collectors, solar energy storage, solar pond, applications of solar energy, cooking, pumping, distillation, solar PV energy generation | 7 |
| III | **Wind Energy Conversion Systems**<br>Wind data and energy estimation, availability of wind energy and wind velocity, site selection, basic wind energy conversion systems, types of wind machines, performance of wind m/c, energy storage, and applications of wind energy | 6 |
| IV | **Bio-Energy and Fuel cell**<br>Bio-mass and photosynthesis, biogas generation, types of biogas plants, factors affecting biogas generation, community biogas plants, biogas digester design, design of community biogas plant for a village, problems related to biogas plant Fuel cells- Design and principle of Operation of a fuel cell, Classification and types of fuel cells, Advantages and Disadvantages of Fuel Cell, Applications of Fuel Cells, Batteries- Basic Batteries Theory, Classification of Batteries | 7 |
| V | **Ocean Energy**<br>Ocean thermal energy conversion (OTEC): principle of OTEC, open and closed | 6 |

| | | |
|---|---|---|
| | cycle OTEC, working fluids for OTEC<br>Tidal energy: principle of tide generation, tidal power plants, estimation of energy from tides, site selection for tidal power plants | |
| VI | **Energy Economics and Environment**<br>Life cycle costing, present worth factor, present worth of capital and maintenance cost, energy conservation opportunities, energy audit, co-generation systems, waste heat utilization, impact<br>of conventional energy use on environment | 6 |

| **Text Books** | |
|---|---|
| 1 | G. D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, 5th Edition, 2014 |
| 2 | V. M. Domkundwar, "Solar Energy and Non-Conventional Energy Sources", Dhanpat Rai & Co. Ltd., 1st Edition, 2010 |
| 3 | R. K. Singal, "Non-Conventional Energy Sources", Katson Publication, 2nd Edition, Reprint, 2013 |

| **References** | |
|---|---|
| 1 | Jhon Twidell and Tony Weir, "Renewable Energy Resources", Roultledge Publication, 2nd Edition, 2005 |
| 2 | S. P. Sukhatme, "Solar Energy", McGraw Hill Publication, 4th Edition, 2017 |
| 3 | G. S. Sawhney, " Non-Conventional Resources of Energy", PHI Publication, 5th Edition, 2012 |
| 4 | Recent reports of agencies: International Energy Agency (IEA), Ministry of New and Renewable energy (MNRE), Technology and Action for Rural Advancement (TARA) |

| **Useful Links** | |
|---|---|
| 1 | https://mnre.gov.in/ |
| 2 | https://beeindia.gov.in/ |
| 3 | https://ascelibrary.org/journal/jleed9 |
| 4 | https://onlinecourses.nptel.ac.in/noc21_ch11/preview |

**CO-PO Mapping**

| | **Programme Outcomes (PO)** | | | | | | | | | | | | **PSO** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 |
| **CO1** | 2 | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | 3 | | | 1 | 1 | 1 | | | | 1 | 3 | | | |
| **CO3** | 2 | 3 | | | 1 | 1 | 1 | | | | 1 | 3 | | | |
| **CO4** | 2 | 3 | | | 1 | 1 | 1 | | | | 1 | 3 | | | |
| **CO5** | 2 | 2 | | | 1 | 1 | 1 | | | | 1 | 3 | | | |

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.

**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.<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

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**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME432 |
| **Course Name** | Total Quality Management |

| **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 | Interpreting |
| **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 |
| **CO4** | Gain knowledge of various quality management systems such as ISO 9001, ISO 1400 and understand their role in facilitating organizational excellence. | II | Interpreting |

| **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 | 7 |

| | | |
|---|---|---|
| | focus, customer satisfaction, customer complaints and customer retention | |
| 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

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**AY 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME432 |
| **Course Name** | Total Quality Management |

| **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 | Interpreting |
| **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 |
| **CO4** | Gain knowledge of various quality management systems such as ISO 9001, ISO 1400 and understand their role in facilitating organizational excellence. | II | Interpreting |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|
| I | **Introduction**<br>Definitions of quality, need and evolution of quality, product quality and | 7 |

| | | |
|---|---|---|
| | 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 | |
| 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 | | | | | | |
| **CO4** | | | | 1 | | 2 | | | | 1 | 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.<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 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME433 |
| **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 |
| **CO4** | Analyse the mechanical systems using different health monitoring techniques | IV | Analysing |

| Module | Module Contents | Hours |
|---|---|---|
| I | **Types of Maintenance** | 7 |

| | | |
|---|---|---|
| | Types of maintenance, basic idea of health monitoring and condition monitoring of structures and machines. Critical speed of shafts, Some basic techniques. | |
| 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 |
| **CO4** | **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.<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 2024-25**

| Course Information | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 6ME434 |
| **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 |

| **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.<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 2024-25**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME435 |
| **Course Name** | Design of Transmission Systems |

