Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Heat Transfer
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**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,		
CO1	Demonstrate the basic laws of heat and mass transfer and compute heat transfer rates.	Apply
CO2	Analyze problems involving steady and transient state heat transfer.	Analyze
CO3	Assess the heat exchanger performance by using the LMTD and NTU.	Evaluate

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	9

	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 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, 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	3
CO1			3									1			
CO2	1	2		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

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	6	6	18	**30**
4	Analyze	7	7	21	**35**
5	Evaluate	7	7	21	**35**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Applied Thermodynamics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

Course Objectives	
1	To learn about gas and vapor cycles and their first law and second law efficiencies
2	To understand about the properties of dry and wet air and the principles of psychometric.
3	To learn about gas dynamics of air flow
4	To learn about the compressors with and without intercooling.
5	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,		
CO1	Understand various practical power cycles	Understand
CO2	Recognize phenomena occurring in high speed compressible flows.	Apply
CO3	Analyze energy conversion in various thermal devices such as steam turbines and compressors.	Analyze

Module	**Module Contents**	**Hours**
I	**Vapour Power Cycles** Revision of basic Rankine Cycle. Rankine cycle with superheat, reheat and regeneration.	4
II	**Gas Power Cycles** Air standard Otto, Diesel and Dual cycles, Air standard Brayton cycle, effect of reheat, regeneration and intercooling	5
III	**Psychrometry** Psychrometry: Properties of dry and wet air, use of psychrometric chart, Psychrometric processes: involving heating/cooling and humidification/dehumidification.	4
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, necessity of cooling , isothermal efficiency, heat rejected, effect of clearance volume, volumetric efficiency, necessity of multistage, optimum intermediate pressure for minimum	4

	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 turbine, Analysis of steam turbines, velocity and pressure compounding of steam turbines. Numerical on steam turbines.	4

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	3
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 1,2,3; Where, 1:Low, 2:Medium, 3:High

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	6	6	18	**30**
3	Apply	7	7	21	**35**
4	Analyze	7	7	21	**35**
5	Evaluate				
6	Create				

Total	**20**	**20**	**60**	**100**

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AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Manufacturing Technology Lab
Desired Requisites:	Basic knowledge of manufacturing processes and tool engineering.

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

Course Objectives	
1	To summarize the tooling techniques.
2	To illustrate the knowledge to students on various concepts of manufacturing technology.
3	To elaborate various techniques for production planning and control.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Classify tools and tooling techniques, production planning control methods	Understand
CO2	Differentiate various concepts of manufacturing technologies	Analyze
CO3	Design of jig and fixture, press tool	Create

List of Experiments / Lab Activities

Interactive sessions and learning activities on **any eight topics** of the following:

1. Tool geometry of single point cutting tools and inserts.
2. Tool geometry of multipoint cutting tools.
3. Design of drilling jig.
4. Design of milling fixture.
5. Design of press tool assembly.
6. Types of assemblies in manufacturing industries.
7. Different manufacturing process sheets and their selection.
8. Production planning and control techniques.
9. MRP-I and MRP-II
10. Interchangeability and selective assembly.

Text Books

1	Kalpakjian and Schmid, "Manufacturing Processes for Engineering Materials", Pearson India, 5th Edition, 2014
2	P. C. Sharma, "Text Book of Production Engineering", S. Chand Company, New Delhi, 2008
3	K.C. Arora, "Production and Operations Management" Laxmi Publications Ltd., New Delhi, 2004

References

1	P. H. Joshi, “Jigs and Fixtures”, Tata McGraw-Hill Publishing Ltd., New Delhi, ISBN:9780070680739, 2010
2	Edward Hoffmann, “Jig and fixture design”, Cengage Learning, 5th edition,2008
Useful Links	
1	https://www.youtube.com/watch?v=7yzvno4AvKw
2	https://www.youtube.com/watch?v=9qBZyzjoqAo
3	https://www.youtube.com/watch?v=ygFTjc8foeI

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

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)				
Bloom’s Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10	10	10	**30**
Apply				
Analyze	10	10	15	**35**
Evaluate				
Create	10	10	15	**35**
Total Marks	**30**	**30**	**40**	**100**

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AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Heat Transfer Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/Week	-			
Interaction	-	**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,		
CO1	Understand the basic laws and concepts of Conduction, Convection and Radiation, Boiling and Condensation heat transfer.	Understand
CO2	Analyze problems of Radiation, Convection Heat Transfer and problems involving steady and transient state heat conduction in simple geometries.	Analyze
CO3	Evaluate the heat exchanger performance by using the method of log mean temperature difference and effectiveness methods.	Evaluate

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	3
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															

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)

Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10	10	10	**30**
Apply				
Analyze	10	10	15	**35**
Evaluate	10	10	15	**35**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme	B. Tech. (Mechanical Engineering)				
Class, Semester	Third Year B. Tech., Sem. V				
Course Code					
Course Name	Applied Thermodynamics Lab				
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/Week	-			
Interaction	-	**Credits: 1**			

Course Objectives	
1	To learn about of phychrometric processes and comfort conditions
2	To develop the student's skills in applying the isentropic flow and normal shock to some flow systems.
3	To develop student's ability to demonstrate different power cycles

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO3	Understand different power cycles	Understand
CO2	Interpret the different physchrometric processes and	Analyze
CO1	Investigate the sonic , subsonic and supersonic flow situations	Apply

List of Experiments / Lab Activities

List of Experiments:

1. Study of factors affecting the performance of Rankine cycle through numericals.
2. Study of factors affecting the performance of Gas Power cycles through numericals.
3. Study of different psychrometric processes through numericals.
4. Study of stagnation properties through numericals.
5. Study of centrifugal compressor and its performance through numericals.
6. Study of velocity and pressure compounding in steam turbines.

