T.Y.B.Tech Mechanical

SEM-I & II Syllabus

AY 2023-24

(DAC Mech)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME321
Course Name	Machine Design
Desired Requisites:	

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

Course Objectives

1	To take overview of codes, standards and design guidelines for different machine elements.
2	To explain the effect of combined loading on machine elements and safety critical design.
3	To appraise the relationships between component level design and overall machine system design and performance.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply theories of failure in design of various machine elements.	III	Applying
CO2	Estimate design parameters of machine elements.	IV	Analysing
CO3	Evaluate the performance of machine elements subjected to different loading conditions.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Basics of engineering design** General Design process and procedure, types of loads, factor of safety- its selection and significance, theories of failure and their applications, aesthetic and ergonomic considerations in design	4
II	**Design of shafts and accessories** Design of solid and hollow shafts based on elastic theories of failure, transmission and line shafts, splined shafts, types of couplings, design of muff, rigid flange and flexible bushed pin type flange couplings, design of keys and splines	5
III	**Design of screws and joints** Forms of threads, design of power screws and nuts, types of induced stresses, efficiency of power screw, self-locking and overhauling properties, introduction to re -circulating ball screw. Types of welded, bolted and riveted joints, design of welded, bolted and riveted joints subjected to transverse and eccentric loads	5
IV	**Design of clutches, brakes and springs** Uniform pressure and wear theory, types of clutches and brakes, types of springs, stress and deflection equation for helical springs	4
V	**Design of rolling contact bearing** Design and analysis of rolling contact bearings, selection of bearings from manufacturer's catalogue	4

VI	**Design of sliding contact bearing** Design and analysis of sliding contact bearings, hydrodynamic and hydrostatic bearings, Reynold's equation and numerical solutions using dimensionless parameter	4

Textbooks	
1	V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publication, 3rd Edition, 2008
2	J.F. Shigley, "Mechanical Engineering Design", McGraw Hill Publication, 8th Edition, 2008
3	R. L. Norton, "Design of Machinery", McGraw Hill Publication, 3rd Edition, 2003
References	
1	Timothy Wentzell, "Machine Design", Cengage Learning, 1st Edition, 2009
2	M. F. Spotts, T.E Shoup, Hornberger, Jayaram, Venkatesh, "Design of Machine Elements", Pearson Education, 8th edition, 2011
3	PSG Design Data Book, Third Edition, 1978
Useful Links	
1	https://nptel.ac.in/courses/112/105/112105124/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		3									1	2	
CO2		1	2	2									1	
CO3		2		3								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 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME322
Course Name	Mechatronics and Automation
Desired Requisites:	

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

Course Objectives

1	Understand the mechatronic system, usage and advantages of mechatronics.
2	To understand the importance of automation in the of field machine tool based manufacturing.
3	To get the knowledge of various elements of manufacturing automation-CAD/CAM, sensors, pneumatics, hydraulics and CNC.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Identify basic elements of mechanical, electrical, and control systems for automation and analyze them.	III	Applying
CO2	Employ use of mechatronic system, software's, controllers and optimization techniques for automation systems.	IV	Analysing
CO3	Verify automation systems knowledge into various modern applications	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Mechatronics** Origin, Scope, History, Evolution. Definition, Application of Mechatronics- Design and modelling, software integration, motion control, Vibration and noise control, microsystems, optics	6
II	**Sensors and Transducers** Role of measurement systems, Sensors in mechatronic systems, classification of sensors, Performance Terminology, Selection of sensors, Types of transducers, Displacement and position measurement, Inductive transducers, Capacitive transducers, piezoelectric transducers, Sensors for robotic systems, Photoelectric transducers, Flow sensors, Thermal transducers, SONAR, Other transducers	7
III	**Signal Conditioning and Controls** Signal generation, Transformers, Semiconductors, Signal manipulation and conversion, ADC and DAC. Relay and contactors. Microprocessor, Microcontroller, PLC, Arduino and Raspberry Pi controllers	7
IV	**Introduction to Automation** Why automation, current trends, Rigid automation Introduction, Mechanisation vs automation, Applications, Goals, Social issues, Low cost automation, Types, Reasons for automation, Issues, Ten strategies.	5

V	**NC and CNC** NC and NC part programming, CNC- adaptive control, automated material handling, assembly, flexible fixtures. **Computer Aided design** Fundamentals of CAD- Hardware in CAD- Computer graphics software and data base, Geometric modeling for downstream applications and analysis methods **Modeling and Simulation** Product design, process route modeling, optimization techniques, case studies and industrial applications	7
VI	**Robotics and automation** Introduction to robotics, mechanical and electro mechanical systems, pneumatics and hydraulics, Illustrative examples and case studies	7

	Textbooks
1	Mikell P. Groover, "Automation, Production systems and computer integrated manufacturing", Prentice Hall, 2007
2	Serope Kalpakjain and Steven R. Schmid, "Manufacturing Engineering and Technology", 7th edition, Pearson, 2013
3	Ibrahim Zeid, CAD/CAM : Theory & Practice, 2nd edition, 2006
4	R.K.Rajput - A textbook of mechatronics, - Education asia.

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

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

CO-PO Mapping

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

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AY 2023-24

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6ME323
Course Name	Computational Methods for Structures and Fluids
Desired Requisites:	

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

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

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Explain the use of mathematical modeling and FEM.	Apply
CO2	Use modern tools, software, and equipment's to analyze and solve the problems and interpret the data	Analyze
CO3	Analyze mechanical components, systems and projects required for industry by using FEM.	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to FEM** Basic concepts of FEM – Historical background, relevance and scope for FEM – need for approximation, applications of FEM in various fields, advantages and limitations of FEM.	6
II	Introduction Discretization, interpolation, shape function, formulation of element characteristics matrices, assembly and solution.	7
III	Introduction, Geometrical approximations, Simplification through symmetry, Basic element shapes and behaviour, Choice of element type, Size and number of elements, Element shape and distortion, Location of nodes, Node and element numbering.	7
	Introduction to CFD	

IV	Philosophy of CFD, Governing equations of Fluid Dynamics, Presentations of Forms particularly suited for CFD, Mathematical behavior of PDEs	7
V	Basic Aspects of Discretization Finite Difference Method, Explicit Implicit approach, Errors and Stability analysis: A broader perspective, properties of discretization schemes, Solution techniques using FDM	6

VI	Finite Volume Method Introduction, FVM for one dimensional diffusion problem, steady state one dimensional convection diffusion problems, different schemes, assessment of different schemes.	7

Text Books	
1	S. S. Rao, "Finite Element Method in Engineering", Elsevier Publication, 4th Edition, 2004
2	P. Seshu, "Textbook of Finite Element Analysis",1st Edition. 2008.
	M. J Fagan, "Finite Element Analysis- Theory and Practice"; Longman Scientific & Technical, 1st Edition, 1992

References	
1	J. N. Reddy, "An Introduction to Finite Element Method", Tata McGraw Hill publication co. 2nd Edition, 1993
2	Logan D. L. "A first course in Finite Element Method", Cengage learning, 4th Edition, 2008.
3	O. C, Zienkiewicz "The Finite Element Method – Basic Concepts and Linear Applications", Tata McGraw Hill publication co., 5th Edition, 2000
4	Anderson, J.D., "*Computational Fluid Mechanics The Basics with applications", McGraw-Hill Publication 2013*
5	H.K.Versteeg and W Malalasekera, "Introduction to Computational Fluid Dynamics" 1995
6	Muralidhar K. and Sundararajan T., "*Computational Fluid Flow and Heat Transfer*", Narosa Publishing House, 2nd edition, New Delhi 2011.
7	Subas V. Patankar*"Numerical heat transfer fluid flow",* Hemisphere Publishing Corporation, 1980.

Useful Links	
1	https://nptel.ac.in/courses/112/106/112106135/
2	https://nptel.ac.in/courses/112/104/112104115/

CO-PO Mapping

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

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

Assessment

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

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

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AY 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME371
Course Name	Computational methods for structures and fluids Lab
Desired Requisites:	

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

Course Objectives

1	To explain the finite element method, its fundamentals and general steps.
2	To describe the underlying theory, assumptions and modeling issues in FEM
3	To provide hands on experience using finite element software to model, analyze and design systems of mechanical engineering.
4	To provide hands on experience using finite element software to simulate structural, fluid and thermal problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Execute the structural, fluid, thermal and dynamic analysis using FEM software.	III	Understanding
CO2	Categorize the mathematical methods and finite element procedures for engineering applications.	IV	Analysing
CO3	Select the procedures for structural, thermal and fluid analysis of 1D, 2D and 3D problems.	V	Evaluating

List of Experiments / Lab Activities

List of Experiments:
Following practical's should be considered for ISE and ESE evaluation.
The students are expected to solve the problems by using any FEM software.

1. Analysis of stepped bar
2. Thermal and fluid analysis of composite wall
3. Torsional analysis of shaft
4. Analysis of truss
5. Problems on shape functions
6. Structural and fluid 2D analysis
7. Structural and fluid 3D analysis
8. Modal Analysis
9. Thermal and fluid 2D analysis
10. Thermal and fluid 3D analysis
11. Geometrical nonlinear analysis
12. Contact nonlinear analysis
13. Material nonlinear analysis
14. Industrial Visit to software company.