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

**Course Objectives**

| | |
|---|---|
| **1** | To gain knowledge on the principles and procedure for the design of Mechanical power transmission components. |
| **2** | To train students in the standard procedure available for design of transmission systems of machines. |
| **3** | To provide the students with knowledge of gear design. |
| | |

**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 various transmission system components and their functions | II | Interpreting |
| **CO2** | Explain the theory of power transmission and gear box design. | III | Apply |
| **CO3** | Use the given data tables to arrive at proper specifications of flexible power transmission element. | IV | Analyze |
| **CO4** | Design the gear box as per the need of functioning of machine. | IV | Evaluate |

| **Module** | **Module Contents** | **Hours** |
|---|---|---|

| | | |
|---|---|---|
| I | 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 | 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 | 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 | Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box, Design of multi-seed gear box for machine tool applications; constant mesh gear box | 8 |
| V | Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses | 5 |
| VI | 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, Design of Machine Elements, 3rd Edition, Tata McGraw-Hill Book Co, 2010. |
| 2 | Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010. |
| 3 | N. K. Mehta, Machine Tool Design and Numerical Control, 3rd ed., Tata McGraw Hill, 2012. |
| | |
| **References** | |
| 1 | R. L. Norton, Design of Machinery, McGraw Hill Publication, 3rd Edition, 2003 |
| 2 | Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010. |
| 3 | Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001. |
| 4 | PSG Design Data Book |

| **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 | | | | | | | 2 | 2 |
| **CO2** | | | 3 | | | | | 2 | | | | | 2 | 2 |
| **CO3** | | | 3 | 2 | | | | | | | | | 3 | 2 |
| **CO4** | | 2 | | | | 1 | | | | | | | 2 | 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 2024-25**

| Course Information | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME435 |
| **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** | Analyze how emerging technologies like IoT, AI and machine learning influence advanced manufacturing systems. | IV | Analyze |
| **CO3** | Defend the working of Robot software/ hardware in CIM environment | V | Evaluating |
| **CO4** | 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, 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. | 7 |
| 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 2024-25**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 6ME437 |
| **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 Combustion, Solid fuel combustion**.** | 7 |

**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.<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 2024-25**

**Course Information**

| | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., SEM-VIII |
| **Course Code** | 6ME438 |
| **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** | Elaborate the use of database system. | IV | Analyzing |
| **CO4** | 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**<br>Computer aided design (CAD), Product data management (PDM), Enterprise resource planning (ERP), Supply chain management (SCM), Customer relationship management (CRM), Knowledge management (KM) | 7 |
| 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 |
| CO4 | | | | 3 | | | | | | | | | 1 | |
| 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 2024-25**

| **Course Information** | |
|---|---|
| **Programme** | B. Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VIII |
| **Course Code** | 6ME439 |
| **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** | Analyze the gear boxes with different speeds | IV | Analyzing |

| | | | |
|---|---|---|---|
| **CO4** | 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, Inertia, Damping and friction. | 7 |
| 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 | | | | | 2 | | | | 2 | 2 | 2 |
| CO4 | | 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 2024-25**

| **Course Information** | |
|---|---|
| **Programme** | B.Tech. (Mechanical Engineering) |
| **Class, Semester** | Final Year B. Tech., Sem VII |
| **Course Code** | 6ME401 |
| **Course Name** | Mechanical Vibrations |

| **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 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 | Understand |
| **CO2** | Apply numerical methods in finding natural frequency and corresponding mode shapes of systems | III | Apply |
| **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 | Analyze |
| **CO4** | Understand type of vibrations in flexible shaft rotor systen | II | Understand |

| **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. (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 motion transmissibility, vibration isolators, commercial isolation materials and shock mounts | 8 |

| | | |
|---|---|---|
| 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 |

**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 |
| **CO4** | 2 | | 2 | | | | | | | | | 2 | 1 | |

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

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