List of experiments (Trial/Demonstration type)

7. Trial on gasoline engine to understand air standard Otto cycle.
8. Trial on diesel engine to understand air standard Diesel cycle.
9. Trial on reciprocating compressor.
10. Trial on steam power plant and demonstration on Power Plant simulator.
11. Trial of Gas Power Plant on 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	3
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															

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)				
Bloom’s Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	10	10	10	**30**
Apply	10	10	15	**35**
Analyze	10	10	15	**35**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

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

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

Course Objectives	
1	To familiarize students with the 2 dimensional CAD modelling.
2	To give hands-on experience to students on creating 2 dimensional models of engineering components.
3	To learn the drafting features of 2 dimensional modelling software.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Use different commands, utilities and tools of 2 dimensional modelling software.	Understand
CO2	Produce 2 dimensional models of engineering components using modelling software.	Create
CO3	Build drafting drawings of the 2 dimensional model prepared using software.	Create

Course contents

Guidelines for Mini Project 1:

1. Students are required to work in a group of maximum five students per group.
2. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
3. A log book to be prepared by each group, wherein the group can record weekly work progress.
4. Faculty advisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
5. The project work shall consist following :
    - Learning and using different commands, features, utilities and tools in the 2 D modelling software such as AutoCAD or other online freeware tools.
    - Preparing 2 D models of different engineering components using software. This shall include sectional views, cut sections, exploded views etc.
    - Preparing assembly and component detail drawing along with drafting for simple assemblies.
6. With the focus on self-learning and innovation within the students through the Mini Projects, it is preferable that the mini project of appropriate level and quality be carried out.
7. Students may complete a mini project as an industry sponsored project, in consultation with the faculty advisor.

8. Students are encouraged to produce drawings / 2 D models for components used in industry. 9. The topic / drawing for the mini project shall be chosen in consultation with the faculty. 10. At the end of the project, students are required to submit the soft copy of the models and or print of the same for evaluation.
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 drawing conventions, standards and standard practices 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	George Omura, Brian C. Benton, "Mastering AutoCAD 2019 and AutoCAD LT 2019", Wiley India Pvt Ltd, 2018 edition, ISBN: 9788126578443, 8126578440
2	Sunil K. Pandey, "Learn AutoCAD in a Easy Way", Unitech Books, 2010

References	
1	Cadfolks, "AutoCAD 2019 for Beginners", Kishore 2018, ISBN 8193724119, 9788193724118
2	Bill Fane, "AutoCAD Dummies", 18th edition
3	https://images-na.ssl-images-amazon.com/images/I/C1BxaOC0-IS.pdf
4	www.thesourcecad.com/autocad-commands/

Useful Links	
1	www.youtube.com/watch?v=QuR-VKis3jU
2	www.youtube.com/watch?v=JfHGU6M_Uwg

CO-PO Mapping

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

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 (for 26-week Sem)	Marks

LA1	Synopsis report and presentation	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Progress review / presentation / demonstration	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Assessment based on implementation and presentation.	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15	15	15	**45**
Apply				
Analyze				
Evaluate				
Create	15	15	25	**55**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

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

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

Course Objectives	
1	To familiarize students with the different 3 dimensional modelling software available in the department / freeware available on-line.
2	To give hands- on experience to students on 3 dimensional modelling of simple assemblies.
3	To enable students to use drafting features of 3 dimensional modelling software.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Use different commands, utilities and tools of 3 dimensional modelling software.	Understand
CO2	Create 3 dimensional models of engineering components and assemblies using modelling software.	Create
CO3	Build drafting drawings of the 3 dimensional model / assemblies prepared using 3 D modelling software.	Create

Course contents

Guidelines for Mini Project 2:

1. Students are required to work in a group of maximum five students per group.
2. Students shall submit implementation plan in the form of a Gantt/PERT/CPM chart, which will cover the weekly activity of the mini project.
3. A log book to be prepared by each group, wherein the group can record weekly work progress.
4. Faculty advisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
5. The project work shall consist following :
   - Students will learn different commands, features, utilities and tools in the 3D modelling software such as CATIA, SOLIDWORKS or other freeware available online.
   - Students will prepare 3 D models of different engineering components and assemblies using the software.
   - Students will prepare assembly drawing and drawing of components, exploded views, sectional views, detailed drafting drawing etc. for the 3 D model.
   - Students may opt for modelling of the components / assemblies of standard engineering parts.

6. With the focus on self-learning and innovation within the students through the Mini Projects, it is preferable that the mini project of appropriate level and quality be carried out.
7. Students may complete a mini project as an industry sponsored project, in consultation with the faculty advisor.
8. Students are encouraged to produce drawings 3 D models for components used in industry.
9. The topic / model for the mini project shall be chosen in consultation with the faculty.
10. At the end of the project, students are required to submit the soft copy of the models and or print of the same for evaluation.

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.

Mini Project shall be assessed based on following points;

1. Quality of problem and clarity
2. Proper use of drawing conventions, standards and standard practices
3. Effective use of skill sets
4. Contribution of an individual's as member or leader
5. Clarity in written and oral communication

Text Books	
1	Danan Thilakanathan, "3D Modeling for Beginners", CreateSpace Independent Publishing Platform, 27-Mar-2016, ISBN 1530799627, 9781530799626
2	Naresh Bhagat, "Workbook on 3 D modelling", LeLogix Design Solutions Pvt.Ltd., 2019, ISBN 8193928504

References	
1	Sachidanand Jha, "CATIA EXERCISES: 200 Practice Drawings For CATIA and Other Feature-Based Modeling Software", Kindle edition, 2019

Useful Links	
1	www.youtube.com/watch?v=PJxr-Va4u7U
2	www.youtube.com/watch?v=z44k-T5gBIg
3	www.youtube.com/watch?v=Zy1HFiraQQQ

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				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															

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.				
Assessmen	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Mark**

t				s
LA1	Synopsis report and presentation	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Progress review / presentation / demonstration	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Assessment based on implementation and presentation.	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15	15	15	**45**
Apply				
Analyze				
Evaluate				
Create	15	15	25	**55**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	
Course Name	Plastic Technology
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 02**			