Text Books	
1	S. S. Rao, "*Finite Element Method in Engineering*", Elsevier Publication, 4th Edition, 2004
2	P. Seshu, "*Textbook of Finite Element Analysis",* 1st Edition, PHI publication, 2008.
3	M. J Fagan, "*Finite Element Analysis- Theory and Practice";* Longman Scientific & Technical, 1st Edition, 1992
References	
1	J. N. Reddy, "*An Introduction to Finite Element Method*", Tata McGraw Hill publication co. 2nd Edition, 1993
2	Logan D. L. "*A first course in Finite Element Method*", Cengage learning, 4th Edition, 2008.
3	O. C, Zienkiewicz *"The Finite Element Method – Basic Concepts and Linear Applications*", Tata McGraw Hill publication co., 4th Edition.
Useful Links	
1	https://www.udemy.com/course/ansys-mechanical-apdl-for-finite-element-simulation
2	https://www.youtube.com/watch?v=qx69C-UyxsE&list=PLtt6-ZgUFmMKFfbOBhmCwG30KIVyvhDop

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	a	b	c	d	e	f	g	h	i	j	k	l	1	2
CO1		2		3				3						
CO2		2		2				2						
CO3		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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AY 2023-24

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6ME342
Course Name	Mini Project 2
Desired Requisites:	

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

Course Objectives	
1	To familiarize students with the concept of project based learning.
2	To give hands-on experience to students on developing problem statement and methodology to attempt solving such problems.
3	To learn the technical report writing skills.

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	Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.	II	Understanding
CO2	Design, and develop the model / prototype / algorithm in order to solve the conceived problem.	III	Illustrating
CO3	Write comprehensive report on mini project work	V	Organising

Course contents

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team.

2. Mini project should include mainly Mechanical Engineering contents but can be multi disciplinary too.

2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices etc. with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

6. Student is expected to detail out specifications, methodology, resources required, critical issues

involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Guidelines for Assessment of Mini Project Practical / Oral Examination:

Report should be prepared as per the guidelines issued by the department.

Mini Project shall be assessed through a presentation and demonstration by the student project group to faculty advisor / a panel of examiners.

Students shall be motivated to publish a paper based on the work in students competitions / Conferences / journals.

1. Mini Project shall be assessed based on following points;
2. Quality of problem and clarity
3. Proper use of knowledge and practices of mechanical and or other engineering disciplines.
4. Effective use of skill sets
5. Contribution of an individual's as member or leader
6. Clarity in written and oral communication

Text Books	
1 ●	
2	

References	
1	Meredith, Jack R., and Samuel J. Mantel Jr. Project management: a managerial approach. John Wiley & Sons, 2011.
2	K. T. Ulrich, S. D. Eppinger, and M. C. Yang , Product Design & Development, , 7th Edition, McGraw Hill, 2019.
3	M. Mahajan, Industrial Engineering and Production Management, 1st Edition, DhanpatRai & Co. (P) Limited, 2015.
4	V. Balachandran and Chandrasekaran, Corporate Governance, Ethics and Social Responsibility, PHI, 2nd Edition, 2011

Useful Links	
1	
2	

CO-PO Mapping

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

<table>
<tr><th colspan="5">Assessment</th></tr>
<tr><td colspan="5">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%.</td></tr>
<tr><th>Assessment</th><th>Based on</th><th>Conducted by</th><th>Typical Schedule</th><th>Marks</th></tr>
<tr><td>LA1</td><td>Lab activities, attendance, journal</td><td>Lab Course Faculty</td><td>During Week 1 to Week 8
Marks Submission at the end of Week 8</td><td>30</td></tr>
<tr><td>LA2</td><td>Lab activities, attendance, journal</td><td>Lab Course Faculty</td><td>During Week 9 to Week 16
Marks Submission at the end of Week 16</td><td>30</td></tr>
<tr><td>Lab ESE</td><td>Lab activities, journal/ performance</td><td>Lab Course Faculty and External Examiner as applicable</td><td>During Week 18 to Week 19
Marks Submission at the end of Week 19</td><td>40</td></tr>
<tr><td colspan="5">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..</td></tr>
</table>

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AY 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME331
Course Name	Energy Conservation and Management
Desired Requisites:	

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

Course Objectives

1	To introduce energy and power scenario, electrical systems, energy auditing, energy conservation and energy impact on environment.
2	To provide knowledge of energy management, energy auditing and energy conservation.
3	To develop skill to carry out energy audit and to suggest methodologies for energy savings.
4	To prepare the students for higher studies and research in the field of energy conservation and management.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain energy and power scenario, electrical systems, energy auditing, energy conservation and energy impact on environment.	III	Applying
CO2	Carryout energy accounting and balancing.	IV	Analysing
CO3	Exercise energy audit and suggest methodologies for energy savings.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction to energy and power scenario of world; national energy consumption data, environmental aspects associated with energy utilization, energy auditing - need, types, methodology and barriers, role of energy managers, instruments for energy auditing	3
II	**Electrical Systems** Components of EB billing, HT and LT supply, transformers, cable sizing, concept of capacitors, power factor improvement, harmonics, electric motors – motor efficiency computation, energy efficient motors, Illumination – Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting	5
III	**Energy Management and Audit** Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	5

IV	**Thermal Systems** Thermal systems, boilers, furnaces and thermic fluid heaters- efficiency computation and energy conservation measures; steam distribution and usage, steam traps, condensate recovery, flash steam utilization; insulation & refractories	4
V	**Energy Conservation in major utilities** Energy conservation in major utilities, pumps, fans, blowers, compressed air systems, refrigeration& air conditioning systems, cooling towers, dg sets. energy economics- discount period, payback period, internal rate of return, net present value; life cycle costing- ESCO concept	5
VI	**Energy and environment, air pollution, climate change** United nations framework convention on climate change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), clean Development Mechanism (CDM), Prototype Carbon Fund (PCF)	4

Textbooks

1	Witte L.C. Schmidt P.S. and Brown D.R., "Industrial Energy Management and Utilization", Hemisphere Publ., Washington, 1988
2	Callaghn P.W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981
3	Murphy W.R. and McKay G., "Energy Management", Butterworths, London, 2003
4	Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry of Power, GOI, 2008 (available at www.energymanager training.com)

References

1	Recent reports of agencies: International Energy Agency (IEA), Ministry of New and Renewable energy (MNRE), Technology and Action for Rural Advancement (TARA)
2	Dale R Patrick, Stephen W Fardo, "Energy Conservation Guidebook", 2^{nd} Edition, CRC Press
3	Albert Thumann, "Handbook of Energy Audits", 6^{th} Edition, The Fairmont Press
4	Bureau of Energy Efficiency Reference book: No.1, 2, 3 4

Useful Links

1	http://nptel.iitm.ac.in/
2	www.bee.com
3	www.powermin.nic.in

CO-PO Mapping

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

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AY 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME332
Course Name	Power Plant Engineering
Desired Requisites:	

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

Course Objectives

1	To introduces the students about different power plants, energy audit and economics.
2	To prepare the students to analyze the power plants and its various parameters.
3	To develop the skill to select, analyze the power plant system and allied parameters
4	

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 energy harvesting from water, fuels like coal, nuclear, diesel and hydrocarbon	III	Applying
CO2	Distinguish and interpret the parameters related to power plants.	IV	Analysing
CO3	Select the appropriate system, instruments and allied parameters based on performance, energy consumption and economics.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction** Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants	4
II	**Hydro-Electric Power Plants** Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants	5
III	**Steam Power Plants** Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator	5
IV	**Other Power Plants** Basic principles and types of diesel plants, advantages and disadvantages of diesel plants ,operation performance of a diesel engine, construction and working principles of gas turbine power plants, basic components and auxiliary systems used in gas turbine power plants, different types of fuels and materials used in gas turbine power plants. Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, advantages and limitations	5

V	**Power Plant Instrumentation and Energy Audit** Steam pressure and steam temperature measurement, flow measurement of feed water, fuel, air and steam with correction factor for temperature, speed measurement, level recorders, smoke density measurement, dust monitor, flue gas oxygen analyzer – analysis of impurities in feed water and steam, dissolved oxygen analyzer, ph meter-fuel analyzer, and pollution monitoring instruments, current simple methods of energy auditing	4
VI	**Power Plant Economics** Load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-output curves, efficiency, heat rate, economic load sharing and simple numerical	4

Textbooks	
1	EL-Wakil, "Power plant Technology", M.M., McGraw Hill, 1st Edition, 2017
2	P.K. Nag , "Power Plant Engineering", Tata McGraw Hill,4th Edition 2017
3	Domkundwar, Arora, "Power plant Technology", Dhanpat Rai and Co. sixth edition 2013

References	
1	Weisman, J., and Eckert, L., "Modem Power Plant Engineering", Prentice Hall, 1st edition. 1999.
2	Kam W. Li and A. Paul Priddy, "Power Plant System Design", John Wiley, 1st edition, 2018.
3	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	NPTEL Course on POWER PLANT ENGINEERING, Department of Mechanical Engineering IIT Roorkee - https://nptel.ac.in/courses/112/107/112107291/
2	Course on Power Plant Engg., IIT Kharagpur, https://youtube.com/playlist?list=PLwOhSTeCfDgmA7LFqMnT0yb83dmr9esWZ

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2											2	
CO3	2	2	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 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME333
Course Name	Operations Research
Desired Requisites:	

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

Course Objectives

1	To enable the students to formulate and solve linear programming problems.
2	To prepare the students to use mathematical models for solving optimization problems.
3	To train the students to analyze real-world problems in view of finding optimal 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	Solve linear programming problems.	III	Applying
CO2	Formulate mathematical models for real life cases.	IV	Analysing
CO3	Select models for optimization under different constraints.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Linear programming problem** Formulation of linear programming problem, graphical solution method, simplex method.	5
II	**Duality concept and integer programming** Duality concept, dual simplex method for LPP, Gomery's cutting plane method for integer programming problem	4
III	**Transportation models** Mathematical formulation, methods to obtain initial basic feasible solution, conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems, degeneracy and its resolution.	5
IV	**Assignment models** Mathematical formulation, balanced and unbalanced assignment problems, maximization problems, assignment with restrictions, traveling salesman problem	4
V	**Game theory** Games theory: introduction, minimax and maximin principle, solution of zero sum two persons games, saddle point, algebraic method, dominance properties, graphical method	4
VI	**Replacement model** Replacement model for items whose maintenance cost increases with time (money value constant) and with change in money value, selection of best machine, replacement of items that fail suddenly, individual and group replacement policies.	4

