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

(Government Aided Autonomous Institute)

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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AY 2024-25

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)