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, packaging and 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	Classify various plastic moulding processes.	Understand
CO2	Articulate design procedure for design of plastic moulds.	Apply
CO3	Discriminate different polymers and their characteristics.	Analyze

Module	**Module Contents**	**Hours**
I	**Polymers** Types of polymer, Polymer alloys, Polymer blends, Composites, Ceramic based composites, Recycling of polymers.	4
II	**Introduction to Moulding Techniques** Compression molding, Basic process and molding cycle, Transfer molding, Rotational molding, Injection molding, Laminates, FRP techniques, Casting.	5
III	**Equipments used for Plastic Moulding** Equipments for compression and transfer molding, Equipments for rotational molding, Equipments for casting, Equipments for injection molding.	4
IV	**Design of Plastic Moulds** Design of Compression moulds, Multi-cavity moulds, Transfer moulds, Moulds heating.	5
V	**Plastic Packaging Techniques** Plastics for packaging, Packaging Characteristic, Various plastics materials used in packaging their properties, advantages & limitations, Fabrication & decorative Techniques.	4

VI	**Different Plastic Processing Techniques** Extrusion, Sheet extrusion, Profile extrusion, Calendaring, Blow Moulding, Thermoforming, Finishing and machining plastics, Equipments for extrusion, calendaring, blow moulding.	4

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							

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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand	10		20	**30**
3	Apply	10	10	20	**40**
4	Analyze		10	20	**30**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2021-22						
Course Information						
Programme		B. Tech. (Mechanical Engineering)				
Class, Semester		Third Year B. Tech., Sem. V				
Course Code						
Course Name		Advanced Strength of Materials				
Desired Prerequisites:		Strength of Materials				
Teaching Scheme		**Examination Scheme (Marks)**				
Lecture	2 Hrs/week	**T1**	**T2**	**ESE**	**Total**	
Tutorial	-	20	20	60	100	
Practical	-	-				
Interaction	-	**Credits: 2**				

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,		
CO1	Explain the concept of theory of elasticity	Understand
CO2	Analyse the deformation behavior of solids under different types of loading and obtain mathematical solutions for simple geometries.	Analyze
CO3	Show basic relations between stress and strains from the theory of elasticity perspective and use energy methods to solve structural problems.	Apply

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	4
II	**Analysis of stress** Principal stresses, Stress invariants, Octahedral stresses, Cauchy's stress formula, Differential equations of equilibrium, Equations of equilibrium in cylindrical coordinates	5
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	4

	rosettes and Strain Measurement.	
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	5
V	**Energy Methods** Introduction, Work done in deformation, Reciprocity theorem, Castigliano theorem, Principle of virtual work, Principle of minimum potential energy, Rayleigh- Ritz method	4
VI	**Shear Center** Bending of Beams, Shear stress distribution and shear centre for thin walled open sections	4

	Text Books
1	S.P. Timoshenko and J.N. Goodier, *"Theory of Elasticity"*, McGraw-Hill Publishing Co. Ltd., 3rd Edition, 1970.
2	Beer and Johnston, *"Mechanics of Materials"*, McGraw Hill, 6th Edition , 2012
3	L.S. Srinath, "*Advanced Mechanics of Solids*", Tata McGraw-Hill Publishing Co. Ltd, 3rd Edition 2009.
	References
1	Shames, I.H. and Pitarresi, J.M, *"Introduction to solid Mechanics"*, PHI learning Pvt. Ltd, 3rd Edition, 2009
2	Hulse, R and Cain J, *"Solid Mechanics"*, Palgrave publisher, 2nd Edition, 2004.
3	F.B Seely and Smith, *"Advanced Mechanics of Materials"*, John Wiley & Sons, 2nd Edition, 1978.
	Useful Links
1	https://nptel.ac.in/courses/112/101/112101095/
2	https://nptel.ac.in/courses/105/105/105105177/
3	https://nptel.ac.in/courses/112/107/112107146/

CO-PO Mapping

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

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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all

modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	6	6	18	**30**
3	Apply	7	7	21	**35**
4	Analyze	7	7	21	**35**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem IV
Course Code	
Course Name	Composite Materials
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

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,		
CO1	Summarize advantages, applications of composites, and Effect of reinforcements.	Understand
CO2	Outline usage, properties various laminates and its role and Manufacturing of composite materials	Apply
CO3	Evaluate mechanics of laminates.	Evaluate

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	3
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 1,2,3; Where, 1:Low, 2:Medium, 3:High

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand	6	6	18	**30**
3	Apply	7	7	21	**35**
4	Analyze				
5	Evaluate	7	7	21	**35**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

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

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

CO1	Select appropriate electrical/ electronic components like diodes, transistors etc. to form meaningful circuits.	Apply
CO2	Analyze logic for operating a particular system by using a PLC or a microcontroller	Analyze
CO3	Summarize the requirements of process elements and equipment's available in modern era	Evaluate

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	3
CO1	2	1													
CO2		1	2										2		
CO3			2												

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 (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)

Bloom’s Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand				
Apply	10	15	15	**40**
Analyze	15	10	15	**40**
Evaluate	5	5	10	**20**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Microprocessors in Automation Lab
Desired Requisites:	

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

Course Objectives

1	To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller.
2	To acquire hands on experience on various experimental set ups related to automation segment
3	To develop a professional approach to lifelong learning in design of some automated systems in industries

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand basics of microprocessor and its components	Understand
CO2	Demonstrate use of microprocessor in control and communication	Analyze
CO3	Apply digital control algorithms for signal processing	Apply

List of Experiments / Lab Activities

Term work shall contain any 10 experiments from following list :