Textbooks

1	Hira D.S. and Premkumar Gupta, "Operation Research", S. Chand and Co. Ltd., Revised Edition, 2008
2	Sharma J.K., "Operations Research: Theory and Applications", Macmillan publishers India Ltd., 4th Edition, 2009
3	Sharma S. D., "Operation Research", Kedarnath and Rannath & Co, 5th Edition, 2005
References	
1	R. Panneerselvam, "Operations Research", Prentice Hall India Pvt. Ltd., 2004
2	Vohra N.D., "Quantitative Techniques in Management", McGraw Hill, 4th Edition, 2010
3	Mahajan Manohar, "Operations Research", Dhanpat Rai and Company Pvt. Ltd., 1st Edition 2006
Useful Links	
1	https://www.youtube.com/watch?v=a2QgdDk4Xjw&list=PLjc8ejfjpgTf0LaDEHgLB3gCHZYcNtsoX

CO-PO Mapping

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

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

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
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	Third Year B. Tech., Sem. VI
Course Code	6ME334
Course Name	Design and Optimization of Mechanical Elements
Desired Requisites:	

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

Course Objectives

1	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability.
2	To use the optimization techniques and tools for necessary engineering practice.
3	To use mathematical methods and computers to make rational decisions in solving a variety of optimization problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Implement different methods for optimum design	III	Applying
CO2	Analyze different optimization techniques.	IV	Analysing
CO3	Evaluate and interpret solution of an optimization problem.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction to Design- The design Process, Conventional versus Optimum design process, optimum design versus optimal control Optimum design problem formulation- The problem formulation process with examples, A general mathematical model for optimum design	4
II	**Optimum design Concepts** Definitions of global and local minima, review of some basic calculus concepts, Unconstrained and constrained Optimum design problems, postoptimality analysis: Physical meaning of Langrange Multipliers, Global Optimality, Engineering design examples	5
III	**Graphical Optimization** Graphical solution process, Use of mathematica for graphical optimization, Design problem with multiple solutions, problem with Unbounded solution, Infeasible problem, Graphical solution for different application.	5
IV	**Linear Programming Methods for Optimum Design** Definition of a standard linear programming problem, Basic concepts related to linear programming problems, Basic ideas and steps of the Simplex method, Two phase simplex method	4
V	**Numerical Methods for Unconstrained Optimum Design** General concepts related to Numerical algorithms, basic ideas and algorithms for step size determination, search direction determination: steepest descent method, conjugate gradient method	4

VI	**Numerical Methods for Constrained Optimum Design** Basic Concepts and Ideas, Linearization of constrained problem, sequential linear programming algorithm, Quadratic programming sub problem, Constrained steepest descent method	4

Textbooks	
1	Jasbir. Arora , Introduction to optimum Design, Elsevier, 4th edition
2	Johnson Ray, C., "Optimum design of mechanical elements", Wiley , John & Sons, 1981.
3	Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers, 2000.
References	
1	Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", PHI India,199
2	Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, NewYork, 1989
3	PSG Design Data Book, Third Edition, 1978
Useful Links	
1	https://www.youtube.com/watch?v=LL20TZGXp3Q

CO-PO Mapping

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

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME372
Course Name	Mechatronics Systems Lab
Desired Requisites:	

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

Course Objectives

1	To revise basic electronic/electrical concepts and understand use of basic electronics components like diodes, transistors etc. and their use in amplification and switching.
2	To Demonstrate use of sensors and their integration with microcontroller and PLC and use of microcontroller for doing various tasks.
3	To make students familiar with various modern and advanced control 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	Select appropriate electrical/ electronic components like diodes, transistors etc. to form meaningful circuits.	III	Applying
CO2	Analyze logic for operating a particular system by using a PLC or a microcontroller	IV	Analysing
CO3	Summarize the requirements of process elements and equipment's available in modern era	V	Evaluating

List of Experiments / Lab Activities

Term work shall contain experiments from following list:

1. Demonstration and development based on Relay logic control
2. PLC based Ladder logic programming
3. Traffic control system for three road crossing.
4. Traffic control system for four road crossing
5. Traffic control system for six road crossing
6. Programming and controlling for lift/ elevator system.
7. Programming and controlling for coin counter systems.
8. Demonstration and use of star delta starter.
9. Programming and controlling for HMI.
10. Programming and controlling for Vending machine operation.

Text Books

1	Gaonkar, "Introduction of 8085", Penram International Publishing (I) Pvt. Ltd, 2002.
2	Hackworth J.and Hackworth D. It, "Programmable Logic Controller — Programming Methods and Applications", Pearson Education, 2006.

References	
1	"Manufacturer's Manuals for different PLC Systems".
2	Gary Dumming, "Introduction to PLC", Delmar Publication

Useful Links	
1	https://www.youtube.com/watch?v=J89K1x7b6Ec&list=PLg0bf3Cfp1mwNBrZ-oERNOAVU_iMpaclW

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1												
CO2		1	2										2	
CO3			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	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	Third Year B. Tech., Sem. VI
Course Code	6ME373
Course Name	Automation Lab
Desired Requisites:	

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

Course Objectives	
1	To study various applications of automated systems for improving the productivity of the manufacturing industry.
2	To demonstrate effective use of various microprocessors, microcontrollers, PLC and other modern control systems for various applications.
3	To develop student's ability to demonstrate different control systems

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge to make simple automated system for industrial use to pick and place applications, welding, painting etc.	III	Applying
CO2	Analyse logic for operating particular system using higher end control system	IV	Analysing
CO3	Create independent small application oriented PLC based design	VI	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Automated bottle filling plant
2. Automatic object detection and identification
3. PLC based motor and actuator control
4. Programming and controlling of automated fluid mixer system
5. Programming and controlling for spot welding mechanism
6. Programming and controlling for spray painting
7. PLC based control of various sensor interface
8. Programming and controlling for pick and place
9. Programming and controlling for annunciator

Automation based analysis on case study in specific manufacturing domain

Textbooks	
1	R Thomas Wright, "Manufacturing and Automation Technology", Tata Mc Hill, 2002.
2	Serope Kalpakjain and Steven R. Schmid, "Manufacturing Engineering and Technology", 7th edition, Pearson, 2013.

References	
1	"Manufacturer's Manuals for different PLC Systems".
2	Gary Dumming, "Introduction to PLC", Delmar Publication

Useful Links	
1	https://www.youtube.com/watch?v=J89K1x7b6Ec&list=PLg0bf3Cfp1mwNBrZ-oERNOAVU_iMpaclW
2	https://nptel.ac.in/courses/112/103/112103293/

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3											
CO2		1		2								1		2
CO3				1	2								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	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	Third Year B. Tech., Sem. VI
Course Code	6ME374
Course Name	Industrial Hydraulics and Pneumatics Lab
Desired Requisites:	

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 develop an interest in oil hydraulic and pneumatic systems.
2	To prepare the students to select an appropriate system for an industrial problem with due reference to the advantages, limitations, cost, economy, etc.
3	To design a hydraulic and pneumatic system for various applications.

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	Operate and control the hydraulic and pneumatic systems.	III	Applying
CO2	Analyse different components and circuits of hydraulic and pneumatic systems.	IV	Analysing
CO3	Design and build hydraulic and pneumatic circuits for automation.	VI	Creating

List of Experiments / Lab Activities

Laboratory work shall contain any 8 experiments from following list :

1. Experiments on hydraulic trainer kit with following circuits
    a. Basic hydraulic circuit for linear and rotary motion.
    b. Regenerative circuit
    c. Traverse and feed circuit
    d. Meter-in, meter-out and bleed-off circuit.
    e. Sequencing circuit with sequence valve
    f. Synchronization motion of cylinders.
2. Experiments on pneumatic trainer kit with following circuits
    a. Pneumatic circuits for linear and rotary motion
    b. Sequencing circuit of type A+ B+ A—B—
    c. Sequencing circuit for A+ B+ B— A—
    d. Sequencing of cylinders with electric and electronic control

Text Books	
1	S R. Majumdar, "Oil Hydraulic Systems-Principles and Maintenance ", Tata McGraw-Hill, New-Delhi, 2006
2	S.R. Majumdar, "Pneumatic Systems: Principles and Maintenance", Tata McGraw-Hill, New-

	Delhi, 2006
References	
1	D.A. Pease, “Basic Fluid Power”, Prentice Hall Ltd., 1988
2	J.J. Pipenger, “Industrial Hydraulics”. McGraw-Hill Publications, 1979
3	Goodwin, “Power Hydraulics
Useful Links	
1	https://www.youtube.com/watch?v=dxAsr14DW6Y&list=PLbMVogVj5nJTKwm1WjlutrAEZrLE995Ja

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

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	Third Year B. Tech., Sem. V
Course Code	6ME375
Course Name	Mechanical Measurement and Control Lab
Desired Requisites:	

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

Course Objectives

1	Students will be able to use various experimental techniques relevant to the subject.
2	Students will acquire hands on experience on the various test-rigs, Experimental setup.
3	Students will be able to function as a team member

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	Measure various mechanical quantities.	V	Evaluating
CO2	Calibrate various mechanical measuring instruments	IV	Analysing
CO3	Compare different measurement techniques.	IV	Analysing

List of Experiments / Lab Activities

List of Experiments

1. Calibration of Bourdon Tube Pressure Gauge.
2. Speed measurement.
3. Strain measurement using resistance strain gauge.
4. Displacement measurement by using LVDT.
5. Vacuum measurement.
6. Calibration of Rota meter for fluid flow measurement.
7. Force measurement using dynamometer.
8. Measurement of the vibration parameters of a rotary machine.
9. Noise measurement and addition /subtraction of noise levels.
10. Measurement of the torque.
11. Calibration of thermocouple and measurement of the temperature using various temperature sensors.

