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	6ME402
Course Name	Refrigeration and Air Conditioning
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/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	Recall knowledge of mathematics, science, and engineering for the needs in refrigeration, air conditioning and cryogenic	II	Understanding
CO2	Apply knowledge of mathematics, science, and engineering for the needs in refrigeration, air conditioning and cryogenic	III	Applying
CO3	Analyze different refrigeration, air conditioning and cryogenic systems with their applications.	IV	Analyzing
CO4	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	7

	vapor heat exchanger, , Calculations and performance of above cycles, Actual vapor compression cycle, Bell Coleman - Reversed Bryton cycle, Air cycles for aircrafts (Descriptive Treatment).	
II	**Multi pressure System and Refrigerants:** **Multi pressure System** Removal of flash gas, Flash inter-cooling, Water-cooling, Multistage, Multi-evaporator and Cascade System. **Refrigerants:** Classification, Desirable Properties like Thermodynamic, physical, & chemical. Comparison among commonly used refrigerants, Selection of Refrigerants, Effect on Ozone depletion and global warming, Alternative Refrigerants.	6
III	**Cryogenics and Vapor Absorption System:** **Cryogenics:** Introduction to cryogenic engineering and application, liquefier and cryocoolers. **Vapor Absorption System:** Aqua Ammonia system, Enthalpy-Concentration chart. analysis of system Lithium Bromide -water vapor absorption system, Coefficient of Performance, Comparison with Vapor Compression cycle. (Descriptive treatment only).	7
IV	**Refrigeration Equipments** Types of Compressor, Condenser, Evaporator, Expansion devices, & selection, use of insulation, its types & applications, Refrigeration and Air-Conditioning Control	7
V	**Psychrometry** 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. **Comfort:** Thermal exchange between human body and environment, factors affecting comfort, effective temperature comfort chart, ventilation requirements	7
VI	**Heating and Cooling Load Calculation:** 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.	5

Text Books	
1	C. P. Arora ,"Refrigeration and Air conditioning", Tata McGraw Hill Education Private Limited , third edition, 2021
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., 2000
4	IHRAE Handbook – Fundamentals of Refrigeration, 2015

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														
CO2														
CO3														
CO4														

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	6ME403
Course Name	Instrumentation & Control
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100
Practical	-	-			
Interaction	-	**Credits: 4**			

Course Objectives	
1	To provide a basic knowledge about measurement systems and their components.
2	To introduce various sensors used for measurement of mechanical quantities
3	To teach system stability and control.
4	To show integration of the measurement systems with the process for process monitoring and control.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Select suitable instrumentation systems for monitoring and control of Industrial processes.	Apply
CO2	Measure mechanical quantities using instruments, their accuracy & range, and use the techniques for controlling devices automatically.	Analyse
CO3	Analyze the system and its mathematical model for standard input responses.	Evaluate
CO4		

Module	Module Contents	Hours
I	Significance of mechanical measurements, Classification of measuring instruments, Generalized measurement system, Types of inputs: Desired, interfering and modifying inputs. Static characteristics: Static calibration, Linearity, Static sensitivity, Accuracy, Static error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. Errors in measurement: Types of errors, Effect of component errors, Probable errors.	6
II	Displacement Measurement: Potentiometer, LVDT, Capacitance Types, Digital transducers, Nozzle flapper transducer. Measurement of Angular Velocity: Analog and Digital tachometers, Stroboscopic Methods. Acceleration Measurement: Theory of accelerometer and vibrometers Strain Measurement : Theory of strain gauges, gauge factor, Temperature compensation, Bridge circuit, Strain gauge based load cells and torque sensors	7
III	Pressure Measurement: Elastic pressure transducers, High pressure measurements, Bridge man gauge. Vacuum measurement Flow Measurement: Ultrasonic flow meter, Magnetic flow meter, Rota meter. Temperature Measurement: Resistance thermometers, Thermistors and Thermocouples, Pyrometers. Sensitivity analysis of sensor.	7
IV	Introduction to control systems. Classification of control system. Open loop and closed loop systems. Mathematical modelling of control systems, Concept of transfer function, Block diagram algebra.	6
V	Time Domain specifications. Step response of second order system. Steady-state error, Error coefficients, Steady state analysis of different type of systems using step, ramp and parabolic inputs.	7
VI	Introduction to concepts of stability, The Routh criteria for stability, Experimental determination of frequency response, Stability analysis using Root locus, Bode	7

	plot and Nyquist Plots, State space modeling, Process control systems, ON-OFF control, P-I-D Control.	