1. Introduction to Number Systems, codes, digital electronics: Logic Gates.
2. Assembly language programming of 8085 microprocessor
3. Assembly language programming of 8086 microprocessor
4. Application of 8087 math coprocessor
5. Use of peripheral devices and their interfacing
6. Analog to Digital converter and Digital to Analog Converter
7. Multiplexed seven segments LED display systems
8. Interrupts and their use in control - Practically demonstrate use of interrupts using Arduino/ Raspberry pie
9. Stepper motor Control using Arduino/ Raspberry pie – Use PWM for speed control of DC motor, output measure motion for stepper motor
10. Read sensor input using Arduino/ Raspberry pie (Sensors– temperature, proximity, and Infrared encoder, light) and display the measured quantity
11. Interfacing hardware for drives
12. Demonstration on water level controller

	13. Demonstration on X-Y plotter
Text Books	
1	William H. Gothmann, “Digital Electronics. An Introduction to Theory and Practice ”, PHI Learning Private Limited, 2nd Edition, 1982
2	Albert Paul Malvino, “Digital Computer Electronics.’ An Introduction to Microcomputers”, Tata McGraw-Hill Publishing Company Ltd, 3rd Edition, 2017
3	Ramesh Gaonkar, “Microprocessor Architecture, Programming, arid Applications with the 8085”,
References	
1	Benjamin C. Kuo, “Digital Control Systems”, Oxford University Press, 2nd Edition, 2007
2	Lance A, Leventhal, “Microcomputer Experimentation with the Intel SDK-85”, Prentice Hall, 1980
3	S. G. Tzafestas, “Microprocessors in Robotic and Manufacturing Systems”, Springer Publications, 1981
Useful Links	
1	https://link.springer.com/article/10.1007/BF01047156
2	https://ieeexplore.ieee.org/document/4321442
3	https://youtu.be/NRdmIe9Afcs
4	https://www.iitk.ac.in/new/microprocessor-and-microcontroller-laboratory

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

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15		10	**25**
Apply	15	15	20	**50**
Analyze		15	10	**25**
Evaluate				
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Industrial Hydraulics and Pneumatics Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs/Week	-			
Interaction	-	**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,		
CO1	Operate and control the hydraulic and pneumatic systems.	Apply
CO2	Analyse different components and circuits of hydraulic and pneumatic systems.	Analyze
CO3	Design and build hydraulic and pneumatic circuits for automation.	Create

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	3
CO1	1		3												
CO2		3	3									1	2		
CO3		3	1	1											

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 (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)

Bloom’s Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand				
Apply	10	10	10	**30**
Analyze	10	10	15	**35**
Evaluate				
Create	10	10	15	**35**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

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Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	
Course Name	Mechanical Measurement and Control Lab
Desired Requisites:	

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

CO1	Measure various mechanical quantities.	Evaluate
CO2	Calibrate various mechanical measuring instruments	Analyze
CO3	Compare different measurement techniques.	Analyze

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	3
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															

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply				
Analyze	15	15	20	**50**
Evaluate	15	15	20	**50**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*						
AY 2021-22						
Course Information						
Programme		B. Tech. (Mechanical Engineering)				
Class, Semester		Third Year B. Tech., Sem. V				
Course Code						
Course Name		Energy Engineering				
Desired Requisites:						

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

Course Objectives	
1	To introduce students about alternate energy sources, their importance, needs, global scenario and economic considerations.
2	To provide knowledge of solar, bio, wind and ocean energy plants and its design methodology.
3	To prepare the students to analyze the performance and economics of thermal energy systems.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Discuss global energy scenario and energy systems	Understand
CO2	Distinguish and analyze solar, wind and bio mass as alternate sources of energy.	Apply
CO3	Assess the performance and economic considerations of energy systems.	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction to Non-Conventional Energy Sources** Introduction, Indian and global energy scenario, fossil fuels, India's energy production, consumption and demand of energy, solar energy and other non-conventional energy resources, role of alternate energy sources of worlds power generation in future	3
II	**Solar Energy** Extra-terrestrial solar radiation, solar radiation on earth, beam and diffused radiation, global radiation on a surface, solar radiation geometry, solar energy collectors, solar energy storage, solar pond, applications of solar energy, cooking, pumping, distillation, solar PV energy generation	5
III	**Wind Energy Conversion Systems** Wind data and energy estimation, availability of wind energy and wind velocity, site selection, basic wind energy conversion systems, types of wind machines, performance of wind m/c, energy storage, and applications of wind energy	5
IV	**Bio-Energy and Fuel cell** Bio-mass and photosynthesis, biogas generation, types of biogas plants, factors affecting biogas generation, community biogas plants, biogas digester design, design of community biogas plant for a village, problems related to biogas plant Fuel cells- Design and principle of Operation of a fuel cell, Classification and types of fuel cells, Advantages and Disadvantages of Fuel Cell, Applications of	5

	Fuel Cells, Batteries- Basic Batteries Theory, Classification of Batteries	
V	**Ocean Energy** Ocean thermal energy conversion (OTEC): principle of OTEC, open and closed cycle OTEC, working fluids for OTEC Tidal energy: principle of tide generation, tidal power plants, estimation of energy from tides, site selection for tidal power plants	4
VI	**Energy Economics and Environment** Life cycle costing, present worth factor, present worth of capital and maintenance cost, energy conservation opportunities, energy audit, co-generation systems, waste heat utilization, impact of conventional energy use on environment	4

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

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

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

Civil

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

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

Electrical

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

Computer Science

CO-PO Mapping															
	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2														
CO2	1	1			1										
CO3	1	1	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	1	1			1										
CO3	1	1	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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand	7	8	20	**35**
3	Apply	8	7	17	**32**
4	Analyze	5	5	23	**33**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem. V			
Course Code					
Course Name		Non-Conventional Machining Processes			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	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 product.

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	7

	Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications-Micro-EDM, Micro-WEDM.	
IV	**Chemical Type AMPs:** Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant -techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications .Principles of ECM- 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	Mishra, P. K., Non-Conventional Machining, The Institution of Engineers (India), Text Book Series, New Delhi, 1997
2	Garry F. Benedict, Unconventional Machining Process, Marcel Dekker Publication, New York, 1987
3	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	Chua C. K. and Leong, Lim, “Rapid Prototyping Principles and Applications”, 2nd edition, John Wiley and Sons.