Text Books

1	Kumar D.S., Mechanical Measurement and Control, Metropolitan Book Co. Pvt. Ltd., New Delhi, 4th Edition, 2007.
2	Beckwith and Buck, Mechanical Measurement, Pearson Education Asia, 5th Edition, 2001.
3	Rao S. S., Mechanical Vibrations, Pearson education, 5th edition, 2010

References

1	Doebel in Emesto, Measurement Systems, McGraw Hill International Publication Co. New York, 4th Edition,1990
2	Rettinger Michael, Acoustic Design and Noise Control, Vol. I &II, Chemical Publishing Co. New York, 1st edition, 19

Useful Links	
1	http://mdmv-nitk.vlabs.ac.in/
2	http://va-coep.vlabs.ac.in/
3	https://sm-nitk.vlabs.ac.in/

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				1	
CO2		3		1								2		
CO3		3							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	Third Year B. Tech., Sem VI
Course Code	6ME376
Course Name	Robotics Lab
Desired Requisites:	

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 deliver the knowledge of advance concepts and implementation of Industrial Automation and Robot programming.
2	To provide the basic understanding of Hydraulic and Pneumatic systems, SCADA and DCS systems and Robotics systems use in modern industries.
3	To acquire knowledge of various power systems in industries, Industrial distribution systems, buses, protocols, Electrical controls of motors etc.

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	Estimate continuous-time control using software for the manipulation, transmission, and recording of data.	IV	Analyze
CO2	Decide suitable actuators and sensors and integrate them with embedded control systems.	V	Evaluate
CO3	Design static and dynamic logic systems used for combinational, synchronous and asynchronous sequential logics.	VI	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities: (10 experiments from the list given below)

1. Various features of Gripper system in Robot
2. Various Robot programming parameters
3. Robot programme for simple pick and place
4. Robot programming for complex pick and place
5. Robot programming for simple palletization
6. Robot programming for complex palletization
7. Robot programming for colour based object identification
8. Robot programming for shape based object identification
9. Robot programming for comparison of two or more jobs
10. Study, designing system and demonstration of robot anatomy
11. Study, designing system and demonstration of various drive systems used in robotics
12. Study, designing system and demonstration of various sensors used in robot

Textbooks	
1	Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing,", Prentice Hall International, 2004
2	Groover M.P., Nagel R.N., Ordey N.G., "Industrial Robotics- Technology, Programming and Applications", McGraw Hill International, 1999

3	R.K. Mittal, I.J. Nagrath, "Robotics and Control,", Tata McGraw Hill, 1997
4	Pradeep Chaturvedi, N.K. Tewari, P.V. Rao, G.S. Yadav, "Modern Trends in Manufacturing Technology,", IE India, New Delhi, 2002
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		2											2	2
CO2				3								1		1
CO3			3						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	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 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6ME377
Course Name	Internal Combustion Engines Lab
Desired Requisites:	

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

Course Objectives

1	To study Engines performance parameters such as BMEP, Torque, BSFC and their relationship to operating conditions.
2	To study Ideal air standard cycles and fuel/air cycles.
3	To understand roll of Parameters affecting volumetric efficiency, valve timing, port design.
4	To know about Turbocharging: compressor and turbine performance, matching components, introduction to impeller design.
5	To study combustion Processes in both spark and compression ignition engines: flame structure, cycle-to-cycle variation, knock, ignition, fuel injection, octane number, ignition delay, cetane number.
6	To study Emissions: NOx, CO, UHC, Smoke, and Catalic converters.

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 the Basics of engine construction and working of 2 strokes, 4 stroke petrol and diesel engines.	III	Applying
CO2	Analyze the heat balance sheet of 4 stroke petrol and diesel engines by taking trials.	IV	Analysing
CO3	Evaluate the performance of computerized multi cylinder 4 stroke engine.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

Term work shall contain any 5 to 6 experiments from following list :

Study group:-

1. Constructional details of I.C. Engines
2. Dismantling and assembly of I.C. Engine.
3. Study of Engine air inlet, exhaust, cooling and lubrication systems.
4. Study of Ignition system and starting system.
5. Study of carburetor and petrol injection system.
6. Study of fuel injection system of diesel engine.

Test group:-

7. Test on slow speed diesel engine.
8. Test on high speed diesel engine.
9. Test on variable speed four stroke petrol engine.
10. Morse test on multi cylinder engine.
11. Test on computerized I.C. engine test rig.
12. Measurement of I.C. engine emissions.

Textbooks

1	Ganeshan, "Internal Combustion Engines ", Tata Mac Hill Publication, 2nd Edition, 1999
2	Mathur and Sharma, "Internal Combustion Engines", Dhanpat Rai publication, 2nd Edition, 2000

References	
1	Y. Obert, “Internal Combustion Engines and Air Pollution ”, ln-text Educational Publishers, 51st Edition, 1973
2	John B Heywood, “Internal Combustion Engines fundamentals”, McGraw-Hill, Revised 2nd Edition, 1988
Useful Links	
1	https://www.youtube.com/watch?v=lMkioRm5ZTs&list=PLkUEX3IbW7leYWEB0baTgg6SbS2zVE-Au

CO-PO Mapping													
	Programme Outcomes (PO)											**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2									2		2	
CO3	2	2	2		1						2		2	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	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 5 Marks Submission at the end of Week 5	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 6 to Week 9 Marks Submission at the end of Week 9	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 10 to Week 12 Marks Submission at the end of Week 12	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	Third Year B. Tech., Sem VI
Course Code	6ME378
Course Name	Industry 4.0 Lab
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Practical	2Hrs/week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	–	30	30	40	100
		Credits: 1			

Course Objectives	
1	To provide the knowledge of Fourth Industrial Revolution which is very much driven by the smartness in automating decision making and processes.
2	To provide a comprehensive coverage on, among others, the role of data, manufacturing systems, various Industry 4.0 technologies, applications and case studies.
3	To draw input from researchers and practitioners on what are the opportunities and challenges brought about by Industry 4.0, and how organizations and knowledge workers can be better prepared to reap the benefits of this latest revolution.

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 revolutions going on in industrial automation and manufacturing.	II	Understanding
CO2	Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world.	IV	Analyze
CO3	Use integration of data with manufacturing system effectively.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Topics (Applicable for Interaction mode):

1. Predictive Maintenance Optimization
2. Industrial Internet of Things
3. Cloud Manufacturing,
4. Digital Twin
5. Cyber security
6. Virtual/ Augmented Reality
7. Human-Robot Collaboration Optimization
8. Big Data and Analytics
9. Autonomous Robots
10. Cybersecurity in Industrial Control Systems
11. Additive Manufacturing Process Optimization
12. Smart Manufacturing

Textbooks

1	Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, ISBN-1484220463, 2017.
2	Klaus Schwab, The Fourth Industrial Revolution, Portfolio Penguin, ISBN-0241300754, 2017.

References

1	Klaus Schwab, Nicholas Davis, Shaping the Future of the Fourth Industrial Revolution: A guide to building a better world, Portfolio Penguin, 2018.
2	Giacomo Veneri Antonio Capasso, Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0, 2018.

Useful Links	
1	https://www.industry.gov.au/sites/default/files/July%202018/document/pdf/industry-4.0-testlabs-report.pdf?acsf_files_redirect
2	https://www.wichita.edu/academics/engineering/ime/_centers_and_labs/Industry40_Lab.php
3	https://www.industry40lab.org/

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

The strength of mapping is to be written as 1,2,3; 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	Third Year B. Tech., Sem VI
Course Code	6ME379
Course Name	Advanced Manufacturing Technology Lab
Desired Requisites:	Basic knowledge of machining, tool engineering and measuring instruments

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

Course Objectives	
1	To summarize the tooling techniques.
2	To illustrate the knowledge on various concepts of advanced manufacturing technology.
3	To explore the importance of measurement of various parameters and various methods of measuring the dimensions of manufactured parts.

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 tooling techniques.	II	Applying
CO2	Compare the various latest manufacturing technologies.	III	Analyzing
CO3	Use dimensional measuring instruments,calibrate and examine accuracy of components.	V	Evaluating

List of Experiments / Lab Activities

1. Demonstration of CNC machine and hands on experience of tool and component settings on Job.
2. Demonstration and hands-on experiment with component on micromachining-center.
3. Experiment on Machining of non-metals using fiber laser machine set-up and examine the job under metallurgical microscope.
4. Demonstration and one Case study on Micro-Electro Discharge machine [EDM]
5. Demonstration and one Case study on Micro- Wire Electro Discharge machine [WEDM]
6. Demonstration and one Case study on Electro Chemical machine [ECM].
7. Demonstration and hands on job on 3-D Printing machine set-up with hardness testing.
8. Reports on industry visits/ R&D organizations related to advanced Manufacturing Processes.

Text Books	
1	Kalpakjian and Schmid, "Manufacturing Processes for Engineering Materials", Pearson India, 5th Edition, 2014
2	Jagadeesha T., "Nontraditional Machining Processes", Wiley India-Dreamtech Presss ,2020
3	Jagadeesha T., "Unconventional Machining Processes", Wiley India-Dreamtech Presss ,2020

4	P.C.Sharma, "Text Book of Production Engineering", S. Chand Company, New Delhi, 2008
5	R.K. Jain, "Engineering Metrology", Khanna Publisher, 21st Edition

References

1	P.H.Joshi,"Jigs and Fixtures", Tata McGraw-Hill Publishing Ltd., New Delhi, ISBN:9780070680739, 2010
2	J.F.W. Gayler and C.R. Shotbolt, "Metrology for Engineers", Cassell, 1990
3	Pandey P. C., Shan H. S. "Modern Machining Processes", , Tata McGraw-Hill Publishing Co. Ltd, New Delhi (ISBN 0-07-096553-6) 1977
4	Benedict G. F., "Nontraditional Manufacturing Processes", Marcel Dekker, Inc. New York (ISBN 0-8247-7352-7), 1987
5	Bob Babson, "3D Printing" -The Complete Guide, PUBLISHER-Abbott Properties, ISBN 13:9780359753284,2016

Useful Links

1	https://www.youtube.com/watch?v=FqSJhY_lctc&list=PLkUEX3IbW7le4Okwm_qe4a1h6634USZTi
2	https://www.youtube.com/watch?v=5--saq-oYBE&list=PLrcSDk_gQ7jiQCfWEzw93ZMaxHkg2v-CC
3	https://www.youtube.com/watch?v=7yzvno4AvKw
4	https://nptel.ac.in/courses/112/103/112103202/
5	https://www.youtube.com/watch?v=yWBGnkhGKz8
6	https://www.youtube.com/watch?v=Cz-KsEBLWNI
7	https://www.youtube.com/watch?v=r4Qws2G3f8E
8	https://www.youtube.com/watch?v=cxU1zUOpGLk
9	https://www.youtube.com/watch?v=QJ-kKIdALRk
10	https://youtu.be/sFFcPPj4Ti8
11	https://www.youtube.com/watch?v=6XYQIXfsZwU&pp=ygUfM2QgcHJpbnRpbmcgZXhhbXBsZSB2aWRlbyBucHRlbA%3D%3D
12	https://www.youtube.com/watch?v=t7yv4gSnNkE&list=PLwdnzlV3ogoWI8QEu4hsT-n_r8UbWbquy

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		
CO2			3			2							2		
CO3				3								2	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.