Text Books	
1	Ernest O. Doeblin, “Measurement Systems: Application and Design”, Tata McGraw- Hill, 5th Edition, 2004.
2	Katsuhiko Ogata, “Modern Control Engineering”, Prentice Hall of India Pvt. Ltd., 5th Edition, 2010.
3	Kumar D S, “Mechanical Measurements and Control”, Metropolitan publication, 4th Edition, 2006.

References	
1	Thomas G. Beckwith, Roy D. Marangoni, John H. LienhardV , “Mechanical Measurements”, Pearson Education India, 6th Edition, 2007.
2	Gregory K. McMillan, “Process/Industrial Instruments and Controls Handbook”, McGraw-Hill: New York, 5th Edition, 1999.
3	Holman J.P., “Experimental Methods for Engineers”, Tata McGraw-Hill., 7th Edition, 2004.
4	Williams Bolton, “Instrumentation and control”, Elsevier Limited, 2nd Edition, 2015.
5	Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, Newnes Publishers, 1st Edition, 2000.

Useful Links	
1	https://nptel.ac.in/courses/108/101/108101037/

CO-PO Mapping

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

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

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)

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AY 2024-25

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII

Course Code	6ME451
Course Name	Mechanical Vibrations Lab
Desired Requisites:	NA

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs./Week	**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.	III	Applying
CO2	Determine natural frequency and corresponding mode shapes of systems.	IV	Analyzing
CO3	Measure force and motion transmissibility of given system.	V	Evaluating
CO4	Prepare detailed report of measured vibrations for effective condition monitoring.	IV	Analyzing

Course contents

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	https://mdmv-nitk.vlabs.ac.in/ Virtual Laboratory

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
CO4	1			2			1	1		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	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 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 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

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AY 2024-25

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6ME452
Course Name	Refrigeration & Air Conditioning Lab
Desired Requisites:	NA

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 (Any 08)

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.

Text Books	
1	Dossat "Refrigeration", Pearson, fourth edition, 2007.
2	C. P. Arora ,"Refrigeration and Air conditioning", Tata McGraw Hill Education Private Limited , fourth edition,2021

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=SQFVcewUxv8&list=PLyk9QQFFEsXVrCI-PFEsvof_2rxzo60K_&index=6
2	https://www.youtube.com/watch?v=sYYnftYgMbw&t=27s
3	https://www.youtube.com/watch?v=nk9rUnz47o8
4	https://www.youtube.com/watch?v=_NEjPFcPvlQ

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 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 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 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.				

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6ME453
Course Name	Techno Socio Activity
Desired Requisites:	NA

Teaching Scheme		Examination Scheme (Marks)			
Practical	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	1 Hrs./Week	30	30	40	100
		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	Understand the learning through the vocational skills and internships.	IV	Analyzing
CO4	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											3		1	
CO4							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, 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 Marks Submission at the end of Week 8	30

LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 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 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.

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6ME491
Course Name	Project I
Desired Requisites:	Basic and advanced concepts and principles in mechanical engineering, graduate level courses. Latest developments in 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**	**Bloom's**

		Taxonomy Level	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.	IV	Analyze
CO3	Will be able to analyze and give solutions for a specific problem statement related to their project.	V	Evaluate
CO4	Will be able to prepare and present a detailed report based on project work spread over two semesters.	VI	Create

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 shall contain: -

- Need of project- How you are inspired of particular project.
- Aim and objective of project topic.
- Idea/ideas used in the project work.
- How will you execute the proposed idea?
- Various steps that will be followed (sequential) in the project work.
- Schedule to be followed for completion of project work.
- Cost estimate for the project including material / financial assistance expected from the department.
- 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
CO4										2	2	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 by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 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 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.

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AY 2024-25

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6ME411
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 aware about processes and methods of production planning and control.
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	Interpret the various concepts in production planning and control	II	Understanding
CO2	Execute methods, processes, and their types in industrial engineering.	III	Applying
CO3	Examine the basic concepts of industrial engineering in the manufacturing and service sector.	IV	Analyzing
CO4	Appraise various tools and techniques for solving the industrial engineering problems.	V	Evaluating

Module	Module Contents	Hours
I	**Introduction of I.E., Productivity and PPC** 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** 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** Definitions, objectives, various recording techniques, methods improvement techniques, principles of motion economy, Therbligs, micro-motion study, MOST	6
IV	**Work measurement** Definitions, objectives, activity and elements, performance rating, rating methods, allowances, group timing techniques, work sampling, PMTS.	7
V	**Inventory Control** Different Models of Inventory Systems, MRP, Make or Buy decision.	7
VI	**Network Techniques** 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. 1 January 2018
2	Martand Telsang "Industrial Engineering and Production Management" S. Chand & Company Ltd., New Delhi Year 2003\
3	Miller.D.M. & Schmidt.J.W. "Industrial Engineering &Operations Research" WIE 1984