	Useful Links
1	https://nptel.ac.in/courses/112/105/112105212/
2	https://nptel.ac.in/courses/112/103/112103202/
3	https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-me15/
4	https://onlinecourses.nptel.ac.in/noc20_me17/preview

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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20

marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	7	8	20	**35**
3	Apply	8	7	17	**32**
4	Analyze	5	5	23	**33**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

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

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

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,		
CO1	apply theories of failure in design of various machine elements.	Apply
CO2	estimate design parameters of machine elements.	Analyze
CO3	evaluate the performance of machine elements subjected to different loading conditions.	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	4

	manufacturer's catalogue	
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

Text Books	
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	3
CO1	2		3									1	2		
CO2		1	2	2									1		
CO3		2		3								1		2	

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

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				
3	Apply	7	7	20	**34**
4	Analyze	6	6	20	**32**
5	Evaluate	7	7	20	**34**
6	Create				
Total		**20**	**20**	**60**	**100**

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

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Automation in Manufacturing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

Course Objectives	
1	To understand the importance of automation in the of field machine tool based manufacturing.
2	To get the knowledge of various elements of manufacturing automation-CAD/CAM, sensors, pneumatics, hydraulics and CNC.
3	To work on the basics of product design and the role of manufacturing automation.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Identify basic elements of mechanical, electrical, and control systems for automation and analyze them.	Apply
CO2	Employ use of software's, controllers and optimization techniques for automation systems.	Analyze
CO3	Verify automation systems knowledge into various modern applications	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Automation** Why automation, current trends, CAD, CAM, CIM; Rigid automation: Part handling, machine tools. Flexible automation: Computer control of machine tools and machining centers	4
II	**NC and CNC** NC and NC part programming, CNC- adaptive control, automated material handling, assembly, flexible fixturing	4
III	**Computer Aided design** Fundamentals of CAD- Hardware in CAD- Computer graphics software and data base, Geometric modeling for downstream applications and analysis methods	5
IV	**Computer Aided Manufacturing** CNC technology, PLC, Micro controllers, CNC-Adaptive control	5
V	**Robotics and automation** Introduction to robotics, mechanical and electro mechanical systems, pneumatics	4

	and hydraulics, Illustrative examples and case studies	
VI	**Modeling and Simulation** Product design, process route modeling, optimization techniques, case studies and industrial applications	4

Text Books	
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
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
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	3
CO1	2	1													
CO2		1	2		1								2		
CO3	1			1	2	1							2		
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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	8	18	**33**

4	Analyze	6	6	22	**34**
5	Evaluate	7	6	20	**33**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Engineering Metrology
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	1Hr/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 1**			

Course Objectives	
1	To elaborate basic concepts of standards and methods of dimensional measurement.
2	To train the students to apply principles of magnification and interferometry.
3	To explain importance of measurement of various parameters of screw threads and gears.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Compare types of standards, linear and angular measurements.	Apply
CO2	Utilize measuring instruments for different dimensional parameters.	Analyze
CO3	Estimate the limits of gauges and deviation in measurement parameters.	Evaluate

Module	**Module Contents**	**Hours**
I	**Linear and angular measurements** Slip gauges and other devices of linear measurements; Bevel protractor, spirit level, clinometers, angle dekkor, sine bar, angle slip gauges	2
II	**Tolerances and gauging** Unilateral and bilateral tolerances, limit and fits, types of fits, plain gauges and gauge design	3
III	**Magnification** Mechanical, optical, electrical, pneumatic methods of magnification, comparators	2
IV	**Interferometry** Interferometry: principles of interferometry and application in checking of flatness and height	2
V	**Screw thread inspection** Errors in screw threads, measurement of major, minor, effective diameters, pitch and thread angle, floating carriage diameter measuring machine.	2
VI	**Gear Inspection** Measurement of spur gear: errors in gears, checking of individual elements and composite errors, gear tooth Vernier caliper	2

Text Books	
1	R.K. Jain, “Engineering Metrology”, Khanna Publisher, 2009
2	M. Mahajan, “Statistical Quality Control” Dhanpat Rai & Co., 2012
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	R.C. Gupta, “Statistical Quality Control”, Khanna Publication, 9th Edition,1998

Useful Links	
1	https://nptel.ac.in/courses/112/104/112104250/
2	https://nptel.ac.in/courses/112/106/112106179/

CO-PO Mapping

	Programme Outcomes (PO)												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1													
CO2			3	2									2		
CO3			2	3								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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom’s Taxonomy Level (Marks) For Theory Course

Bloom’s Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				
3	Apply	7	6	20	**33**
4	Analyze	7	7	20	**34**
5	Evaluate	6	7	20	**33**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Design of Machine Elements Lab
Desired Requisites:	

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

Course Objectives	
1	To familiarize the students with Mechanical Engineering Design Process.
2	To explain the mathematical process required for design of mechanical systems.
3	To use the data tables for design of machine elements

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Apply knowledge of theories of failure and other design considerations for design of springs, brakes and clutches	Apply
CO2	Use data tables for selection and analysis of bearings, couplings, clutches, breaks and welds.	Analyze
CO3	Investigate stresses in machine elements	Evaluate

List of Experiments / Lab Activities

List of Experiments:

Term Work contains following:-

1. Aesthetic and ergonomic considerations in product design
2. Design of shaft
3. Design of rigid / flexible flange coupling
4. Design of screw jack
5. Design of spring
6. Design of clutch
7. Design of brake
8. Bearing design and selection
9. Design of bolted / riveted / welded joints
10. Design of gears

Text Books	
1	V. B. Bhandari, "Design of Machine Elements", TMGH 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, First 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	3
CO1	1												2		
CO2		3	2		2	3	3					1		2	
CO3		3					2			1					