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	Third Year B. Tech., Sem. VI
Course Code	6ME336
Course Name	Basics of Automobile Engineering
Desired Requisites:	

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

Course Objectives

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

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Comprehend about I C Engines, various automotive systems, components and recent trends in automotive systems.	II	Understand
CO2	Apply vehicle dynamics concepts to investigate influence of various parameters in automotive system.	III	Applying
CO3	Analyze acceleration, barking and steering performance of a vehicle in different driving conditions.	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction, classification, Types of I C Engine.** Engine cycles, Combustion in SI & CI engines, Supercharging & emission control techniques, Engine performance parameters.	6
II	**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. Engine cycles.	6
III	**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.	8
IV	**Electric and Hybrid Electric vehicles** Classification and working of Electric and Hybrid vehicles, Design	6

	considerations, Electric and Hybrid vehicles- Layout, advantages and limitations. Present scenario of Electric vehicles, issues and challenges in the Electric Vehicle.	
V	**Transmission System ,Suspension, Steering, Braking and Electrical System** Automobile clutch requirements, Types & functions - clutches, gearboxes, construction and Working, Principle of operation of automatic transmission, Torque converter, Epicyclic gear train, Propeller shaft, Universal joint, Final drive, Differential, Rear axles. Suspension requirements, Sprung and Unsprung mass, Types of automotive suspension systems. Function of steering, Steering system layout, Automotive steering mechanism, Types of steering gear boxes, , Types of braking mechanism, Calculation of braking force required, stopping distance and dynamic weight transfer Automotive batteries, Automotive electric systems, Engine electronic control modules, Safety devices.	8
VI	**Recent trends in Automotive Development** NVH and crashworthiness of vehicles, Emission norms and control, Testing and certification of vehicles. Introduction to Electric and Hybrid power trains.	5

Text Books	
1	V Ganesan, "Internal combustion Engine", McGraw Hill Education ,4th Edition, 2012
2	Kripal Singh, "Automobile Engineering Vol. II", Standard Publishers Distributors, Tenth Edition , 2007
3	P S Gill, "Automobile Engineering II", S K Kataria and Sons, Second Edition, 2012
4	R K Rajput, "Automobile Engineering", Laxmi Publications, First Edition, 2007

References	
1	John B Heywood, "Internal Combustion Engines fundamentals", McGraw-Hill, Revised 2nd Edition, 2017
2	Newton, Steeds and Garrett, "The Motor Vehicle", Butterworths International Edition, 11th Edition, 1989
3	Crouse and Anglin, "Automotive Mechanics", McGrawhill Publication, Tenth Edition, 2007
4	P W Kett, " Motor Vehicle Science Part - 2, " Chapman & Hall" , 2nd Edition, 1982

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_me69/preview
2	https://nptel.ac.in/courses/107/106/107106088/
3	https://nptel.ac.in/courses/107/106/107106080/
4	https://ed.iitm.ac.in/~shankarram/Course_Files/ED5160/ED5160_Journal_Complete_Notes.pdf

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

CO3		1		2								1			
	Programme Outcomes (PO) Information technology												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1		1									1				
CO2		1		1											
CO3				1								1			
	Programme Outcomes (PO) Computer science and engineering												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1		1	1								1				
CO2		1		1											
CO3												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)

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Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6ME380
Course Name	H-2 Project Management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	2 Hour/week	30	30	40	100
		Credits: 2			

Course Objectives

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

Course Outcomes (CO) with Bloom's Taxonomy Level

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

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

Contents

Module	Module content	Hours
1	**Introduction to Project Management.** Phases in the life cycle of projects and their significance, characteristics of projects from conventional organizations, objectives of the project and interdependence of cost on schedules	4
2	**Project Cost, Planning, feasibility, risk.** Controlling Schedules, Cost, specifications or quality, Monitoring both the cost and schedule of a project in financial terms, Baseline Cost Curves and their significance in the overall project cost impact	4
3	**Critical Path Networks - Principles of Resource Scheduling.**	4

	Numeric Models of Project, Non-Numeric Models of Project, Scoring Models of Project, Project Network and CPM, Gantt Charts, Resource allocation and Controlling phases of a project	
4	**Executing and Controlling.** Audit schedules and auditing a project and identifying deviations, quality needs in a project, applying relevant quality tools in a project and interpreting the results of the tools to monitor the quality **Commercial Management and various regulations.** Potential risks in a project, Categorizing of project risks, and defining the strategies for managing the project risks	4
5	**Study and use of software related to Project Management System.**	3
6	**Human Values and Professional Ethics** Need, basic guidelines, content & process for value education, understanding harmony in the human being- harmony in myself, understanding harmony in the family & society- harmony in human relationship, understanding harmony in the nature & existence, implications of the above holistic understanding of harmony on professional ethics.	7

Text Books	
1	Dennis Lock , Project Management - Gower Publishing Limited, 2013
2	Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, Project Management in Practice - JOHN WILEY & SONS, INC., 2011
3	Horald Kerzner, Project Management: A systems approach to planning, scheduling and controlling, John Wiley & Sons Inc., 2009

References	
1	K. Nagarajan, Project Management, New Age Int., 2nd ed. 2004.
2	B.M.Naik, Project Management-Scheduling and Monitoring by PERT/CPM, 1984
3	William R Duncan, A guide to the project management body of knowledge, PMI Publications, 1996
4	The factories act 1948 – Government of India 6. Meri Williams , The Principles of Project Management By – Site point Pvt Ltd., 2008

Useful Links	
1	https://www.apm.org.uk/resources/what-is-project-management/
2	https://www.projectmanager.com/project-management

CO-PO Mapping

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

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

Assessment

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 *(Government Aided Autonomous Institute)*					
AY 2023-24					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem. V			
Course Code		6ME301			
Course Name		Heat Transfer			
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 introduce the various mechanisms of heat and mass transfer that characterizes a given physical system.
2	To make the students familiarize conservation equations along with models for heat transfer processes.
3	To prepare the students for analysis of one-dimensional steady and unsteady partial differential equations.
4	To train the students to develop representative models of real-life heat transfer processes and systems

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 basic laws of heat and mass transfer and compute heat transfer rates.	III	Applying
CO2	Analyze problems involving steady and transient state heat transfer.	IV	Analysing
CO3	Assess the performance of thermal systems under different operating and geometrical conditions.	V	Evaluating

Module	Module Contents	Hours
I	**Introduction** Introduction to Heat transfer, difference between thermodynamics and heat transfer, modes of heat transfer. laws of heat transfer, thermal conductivity coefficient of heat transfer and Boiling & Condensation (Theory part)	4
II	**Conduction** Simple steady state problems in heat conduction, concept of thermal resistance and conductance. General equation of temperature field in three dimensional Cartesian coordinate systems. Application of above (one dimensional case) equation to the system of plane wall (including composite structure) as well as to the system with radial heat conduction i.e. cylinders and Sphere (including composite structures). Steady state conduction one dimensional) through extended surface (fins) of constant cross section. One dimensional steady state heat conduction with uniform heat generation, (plane wall and solid cylinder) critical radius of insulation. Concept of unsteady state heat conduction. Transient heat flow system with negligible internal resistance	9
III	**Radiation** Nature of thermal radiation, definitions of absorptivity, reflectivity, transmissivity, monochromatic emissive power, total emissive power and emissivity, concept of black body and gray body, Kirchhoff laws, Wien's law and Planck's law, deduction of Stefan Boltzmann equation. Lambert's cosine rule, intensity of radiation, energy change by radiation between two black surfaces with non-absorbing medium in between and in absence of reradiating surfaces, geometric shape factor, energy	9

	exchange by radiation between two gray surfaces without absorbing medium and absence of radiation and radiosity, radiation network method, network for two surfaces	
IV	**Free Convection** Mass, momentum and energy conservation equations, non-dimensional numbers, hydrodynamic and thermal boundary layers, basics of heat transfer in external and internal laminar and turbulent flows, and use of co-relations. Free Convection and use of its co-relations	6
V	**Forced Convection** External flow: Thermal analysis of Flow over flat plate, cylinder, sphere and flow across tubes. Internal flow: Convection correlations, Hydrodynamic and thermal considerations, thermal analysis and convection correlations for circular and non-circular tubes.	6
VI	**Heat Exchangers** Exchangers, Tubular heat exchangers, Extended surface heat exchangers. Classification according to flow arrangement. Fouling factor, mean temperature difference, LMTD for parallel flow, counter flow, mean temperature for cross flow, correction factor, and special cases. The effectiveness by NTU method, effectiveness of parallel, counter flow and cross flow heat exchangers and design consideration. Heat pipe component and working principle.(Elementary treatment only) Types of Heat exchangers	5

Text Books	
1	P. K. Nag, "Heat Transfer", Tata McGraw Hill Publishing, 3^{rd} Edition, 2011
2	Yunus. A. Cengel, "Heat Transfer – A Practical Approach", Tata McGraw Hill,5^{th} Edition, 2017
3	Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley publications, 7^{th} Edition, 2013

References	
1	H. Schlichting , K. Gersten, " Boundary Layer Theory" Springer, 8^{th} Edition, 2000
2	K Ramesh Shah, Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" Wiley, 5^{th} Edition, 2012
3	J P Holman, Souvik Bhattacharyaa, " Heat Transfer" McGraw-Hill, 10^{th} Edition, 2017

Useful Links	
1	https://nptel.ac.in/courses/112/101/112101097/
2	https://www.youtube.com/watch?v=IedD23t5jI4
3	https://web.iitd.ac.in/~pmvs/course_mel242.php

CO-PO Mapping

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

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Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	6ME302
Course Name	Applied Thermodynamics
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 gas and vapor cycles and their first-law and second-law efficiencies
2	To learn about gas dynamics of airflow
3	To learn about compressors with and without inter-cooling.
4	To analyze the performance of steam turbines.