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
4	Maynard.H.B.(Ed.). "Industrial Engineering Handbook" McGraw Hill, 16 June 2001

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

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6ME412
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	Analyze the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.	IV	Analyzing
CO4	Analyze the plastic behavior of materials	IV	Analyzing

Module	Module Contents	Hours
I	**Analysis of Stress and Strain** 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** 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** Governing equations, stress in thick walled cylinder under internal and external pressure, stresses in rotating flat solid disk, flat disk with central hole	6
IV	**Torsion** 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** Thermoelastic stress-strain relations, Equations of equilibrium, Strain-displacement relations, Thin Circular disk: Temperature symmetric about centre, Long Circular cylinder	7

VI	**Plasticity** 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**	
CO4	**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.

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 VII
Course Code	6ME413
Course Name	Cryogenics
Desired Requisites:	

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

		Credits: 2

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

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	Recall knowledge of mathematics, science, and engineering for the needs in Cryogenic.	II	Understanding
CO2	Apply knowledge of mathematics, science, and engineering for the needs in Cryogenic.	III	Applying
CO3	Analyze different Cryogenic systems.	IV	Analyzing
CO4	Evaluate and interpret the analysis reports in the field of Cryogenic	V	Evaluating

Module	**Module Contents**	**Hours**
I	Module 01 Introduction, properties of cryogenic fluids, properties of materials used in cryogenics at lower temperature, superconductive materials, applications of cryogenics, cryogenic space technology, space simulation, cryogenics in biology & medicines.	**6**
II	Module 02 Gas liquefaction & refrigeration systems, Basics of refrigeration & liquefaction, ideal thermodynamic cycle, Joule Thomson effect, adiabatic expansion, various liquefaction cycles, Liquefaction systems for air, Neon, Hydrogen & Helium gas, Effect of components' efficiencies on system performance.	8

III	Module 03 Gas separation and purification – principles, Gas separation systems for air, hydrogen, and helium.	6
IV	Module 04 Cryocoolers, Cryogenic refrigeration systems, Ideal & practical systems, Joule-Thompson cryocoolers, Stirling Cycle Refrigerators, Gifford-McMahon Cryocoolers, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Dilution refrigerators.	8
V	Module 05 Cryogenic fluid storage & transfer systems, Cryogenic Dewar, Cryogenic Transfer Lines, Two phase flow in cryogenic transfer system, Insulations used in Cryogenic Systems	7
VI	Module 06 Instrumentation in cryogenics to measure Flow, Level and Temperature., Introduction to vacuum technology, safety in cryogenics	6

Text Books	
1	Barron. R.F. *Cryogenic Systems,* McGraw-Hill, 2nd edition 1985.

References	
1	Thomas M. Flynn, "*Cryogenic Engineering*", Marcel Dekker. Inc New York illustrated edition 1997.
2	Marshall Sittig, D. Van Nostrand Co. "*Cryogenics - Research and Applications*", Princeton N.J, Van Nostrand . 1963Scott, R. B, *Cryogenic Engineering*, Scott, R. B. D'Van-Nostrand, 1962.
3	Vance, R. W.*, Applied Cryogenic Engineering, ,* John Wiley and sons, 1st edition 1962.
4	IHRAE Handbook – Fundamentals of Refrigeration, 2015

Useful Links	
1	https://archive.nptel.ac.in/courses/112/101/112101004/

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

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)

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Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Final Year B.Tech, Sem VII
Course Code	6OE429
Course Name	Additive Manufacturing
Desired Requisites:	

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

Course Objectives	
1	To impart knowledge to the students on 3D printing technologies
2	To develop students to select material, process and application of 3D Printing.
3	To make students aware of software tools, processes and techniques of additive manufacturing.