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)				
Bloom’s Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	10	10	20	**40**
Analyze	10	10	10	**30**
Evaluate	10	10	10	**30**
Create				
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Automation in Manufacturing Lab
Desired Requisites:	

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

CO1	Apply knowledge to make simple automated system for industrial use to pick and place applications, welding, painting etc.	Apply
CO2	Analyse logic for operating particular system using higher end control system	Analyze
CO3	Create independent small application oriented PLC based design	Create

List of Experiments / Lab Activities

Term work shall contain experiments from following list:

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
10. Automation based analysis on case study in specific manufacturing domain

Text Books

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	3
CO1	3		3												
CO2		1		2								1		2	
CO3				1	2								2		

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	10	10	15	**35**
Analyze	10	10	15	**35**
Evaluate				

Create	10	10	10	**30**
Total Marks	**30**	**30**	**40**	**100**

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Course Information

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

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/Week	-			
Interaction	-	**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 screw threads and gears.
3	To prepare the students to calibrate linear and angular measuring instruments.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Use measuring instruments for dimensional measurement and calibration purpose.	Apply
CO2	Inspect components for quality characteristics by using different methods of measurement.	Analyze
CO3	Calibrate metrological instruments used for linear and angular measurements	Evaluate

List of Experiments / 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.
9. To use Tool Maker's microscope.
10. To study and use a surface roughness tester.
11. To study and use coordinate measuring machine.

Text Books

1	R.K. Jain, "Engineering Metrology", Khanna Publisher, 21st Edition
2	I.C. GUPTA, "Engineering Metrology", Dhanpat Rai & Sons, 2nd Edition, 1988

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
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	3
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. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	10	10	10	**30**
Analyze	10	10	15	**35**
Evaluate	10	10	15	**35**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme		B.Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem VI			
Course Code					
Course Name		Mini Project 3			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./Week	-			
Interaction	-	**Credits: 01**			

Course Objectives	
1	To familiarize students with the different machine tools used to produce components.
2	To provide hands- on experience by operating conventional machine tools.
3	To provide hands-on experience by handling advanced machine tools.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Use different machines and laboratory set ups.	Apply
CO2	Operate different advanced machines and welding equipment.	Apply
CO3	Create a component / part as per given drawing / design / model.	Create

Course contents

Students need to choose different topics / concepts / ideas for mini projects 3 and 4.

Guidelines for Mini Project 3:

1. Students shall complete the mini project in a group of maximum five students.
2. Students are encouraged to choose the mini project, which solves real life problems / live industrial problems / sponsored mini projects.
3. The mini project can be any of the form given below :
   a) Manufacturing / fabrication of the components / sub assembly / assembly modelled in mini project 1.
   b) Making physical working models, prototypes and scaled models, of a concept machine or development / repair / modifications of laboratory set-ups.
   c) Making virtual / CAD models of sufficiently complex machines / concepts.
   d) Making study, modeling, analysis, programming and simulation of a system / machine / operation / process.
   e) Tools / gadgets / devices / applications involving use of other emerging technologies such as Arduino, Raspberry pi or other electronic tools, simulation software.
   f) Any other project work in mechanical or multidisciplinary areas in consultation with the faculty in charge.
4. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.

5. A log book to be prepared by each student / group, wherein they can record weekly work progress,
6. Faculty advisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate / validate the same with proper justification.

Students may use the following facilities available.

1. Wood turning lathe
2. Centre Lathe machine
3. Grinding machine
4. Milling machine
5. Shaping machine
6. CNC machine
7. Wire EDM machine
8. CNC router
9. Welding - spot welding, smart welding machine
10. Co-ordinate measuring machine (CMM)
11. 3D printer
12. Programmable logic controller (PLC)
13. Any other laboratory facility available

Guidelines for Assessment of Mini Project Practical / Oral Examination:

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

Mini Project shall be assessed based on following points;

- Innovativeness in solutions
- Use of engineering principles / norms
- Cost effectiveness
- Quality of workmanship and accuracy
- Demonstration of the mini project work
- Effective use of skill sets
- Contribution of an individual's as member or leader
- Clarity in written and oral communication
- Technical report prepared

Text Books	
1	Suitable books and e books on design engineering, manufacturing processes, thermal engineering, design of experiments, optimization techniques suitable for selected project domain.

References	
1	Suitable user manuals of software tools and research papers from reputed national and international journals and conferences.

Useful Links	
1	Any online resources suitable for the project domain.

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

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 (for 26-week Sem)**	**Marks**
LA1	Synopsis report and presentation	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Progress review / presentation / demonstration	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Assessment based on implementation and presentation.	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom’s Taxonomy Level (Marks) (For lab Courses)				
Bloom’s Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	20	20	20	**60**
Analyze				
Evaluate				
Create	10	10	20	**40**
Total Marks	**30**	**30**	**40**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	
Course Name	Mini Project 4
Desired Requisites:	

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

Course Objectives

1	To familiarize students with the different machines available in department and institute.
2	To provide hands- on experience by operating conventional machine tools.
3	To provide hands-on experience by handling advanced machine tools.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand different machining processes and applications of various conventional machines available in the department.	Understand
CO2	Operate different advanced machines and welding equipment.	Apply
CO3	Create a component / part as per given drawing / design / model.	Create

Course contents

Students need to choose different topics / concepts / ideas for mini projects 3 and 4.

Guidelines for Mini Project 4:

1. Students shall complete the mini project in a group of maximum five students.
2. Students are encouraged to choose the mini project, which solves real life problems / live industrial problems / sponsored mini projects.
3. The mini project can be any of the form given below :
    a) Manufacturing / fabrication of the components / sub assembly / assembly modelled in mini project 2.
    b) Making physical working models, prototypes and scaled models, of a concept machine or development / repair / modifications of laboratory set-ups.
    c) Making virtual / CAD models of sufficiently complex machines / concepts.
    d) Making study, modeling, analysis, programming and simulation of a system / machine / operation / process.
    e) Tools / gadgets / devices / applications involving use of other emerging technologies such as Arduino, Raspberry pi or other electronic tools, simulation software.
    f) Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
    g) Any other project work in mechanical or multidisciplinary areas in consultation with the faculty in charge.