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 practical power cycles.	II	Understanding
CO2	Recognize phenomena occurring in high-speed compressible flows.	III	Applying
CO3	Analyze energy conversion in various thermal devices such as steam turbines and compressors.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Combustion** Introduction to solid, liquid, and gaseous fuels – stoichiometry, exhaust gas analysis – the first law analysis of combustion reactions- heat calculations using enthalpy tables – adiabatic flame temperature.	4
II	**Vapor Power Cycles** Revision of basic Rankine Cycle. Rankine cycle with superheating, reheat, and regeneration. Numerical treatment.	8
III	**Gas Power Cycles** Air standard Otto, Diesel, and Dual cycles, Air standard Brayton cycle, the effect of reheat, regeneration and intercooling	8
IV	**Compressible Flow** Basics of compressible flow, stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow	5
V	**Compressors** **Reciprocating compressors**: construction, work input, the necessity of	7

	cooling, isothermal efficiency, heat rejected, the effect of clearance volume, volumetric efficiency, the necessity of multistage, optimum intermediate pressure for minimum work required, after cooler, free air delivered, air flow measurement, capacity control. **Rotodynamic Air Compressors**: Centrifugal compressor, velocity diagram, theory of operation, losses, adiabatic efficiency, effect of compressibility, diffuser, pre-whirl, pressure coefficient, slip factor, performance.	
VI	**Steam Turbines** Types of steam turbines, Analysis of steam turbines, velocity and pressure compounding of steam turbines. Numericals on steam turbines.	7

Text Books	
1	P. K. Nag "Engineering Thermodynamics", Tata McGraw Hill Publication, 6th Edition, 2017
2	R. Yadav, "Fundamentals of Thermodynamics", Central Publication house, Allahabad, Revised 7th Edition, 2011

References	
1	Cengel and Boles, "Thermodynamics an Engineering Approach", Tata McGraw-Hill publication, Revised 9th Edition, 2019
2	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., "Fundamentals of Thermodynamics", John Wiley and Sons, 7th Edition, 2009
3	Moran, M. J. and Shapiro, H. N., "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 8th Edition, 1999

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 a teacher's assessment. The mode of assessment can be field visits, 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	Third Year B. Tech., Sem. V
Course Code	6ME303
Course Name	Engineering Metrology and Manufacturing Technology
Desired Requisites:	

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

Course Objectives

1	To elaborate basic concepts of standards and methods of dimensional measurement.
2	To train the students to apply principles of magnification, interferometry and instruments for screw threads and gears inspection.
3	To illustrate the knowledge to students on various concepts of metrology and manufacturing technology.

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	Compare and utilize standards and measuring instruments for different dimensional parameters.	III	Applying
CO2	Estimate the limits of gauges and deviation in measurement parameters.	IV	Analysing
CO3	Illustrate the knowledge to students on various concepts of metrology and manufacturing technology.	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Linear and angular measurements** Metrology and measurement, Errors in measurement, Slip gauges and other devices of linear measurements; Bevel protractor, spirit level, clinometers, angle dekkor, sine bar, angle slip gauges	7
II	**Tolerances and gauging** Unilateral and bilateral tolerances, limit and fits, types of fits, plain gauges and gauge design, interchangeability and selective assembly	7
III	**Magnification and Interferometry** Mechanical, optical, electrical, pneumatic methods of magnification, comparators; Principles of interferometry and application in checking of flatness and height	6
IV	**Screw thread and Gear Inspection** Errors in screw threads, measurement of major, minor, effective diameters, pitch and thread angle, floating carriage diameter measuring machine; Errors in gears, checking of individual elements and composite errors, gear tooth Vernier caliper Tool Makers microscope, profile projector,	6
V	**Surface Finish Measurement** Types of textures obtained during m/c operation, direction of lay, texture symbols, instruments used in surface finish assessment; Coordinate measuring machine	6

VI	**Jigs and Fixtures** Holding tools, Jigs and fixtures, principles, applications and design	7

Textbooks	
1	R.K. Jain, "Engineering Metrology", Khanna Publisher, 2009
2	P. H. Joshi, "Jigs and Fixtures", Tata McGraw-Hill Publishing Ltd., New Delhi, 2010
3	I.C. GUPTA, "Engineering Metrology", Dhanpat Rai & Sons, 2018
References	
1	J.F.W. Gayler and C.R. Shotbolt, "Metrology for Engineers", Cassell, 5th Edition, 2015
2	K.W.B. Sharp, "Practical Engineering Metrology", Pitman London, 1st Edition 1973
3	Edward Hoffmann, "Jig and fixture design", Cengage Learning, 5th edition,2008
Useful Links	
1	https://nptel.ac.in/courses/112/104/112104250/
2	https://nptel.ac.in/courses/112/106/112106179/
3	https://www.youtube.com/watch?v=7yzvno4AvKw

CO-PO Mapping

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

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

Assessment

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	Third Year B. Tech., Sem. V
Course Code	6ME351
Course Name	Heat Transfer Lab
Desired Requisites:	

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

Course Objectives

1	Introduce the various mechanisms of heat and mass transfer that characterizes a given physical system.
2	Formulate conservation equations along with models for heat transfer processes and use of analytical to solve one-dimensional steady and unsteady partial differential equations.
3	To develop representative models of real processes and systems and draw conclusions concerning process/system design or performance from attendant analysis.
4	To develop a professional approach to lifelong learning in design of some thermal systems 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	Understand the basic laws and concepts of Conduction, Convection and Radiation, Boiling and Condensation heat transfer.	II	Understanding
CO2	Analyze problems of Radiation, Convection Heat Transfer and problems involving steady and transient state heat conduction in simple geometries.	IV	Analysing
CO3	Evaluate the heat exchanger performance by using the method of log mean temperature difference and effectiveness methods.	V	Evaluating

List of Experiments / Lab Activities

List of Experiments:

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

Experiments

1. To find Thermal Conductivity of metal bar, insulating powder.
2. To find thermal conductivity of Composite wall and evaluate the performance of Pin fin.
3. To verify the Stefan –Boltzmann constant and find the emissivity of non-black surface.
4. To find the Heat Transfer coefficient in Natural Convection.
5. To find the Heat Transfer coefficient in Forced Convection.
6. Trial on Heat exchanger – parallel / counter flow.
7. To conduct the experiment on Pool Boiling, critical heat flux.
8. To find the Heat Transfer coefficient in Drop and film condensation.
9. Experiment on unsteady state heat transfer.

   Trial on compact heat exchanger and its performance

Demonstration / Study

1. Heat Pipe Demonstration.
2. Various applications of heat exchanger in process and food industries.
3. Visit to / Demonstration of Heat exchanger manufacturing plant/dairy plant

Text Books	
1	P. K. Nag, "Heat Transfer", Tata McGraw Hill Publishing, 3rd Edition, 2011
2	Yunus. A. Cengel, "Heat Transfer – A Practical Approach", Tata McGraw Hill, 5th Edition, 2017
3	Incropera and Dewitt, "Fundamentals of Heat and Mass Transfer", Wiley publications, 7th Edition, 2013
References	
1	H. Schlichting , K. Gersten, " Boundary Layer Theory" Springer, 8th Edition, 2000
2	K Ramesh Shah, Dusan P. Sekulic, "Fundamentals of Heat Exchanger Design" Wiley, 5th Edition,2012
3	J P Holman, Souvik Bhattacharyaa, " Heat Transfer" McGraw-Hill, 10th Edition, 2017
Useful Links	
1	https://nptel.ac.in/courses/112/101/112101097/
2	https://www.youtube.com/watch?v=IedD23t5jI4
3	https://web.iitd.ac.in/~pmvs/course_mel242.php

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2									2		2	
CO3	2	2	2		1						2		2	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	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	Third Year B. Tech., Sem. V
Course Code	6ME352
Course Name	Applied Thermodynamics Lab
Desired Requisites:	

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

Course Objectives

1	To learn about different power cycles
2	To develop the student's skills in applying the isentropic flow and normal shock to some flow systems.
3	To develop students' ability to investigate the engines and rotodynamic machines' performance.

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 different power cycles	II	Understanding
CO2	Analyze the sonic, subsonic, and supersonic flow situations	IV	Analyzing
CO3	Investigate the performance of the engines and rotodynamic machines.	III	Applying

List of Experiments / Lab Activities

List of Experiments:

1. Study of factors affecting the performance of the Rankine cycle through numerical.
2. Study of reheat cycle with the help of numerical.
3. Study of the regenerative cycle with the help of numericals
4. Study of factors affecting the performance of Gas Power cycles through numericals.
5. Study of stagnation properties through numericals.
6. Study of centrifugal compressor and its performance through numericals.
7. Study of velocity and pressure compounding in steam turbines.

List of experiments (Trial/Demonstration type)

8. Trial on a gasoline engine to understand air standard Otto cycle.
9. Trial on diesel engine to understand air standard Diesel cycle.
10. Trial on the reciprocating compressor.
11. Trial on steam power plant and demonstration on Power Plant simulator.
12. Trial of Gas Power Plant on the simulator.