Course Outcomes (CO) with Bloom's Taxonomy Level			
At the end of the course, the students will be able to,			
CO1	Understand 3D printing process, data formats and software.	II	Understand
CO2	Select 3D printing techniques and materials.	III	Apply
CO3	Justify product quality and applications of 3D Printing in various domains.	IV	Analyze
CO4	Evaluate the quality and feasibility of additive manufacturing prototypes and finished products.	V	Evaluate

Module	Module Contents	Hours
I	**Introduction to 3D Printing** Overview, History, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes	4
II	**CAD Models** CAD Data formats, Data translation, Data loss, STL format; CAD model preparation, Part Orientation and support generation, Model Slicing, Software features	4
III	**3D Printing Techniques** Stereo-lithography Apparatus (SLA), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS), SLM, Binder Jet technology	5
IV	**Materials for 3D Printing** Polymers and their properties, Metals, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties; Support Materials	5
V	**Post Processing and Product Quality** Requirement and Techniques, Support Removal, Sanding, Acetone treatment, polishing; Inspection and testing; Defects and their cause	4
VI	**Application Domains** Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools, Retail industry.	4

Text Books	
1	LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
3	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

References	
1	T. A. Grimm & Associates, "Users Guide to Rapid Prototyping", Society of Manufacturing Engineers (SME) ISBN 0872636976, 2014.
2	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3	C. E. Bocking, AEW Rennie, "Rapid & Virtual Prototyping & applications", Wiley Eastern, 2011.

Useful Links	
1	NPTEL and MOOC links

Civil

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		2							1			
CO3			2		2							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	3
CO1			2		2										
CO2			2		2							1			
CO3			2		2							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	3
CO1			2		2										
CO2			2		2							1			
CO3			2		2							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	3
CO1			2		2										
CO2			2		2							1			
CO3			2		2							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	3
CO1			2		2										
CO2			2		2							1			
CO3			2		2							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. 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)

(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** 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. Electric and Hybrid vehicles- Layout, advantages and limitations.	4

II	**Vehicle Performance** 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** Transmission System : Function, requirement and types of following parts: Automobile clutch, Gearbox, Differential, final drive, rear axle, propeller shaft. Suspension, Steering Braking and Electrical System: 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** 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. Hybrid Vehicles: Hybrid electric drivetrains concepts, architecture, design, control strategies, merits and demerits.	6
V	**Electric Propulsion Systems & Energy storage devices** Electric propulsion systems: DC motor drives, induction motor drives, permanent magnet motor drives and switched reluctance motor drives. 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** Road Test, free acceleration test, down test, passer by noise test, road load data acquisition for vehicle. 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

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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 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**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 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 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.				

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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** 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** 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** 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** 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** Ocean thermal energy conversion (OTEC): principle of OTEC, open and closed	6

	cycle OTEC, working fluids for OTEC 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** 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 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. 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	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** 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** 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** Control charts, process capability, six sigma- concepts, methodology, applications, bench marking process, FMEA- stages and types, PDCE cycle, 5S, Kaizen	7
IV	**TQM Techniques** Just in time (JIT), Quality Function Deployment (QFD), Taguchi quality loss function, TPM- concepts, improvement needs, performance measures	7
V	**Quality systems** 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** 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 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** 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** 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** Control charts, process capability, six sigma- concepts, methodology, applications, bench marking process, FMEA- stages and types, PDCE cycle, 5S, Kaizen	7
IV	**TQM Techniques** Just in time (JIT), Quality Function Deployment (QFD), Taguchi quality loss function, TPM- concepts, improvement needs, performance measures	7
V	**Quality systems** 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** 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. 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	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** Study of periodic and random signals, probability distribution, statistical properties, power spectral density functions of commonly found systems, spectral analysis	6
III	**Fourier Transform** 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** 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** 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** 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. 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	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** 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** Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.	7
III	**Normal And Oblique Shocks** Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications	6
IV	**Jet Propulsion** 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** Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion.	6
VI	**Performance Study** 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. 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)

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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 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	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** - Introduction, definition, importance, components, automation and evolution of CIM. Advantages, limitations, scope and globalization view. - Product Development through CIM: 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** - In-process and post process methodologies, integrations of CNC machines, robot in CIM environment. - Communication, software/ Hardware: Availability of software, network topologies for LAN, network interface card and protocols, Network operating systems. - CIM models: 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** 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** 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** 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. Robot Sensors, Actuators and Motion Conversion: -Internal and external sensors, force sensors, thermocouples, performance characteristics, standard test signals, controllers, PLC and robotics. -Robot actuators, micro grippers, motion conversion systems, harmonic drives, robot safety.	8
VI	**Advanced Systems** Heuristics decision for robot, Fuzzy logic for robot control, Artificial Neural Network for robotics, Biped Robot, Biomimetic robotics, calibration. 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 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	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. 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)

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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** 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** 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** PLM Need, PLM overview, PLM system architecture, PLM functionalities, PLM systems and its benchmarking	6
IV	**Pillars of PLM systems** 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** 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** 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 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)

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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) (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)

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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** 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** (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** (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** 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** Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, introduction of X – Y plotter, spectral analyzers, FFT analyzer. **Introduction to Numerical Methods in Vibration** 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** 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
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.
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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)