4. Students shall submit an implementation plan in the form of Gantt / PERT / CPM chart, which will cover weekly activity of mini project.
5. A log book to be prepared by each student / group, wherein they can record weekly work progress,
6. Faculty advisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
7. Students shall convert the best solution into a working model using various components of their domain areas and demonstrate / validate the same with proper justification.

Students may use the following facilities available.

1. Wood turning lathe
2. Centre Lathe machine
3. Grinding machine
4. Milling machine
5. Shaping machine
6. CNC machine
7. Wire EDM machine
8. CNC router
9. Welding - spot welding, smart welding machine
10. Co-ordinate measuring machine (CMM)
11. 3D printer
12. Programmable logic controller (PLC)
13. Any other laboratory facility available

Guidelines for Assessment of Mini Project Practical / Oral Examination:

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

Mini Project shall be assessed based on following points;

- Innovativeness in solutions
- Use of engineering principles / norms
- Cost effectiveness
- Quality of workmanship and accuracy
- Demonstration of the mini project work
- Effective use of skill sets
- Contribution of an individual's as member or leader
- Clarity in written and oral communication
- Technical report prepared

	Text Books
1	Suitable books and e books on design engineering, manufacturing processes, thermal engineering, design of experiments, optimization techniques suitable for selected project domain.

	References
1	Suitable user manuals of software tools and research papers from reputed national and international journals and conferences.

	Useful Links
1	Any online resources suitable for the project domain.

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							3		2		3		
CO2	2		3		2				3		3		2	1	
CO3		3		2	3		1	3				3		1	

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 (for 26-week Sem)**	**Marks**
LA1	Synopsis report and presentation	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Progress review / presentation / demonstration	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Assessment based on implementation and presentation	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates the starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand	15	10	10	**35**
Apply	10	15	10	**35**
Analyze				
Evaluate				
Create	5	5	20	**30**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem. VI			
Course Code					
Course Name		Energy Conservation and Management			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**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,		
CO1	Explain energy and power scenario, electrical systems, energy auditing, energy conservation and energy impact on environment.	Apply
CO2	Carryout energy accounting and balancing.	Analyze
CO3	Exercise energy audit and suggest methodologies for energy savings.	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	5

	the input energy requirements, fuel and energy substitution, energy audit instruments and metering	
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

Text Books	
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", 2nd Edition, CRC Press
3	Albert Thumann, "Handbook of Energy Audits", 6th 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	3
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 1,2,3; Where, 1:Low, 2:Medium, 3:High

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	7	16	**30**
4	Analyze	6	7	22	**35**
5	Evaluate	7	6	22	**35**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2021-22	
Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Power Plant Engineering
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**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

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Describe energy harvesting from water, fuels like coal, nuclear, diesel and hydrocarbon	Apply
CO2	Distinguish and interpret the parameters related to power plants.	Analyze
CO3	Select the appropriate system, instruments and allied parameters based on performance, energy consumption and economics.	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	5
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	7
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	7
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	7
V	**Power Plant Instrumentation and Energy Audit**	6

	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	
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	7

Text Books	
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	3
CO1	2														
CO2		2											2		
CO3	2	2	2		1								2	2	

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 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	7	20	**34**
4	Analyze	6	6	20	**32**
5	Evaluate	7	7	20	**34**

6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**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,		
CO1	Solve linear programming problems.	Apply
CO2	Formulate mathematical models for real life cases.	Analyze
CO3	Select models for optimization under different constraints.	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	3
V	**Game theory and Queuing theory** Introduction to queuing system, probability distributions in queuing models, Kendall's notation, Model I (M/M/I): (∞/∞/FCFS). Games theory: introduction, minimax and maximin principle, solution of zero sum two persons games, saddle point, algebraic method, dominance properties, graphical method	5

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

Text Books	
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	3
CO1	3			3								2	2		
CO2		3		3	1										
CO3			2	2	1										

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

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	8	18	**33**
4	Analyze	6	7	20	**33**
5	Evaluate	7	5	22	**34**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year B. Tech., Sem. VI			
Course Code					
Course Name		Design and Optimization			
Desired Requisites:					

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-				
Interaction	-	**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,		
CO1	Implement different methods for optimum design	Applying
CO2	Analyze different optimization techniques.	Analyzing
CO3	Evaluate and interpret solution of an optimization problem.	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

Text Books	
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	3
CO1	3		2										1		
CO2		2											1		
CO3		2		1									1		

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

Assessment (for Theory Course)

The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				
3	Apply	10	10	25	**45**
4	Analyze	5	5	15	**25**
5	Evaluate	5	5	20	**30**
6	Create				

Total	**20**	**20**	**60**	**100**

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Course Information

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

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2 Hrs./Week	-			
Interaction	-	**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,

CO1	Estimate continuous-time control using software for the manipulation, transmission, and recording of data.	Analyze
CO2	Decide suitable actuators and sensors and integrate them with embedded control systems.	Evaluate
CO3	Design static and dynamic logic systems used for combinational, synchronous and asynchronous sequential logics.	Create

List of Experiments / Lab Activities

List of Experiments: (any 10 experiments)

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 13. Study, designing system and demonstration of various mechanisms, ball screws etc. used in robot

Text Books	
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	3
CO1		2											2	2	
CO2				3								1		1	
CO3			3						3						

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply				
Analyze	10	10	10	**30**
Evaluate	10	10	15	**35**
Create	10	10	15	**35**
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

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AY 2021-22

Course Information

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

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

CO1	Understand the Basics of engine construction and working of 2 strokes, 4 stroke petrol and diesel engines.	Apply
CO2	Analyze the heat balance sheet of 4 stroke petrol and diesel engines by taking trials.	Analyze
CO3	Evaluate the performance of computerized multi cylinder 4 stroke engine.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

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:-

1. Test on slow speed diesel engine.
2. Test on high speed diesel engine.
3. Test on variable speed four stroke petrol engine.
4. Morse test on multi cylinder engine.
5. Test on computerized I.C. engine test rig.