Text Books

1	P. K. Nag "Engineering Thermodynamics", Tata McGraw Hill Publication, 2017, 6th Edition
2	R. Yadav, "Fundamentals of Thermodynamics", Central Publication house, Allahabad, 2011, Revised 7th Edition

References

1	Cengel and Boles, "Thermodynamics an Engineering Approach", Tata McGraw-Hill publication,

	Revised 9th Edition, 2019
2	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., “Fundamentals of Thermodynamics”, John Wiley and Sons, 7th Edition, 2009
3	Moran, M. J. and Shapiro, H. N., “Fundamentals of Engineering Thermodynamics”, John Wiley and Sons, 8th Edition, 1999
Useful Links	
1	https://www.youtube.com/watch?v=v36FiXcxt0k&list=PLkUEX3IbW7leYWEB0baTgg6SbS2zVE-Au&index=3
2	https://www.youtube.com/channel/UC-znD1sQHOQIRqZBrs1UJbA/videos

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2											1	2
CO2	3	2	1		3			3	3		3		1	2
CO3	3	2	3		2	1			3				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. LA1, LA2 together is treated as In-Semester Evaluation.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 5 Marks Submission at the end of Week 5	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 6 to Week 9 Marks Submission at the end of Week 9	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 10 to Week 12 Marks Submission at the end of Week 12	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	Third Year B. Tech., Sem V
Course Code	6ME353
Course Name	Engineering Metrology and Manufacturing Technology Lab
Desired Requisites:	

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

Course Objectives

1	To elaborate various techniques for measuring the dimensions of manufactured parts.
2	To explore the importance of measurement of various parameters of linear, angular and surface characteristics measurement.
3	To illustrate the knowledge to students on various concepts of metrology and manufacturing technology.

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	Use measuring instruments for various parameters measurement.	III	Applying
CO2	Calibrate and analyze metrological instruments used for linear, angular and surface characteristics measurements	IV	Analysing
CO3	Illustrate the knowledge to students on various concepts of metrology and manufacturing technology.	V	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. To calibrate micrometer using slip gauges.
2. To calibrate dial gauge using dial gauge calibration tester.
3. To measure angle by using sine bar.
4. To study and use of comparators.
5. To use optical flat for demonstration of interferometry.
6. To measure parameters of screw thread using floating carriage diameter measuring machine.
7. To inspect gear using gear tooth vernier caliper.
8. To use profile projector and Tool Maker's microscope.
9. To study and use surface roughness tester.
10. To study and use coordinate measuring machine.
11. To design and draw drilling jigs
12. To design and draw milling fixture

Textbooks

1	R.K. Jain, "Engineering Metrology", Khanna Publisher, 21st Edition
2	I.C. GUPTA, "Engineering Metrology", Dhanpat Rai & Sons, 2nd Edition, 1988
3	P. H. Joshi, "Jigs and Fixtures", Tata McGraw-Hill Publishing Ltd., New Delhi, 2010

References

1	J.F.W. Gayler and C.R. Shotbolt, "Metrology for Engineers", Cassell, 1990
2	K.W.B. Sharp, "Practical Engineering Metrology", Pitman London, 1st Edition 1973
3	Edward Hoffmann, "Jig and fixture design", Cengage Learning, 5th edition,2008

Useful Links	
1	https://www.youtube.com/watch?v=FqSJhY_lctc&list=PLkUEX3IbW7le4Okwm_qe4a1h6634USZTi
2	https://www.youtube.com/watch?v=5--saq-oYBE&list=PLrcSDk_gQ7jiQCfWEzw93ZMaxHkg2v-CC
3	https://www.youtube.com/watch?v=7yzvno4AvKw

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	
CO2			3			2							2	
CO3				3								2	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	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	Third Year B. Tech., Sem V
Course Code	6ME311
Course Name	Plastic Technology
Desired Requisites:	

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

Course Objectives	
1	To make the students to understand fundamental principles of plastics technology.
2	To provide the students the knowledge of new concepts like polymers, types of plastics and various plastic processing techniques.
3	To prepare the students to analyze / suggest implementation of plastics and polymer moulding methods.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand different polymers and their characteristics.	II	Understanding
CO2	Articulate various plastic moulding processes.	III	Articulate
CO3	Analyse different types of plastic moulds and the design procedure for the same.	IV	Analyzing

Module	Module Contents	Hours
I	**INTRODUCTION -** Classification of materials, history of plastic materials, comparison of plastics with other engineering materials. Classification of plastics, thermoplastic, thermoset plastics, elastomers and polymers. Polymer structures, properties of polymers, additive methods to modify polymers	6
II	**Commodity Thermoplastics-** Properties - and applications of LDPE - LLDPE- HDPE, HMWHDPE- UHMWHDPE, Polypropylene, Vinyl plastics - Polyvinyl chloride, C-PVC, Polystyrene etc.	7
III	**PROCESSING OF PLASTICS** - Injection molding, extrusion molding, blow molding, rotational molding, vacuum molding, thermoforming, compression molding, resin transfer molding, calendaring process, etc. Secondary processes for plastics i.e. machining, joining, painting, etc. Defects during processing of plastic products.	8
IV	**Design of Plastic Moulds** Design of Compression moulds, different types of compression moulds, Multi-cavity moulds, Transfer moulds, Moulds heating principles and methods	7
V	PLASTICS RECYCLING AND WASTE MANAGEMENT - Applicability and statistics of plastics in various sectors. Issues and challenges with plastics. Impact of plastics on environment and its remedies. Utility of plastics wastes, waste management practices, plastic recycling processes. Case studies for recycling and waste management.	6
VI	**Different plastic processing techniques** Extrusion, Sheet extrusion, Profile extrusion, Calendaring, Blow Moulding, Thermoforming, Finishing and machining plastics, Equipments for extrusion, calendaring, blow moulding	6

Text Books	
1	Bikales, Compression and Transfer Moulding, Wiley, 2nd Edition, 1986
2	Bullers, A guide to Injection Molding of Plastics, Wiley, 1st Edition, 2000
3	J.H. DuBois, W.I. Pribble, Plastic Mold Engineering, Van Nostrand Reinhold, 1st edition, 2000
References	
1	R.P. Singh L.K. Das S.K. Mustafi, Polymer Blends & Alloys, Asian Book Pvt. Ltd., New Delhi, 2nd edition, 2001
2	John Briston, Advances in plastics packaging technology, John Wiley & sons, New York, 2nd edition, 2005
3	Handbook of Engineering Plastics – by Brown / Derock
4	Plastic Engineering Handbook – by Joel Frados
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107221/
2	https://nptel.ac.in/courses/112/107/112107086/
3	https://onlinecourses.nptel.ac.in/noc20_ch41/preview

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			2		
CO2					2										
CO3		2				1		1							
CO4															

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

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AY 2023-24

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	6ME312
Course Name	Advanced Strength of Materials
Desired Prerequisites:	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 strength of materials 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	Explain the concept of theory of elasticity	II	Understanding
CO2	Analyse the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.	IV	Analyzing
CO3	Show basic relations between stress and strains from the theory of elasticity perspective and use energy methods to solve structural problems.	III	Applying

Module	**Module Contents**	**Hours**
I	**Introduction to stress analysis** Assumptions and application of theory of elasticity, Body Force, surface force and stress tensor, The state of stress at a point, Normal, Shear and Rectangular stress components, Stress components on an arbitrary plane, Equality of cross shears	6
II	**Analysis of stress** Principal stresses, Stress invariants, Octahedral stresses, Cauchy's stress formula, Differential equations of equilibrium, Equations of equilibrium in cylindrical coordinates	7
III	**Analysis of Strain** Concept of strain, Deformations in the neighborhood of a point, Change in length of a linear element, Interpretation of shear strain components, Plane strains in polar coordinates, Compatibility conditions, Strain rosettes and Strain Measurement.	6
IV	**Stress-Strain Relations** Generalized statement of Hooke's law, Stress-strain relations for isotropic materials, Relation between the elastic constants, Plane Stress and Plane strain, Mohr's circles for the 3-D state of stress	7

V	**Energy Methods** Introduction, Work done in deformation, Reciprocity theorem, Castigliano theorem, Principle of virtual work, Principle of minimum potential energy, Rayleigh- Ritz method	6
VI	**Shear Center** Bending of Beams, Shear stress distribution and shear centre for thin walled open sections	6

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

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

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AY 2023-24

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6ME313
Course Name	Composite Materials
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 understand the mechanical behavior of composite materials.
2	To get an overview of the methods of manufacturing composite materials.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Summarize advantages, applications of composites, and Effect of reinforcements.	II	Understanding
CO2	Outline usage, properties various laminates and its role and Manufacturing of composite materials	III	Applying
CO3	Evaluate mechanics of laminates.	V	Evaluating

Module	**Module Contents**	**Hours**
I	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance	4
II	Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices.	4
III	Lamina- assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.	5
IV	Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes	4
V	Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai-Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates	5
VI	Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies	4

Text Books

1	Krishan K. Chawla Composite Materials: Science and Engineering, 3rd ed. 2012 edition, Springer.
2	Krishan K. Chawla Metal Matrix Composites ,2006 edition, Springer-Verlag New York Inc.
3	Mulmudi Hemant Kumar, Applications of Composite Materials, Arcler Education Inc, 2018 Edition.
References	
1	Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill,1994
2	Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill,
3	ASM handbook Vol.21, Composites, Editor: D.B. Miracle and S.L. Donaldson, Edition 2020.
Useful Links	
1	https://www.twi-global.com/technical-knowledge/faqs/what-is-a-composite-material
2	https://netcomposites.com/guide/

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	1
CO2	2			2					2					1
CO3					1	2					2		2	1
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

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

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Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6ME314
Course Name	PE-1 CAD/CAM
Desired Requisites: AutoCAD, basic drafting techniques etc.	