6.	Measurement of I.C. engine emissions.
Text Books	
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 ", In-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	3
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															

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 (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.				

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)				
Bloom's Taxonomy Level	**LA1**	**LA2**	**Lab ESE**	**Total**
Remember				
Understand				
Apply	15	15	20	**50**
Analyze	10	10	10	**30**

Evaluate	5	5	10	**20**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	
Course Name	Industry 4.0 Lab
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	2Hrs/week	-			
Interaction	-	**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,		
CO1	Explain various revolutions going on in industrial automation and manufacturing.	Understanding
CO2	Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0 world.	Analyze
CO3	Use integration of data with manufacturing system effectively.	Evaluate

List of Experiments / Lab Activities

Case studies on:

1. Industrial Internet of Things
2. Cloud Manufacturing,
3. Digital Twin
4. Cyber security
5. Virtual/ Augmented Reality
6. Big Data and Analytics
7. Autonomous Robots
8. Smart Manufacturing

Text Books	
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	3
CO1	2					3			3			1	3		
CO2	2			3				3					2		
CO3			2		2									1	

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 (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. 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.

Assessment Plan based on Bloom's Taxonomy Level (Marks) (For lab Courses)

Bloom's Taxonomy Level	LA1	LA2	Lab ESE	Total
Remember				
Understand	15	15	20	**50**
Apply				

Analyze	10	10	10	**30**
Evaluate	5	5	10	**20**
Create				
Total Marks	**30**	**30**	**40**	**100**

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2021-22					
Course Information					
Programme		B. Tech. (Mechanical Engineering)			
Class, Semester		Third Year, Sem VI			
Course Code					
Course Name		3D Printing			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 2**			

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

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

Module	**Module Contents**	**Hours**
I	**Introduction to 3D Printing (Additive Manufacturing)** Overview, History, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes	4
II	**CAD Model** CAD Data formats, Data translation, Data loss, STL format; CAD model preparation, Part Orientation and support generation, Model Slicing, Software features	4
III	**3D Printing Techniques** Stereo-lithography Apparatus (SLA), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS), SLM, Binder Jet technology	6
IV	**Materials for 3D Printing** Polymers and their properties, Metals, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties; Support Materials	4
V	**Post Processing and Product Quality** Requirement and Techniques, Support Removal, Sanding, Acetone treatment,	4

	polishing; Inspection and testing; Defects and their cause	
VI	**Application Domains** Aerospace, Electronics, Health Care, Defense, Automotive, Construction, Food Processing, Machine Tools, Retail industry.	4

Text Books	
1	LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2	Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
3	CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
References	
1	T. A. Grimm & Associates, "Users Guide to Rapid Prototyping", Society of Manufacturing Engineers (SME) ISBN 0872636976, 2014.
2	Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.
3	C. E. Bocking, AEW Rennie, "Rapid & Virtual Prototyping & applications", Wiley Eastern, 2011.
Useful Links	
1	NPTEL and MOOC links

Civil

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

Electronics

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

Electrical

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

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

Computer Science

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

Information Technology

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

Assessment (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	7	8	20	**35**
3	Apply	8	7	17	**32**
4	Analyze	5	5	23	**33**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	
Course Name	Basics of Automobile Engineering
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs./week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**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,		
CO1	Comprehend about I C Engines and various automotive systems and recent trends in automobile design, development, manufacturing and assembly.	Understa nd
CO2	Relate concepts of vehicle dynamics with daily experiences.	Applying
CO3	Analyze acceleration, barking and steering performance of a vehicle in different driving conditions.	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, Electric and Hybrid vehicles- Layout, advantages and limitations.	5
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.	7
IV	**Transmission System**	6

	Automobile clutch requirements, Types & functions, Single plate, Multi plate, Centrifugal and Fluid clutches. Requirements of gear box, Types of gearboxes, construction and Working Principle of operation of automatic transmission, Torque converter, Epicyclic gear train, Construction and working of Propeller shaft, Universal joint, Final drive, Differential, Rear axles.	
V	**Suspension, Steering, Braking and Electrical System** Suspension requirements, Sprung and Unsprung mass, Types of automotive suspension systems. Conventional and Independent systems, Shock absorber. Types of springs, Hotch- kiss and Torque tube drive, Reaction members-Radius rods, Stabilizer bar, Air suspension system. Function of steering, Steering system layout, Automotive steering mechanism, Types of steering gear boxes, Condition for true rolling, Steering geometry-Camber, Caster, King pin inclination, Toe-in and Toe-out, Wheel alignment, Slip angle, Under steer & over steer conditions, Introduction of power steering, Function of automotive brake system, Types of braking mechanism, internal expanding & Disc brake, Mechanical, Hydraulic & Air brake system, Servo and power brakes, Calculation of braking force required, stopping distance and dynamic weight transfer Automotive batteries, Automotive lighting system, Starting system, Charging system, Voltage and current regulator, Electric horn, Dashboard gauges, Wiper & side indicator circuit, Engine electronic control modules, Safety devices.	10
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	3
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	3
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	3
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	3
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	3
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 (for Theory Course)
The assessment is based on 2 in-semester examinations in the form of T1 (Test-1) and T2 (Test-2) of 20 marks each. Also there shall be 1 End-Sem examination (ESE) of 60 marks. T1 shall be typically on modules 1 and 2, T2 based typically on modules 3, 4 and ESE shall be on all modules with nearly 50% weightage on modules 1 to 4 and 50% weightage on modules 5, 6.

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	7	8	20	**35**
3	Apply	8	7	17	**32**
4	Analyze	5	5	23	**33**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**