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

Course Objectives	
1	To impart the knowledge on basic fundamentals, principles and working of various NC, CNC machines and CMM.
2	To explain the students about recent developments in CNC machines and part programming methods for CNC turning and milling operations.
3	To make students aware of different types of cutting tools for machining operations.
4	To develop the students for mathematical representation of geometries and different tolerance techniques.
5	To make students aware of computer use for data exchange formats and 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	Explain appropriate operation and CNC machines for machining.	II	Understanding
CO2	Develop part programs for CNC machining.	III	Applying
CO3	Apply mathematical model to transform the geometries.	III	Applying

Module	Module Contents	Hours
I	**Introduction to CAD/CAM and CNC Tools** Automation in manufacturing, product cycle with and without CAD/CAM, Types of productions, Numerical control definition and history. Main components of NC system, NC Procedure, NC motion control system, Advantages and disadvantages of NC, CNC, DNC, etc. CNC machine tools, principle of operation of CNC, construction features including structure, drive system, tool-work movement actuation system, feedback system, machine control system.	4
II	**Different components of CNC tools** CNC Tooling- Different types of tools and tool holders used on CNC machines, parameters for selection of configuration of cutting tools, Modular tools and fixtures, use of pallets for work holding, palletizing of fixtures.	4
III	**CNC Programming** CNC Programming - Detailed manual part programming on Lathe and machining centres using G and M codes, APT programming-Punched tape in NC, tape coding and formats, APT language, Circular and linear interpolation, CNC programming - Tool length compensation, cutter radius	5

	compensation, sub routine, DO loop, Canned Cycle, etc. Optimization of tool path (to reduce machining time).	
IV	**Geometric Modeling and Analysis** Types of mathematical representation of curves, surfaces, Solid Representation - Boundary Representation (B-rep), Constructive Solid Geometry (CSG) and other methods, Feature Based Modeling, Assembly Modeling, Behavioral Modeling, Conceptual Design & Top-down Design, Modeling of product in CAE softare and analysis techniques using approximation and matrix method. Data exchange formats like IGES, STEP etc.	4
V	**Geometry Transformation** Introduction and need of transformation, Mathematical models of Translation, scaling, reflection, rotation, homogeneous representation, concatenated transformation. Mapping of geometric model, visual realism, projections of geometric model.	5
VI	**Computer Aplication in Design, Manufacturing and Analysis** Collaborative Design, Principles, Approaches, Tools, Design Systems. Product Data Management (PDM), concurrent engineering, PLM concept.	4

Text Books	
1	Geoffrey Boothroyd and Winston A. Knight, "*Fundamentals of machining and machine tools*", Third Edition, CRC Mechanical Engineering.2000
2	Jon Stenerson and Kelly Curran "*Computer Numerical Control: Operations and Programming*", Prentice-Hall of India Pvt. Ltd. New Delhi, 2007.
3	B.S. Pabla, M.Adithan, " *CNC Machines*", New Age International (P) Publishers, First Edition 1994, Reprint 2005.

References	
1	Mikell P. Groover, Emory W. Zimmers, "*CAD/CAM: Computer-Aided Design and Manufacturing*", Prentice-Hall, 1984.
2	Ibrahim Zeid, " *Mastering CAD/CAM*", Tata McGraw Hill Education Pvt Ltd., New Delhi, Special Indian Edition, 2007, Ninth Reprint 2010.
3	Ibrahim Zeid, R. Sivasubramanian, "*CAD/CAM: Theory and Practice*", Tata McGraw Hill Companies, Special Indian Edition, 2009.

Useful Links	
1	https://archive.nptel.ac.in/courses/112/102/112102101/
2	https://nptel.ac.in/courses/112104031
3	https://archive.nptel.ac.in/courses/112/102/112102103/

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	1
CO2					2									1
CO3						2							2	1

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

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
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 2023-24

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6ME341
Course Name	Mini Project 1
Desired Requisites:	

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

Course Objectives

1	To familiarize students with the concept of project based learning.
2	To give hands-on experience to students on developing problem statement and methodology to attempt solving such problems.
3	To learn the technical report writing skills.

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	Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.	II	Understanding
CO2	Design, and develop the model / prototype / algorithm in order to solve the conceived problem.	III	Illustrating
CO3	Write comprehensive report on mini project work	V	Organising

Course contents

Guidelines:

1. The mini-project is a team activity having 3-4 students in a team.

2. Mini project should include mainly Mechanical Engineering contents but can be multi disciplinary too.

2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.

3. Mini Project should cater to a small system required in laboratory or real life.

4. It should encompass components, devices etc. with which functional familiarity is introduced.

5. After interactions with course coordinator and based on comprehensive literature survey/ need analysis, the student shall identify the title and define the aim and objectives of mini-project.

6. Student is expected to detail out specifications, methodology, resources required, critical issues

involved in design and implementation and submit the proposal within first week of the semester.

7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.

8. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.

Guidelines for Assessment of Mini Project Practical / Oral Examination:

Report should be prepared as per the guidelines issued by the department.

Mini Project shall be assessed through a presentation and demonstration by the student project group to faculty advisor / a panel of examiners.

Students shall be motivated to publish a paper based on the work in students competitions / Conferences / journals.

1. Mini Project shall be assessed based on following points;
2. Quality of problem and clarity
3. Proper use of knowledge and practices of mechanical and or other engineering disciplines.
4. Effective use of skill sets
5. Contribution of an individual's as member or leader
6. Clarity in written and oral communication

Text Books	
1 ●	
2	

References	
1	Meredith, Jack R., and Samuel J. Mantel Jr. Project management: a managerial approach. John Wiley & Sons, 2011.
2	K. T. Ulrich, S. D. Eppinger, and M. C. Yang , Product Design & Development, , 7th Edition, McGraw Hill, 2019.
3	M. Mahajan, Industrial Engineering and Production Management, 1st Edition, DhanpatRai & Co. (P) Limited, 2015.
4	V. Balachandran and Chandrasekaran, Corporate Governance, Ethics and Social Responsibility, PHI, 2nd Edition, 2011

Useful Links	
1	
2	

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1		2				3			3	3	
CO2	2	2	3		2				3		3		2	1
CO3		3						3						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 *(Government Aided Autonomous Institute)*					
AY 2023-24					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem. V			
Course Code		6OE329			
Course Name		OE 1-Non Conventional Machining Processes			
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 learn about various nonconventional machining processes the various techniques, performance characteristics and their applications
2	To introduce students with various machine tools and their peculiars used for nonconventional machining.
3	To train the students to identify main variables of nonconventional machining processes and to judge their effect on developed products.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Explain various nonconventional machining processes, tooling and equipment's required for various manufacturing applications.	understa nding
CO2	Exploit the capabilities and applications of nonconventional machining processes.	Apply
CO3	Analyze effect of different parameters influencing on nonconventional machining processes and compare with other technique applications.	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction:** Introduction to nontraditional machining methods -Need for non -traditional machining -Sources of metal removal, Classification on the basis of energy sources -Parameters influencing selection of process.	6
II	**Mechanical Type AMPs:** Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters– MRR- Applications	7

III	**Thermal Type AMPs:** Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications-Micro-EDM, Micro-WEDM.	7
IV	**Chemical Type AMPs:** Principles of Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant -techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications- equipments-Surface Roughness and MRR, Electrical circuit-Process Parameters- ECG and ECH – Applications	7
V	**Medium Assisted AMPs:** Laser Beam Machining: Material removal mechanism, types of Lasers, LBM equipment, process characteristics, applications. Electron Beam Machining: Basic equipment and metal removal mechanism, process characteristics, applications. Plasma Beam Machining: Machining systems, material removal rate, accuracy and surface quality, applications. Ion Beam Machining: Introduction, material removal rate, accuracy and surface effects, applications	7
VI	**Advanced MPs:** Basics and definitions: Principle of layer-based technology, advantages, classification. Rapid Prototyping Process Chain: 3D Modeling, Data Conversion and Transmission, Checking and Preparing, model building, post processing. Rapid prototyping techniques: Stereo lithography, Solid Ground Curing (SGC), Fused Deposition Modeling (FDM)	6

Text Books

1	Jagadeesha T., “Nontraditional Machining Processes”, Wiley India-Dreamtech Presss ,2020
2	Jagadeesha T., “Unconventional Machining Processes”, Wiley India-Dreamtech Presss ,2020
3	Mishra P. K., “Non-Conventional Machining”, The Institution of Engineers (India), Text Book Series, New Delhi, 1997
4	Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd, New Delhi, 2009.

References

1	Hassan El-Hofy, “Advanced Machining Processes: Nontraditional and Hybrid Machining Processes”, McGraw-Hill Co, New York (2005).
2	Benedict, Gary F., “Non-Traditional Manufacturing Processes”, Marcel Dekker Inc., New York (1987)
3	Garry F. Benedict, “Unconventional Machining Process”, Marcel Dekker Publication, New York, 1987

Useful Links

1	https://www.youtube.com/watch?v=oI3RIAvyVxc&list=PLbMVogVj5nJSzoQXmu7dsj9ZKJyZ1P4O8
2	https://www.youtube.com/watch?v=P8zdXuIxQt4
3	https://www.youtube.com/watch?v=Hc6mfNWT8oQ&t=5s
4	https://nptel.ac.in/courses/112/105/112105212/
5	https://nptel.ac.in/courses/112/103/112103202/
6	https://www.youtube.com/watch?v=yWBGnkhGKz8

7	https://www.youtube.com/watch?v=Cz-KsEBLWNI
8	https://www.youtube.com/watch?v=r4Qws2G3f8E
9	https://youtu.be/Sfj8_9oRCNk
10	https://www.youtube.com/watch?v=cxU1zUOpGLk
11	https://www.youtube.com/watch?v=PaYInS9axxw&list=PLzCSUZGIUJkaSyCzPiQMWynGyxmC8hrpl
12	https://www.youtube.com/watch?v=QJ-kKIdALRk

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	2										
CO2	2	2			1				1	1					
CO3	2	2			1	1	1					1			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

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	2									
CO2	2	1			1	1	1					1			
CO3	2	2	2	2	1							1			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High															

Electrical

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