Walchand College of Engineering

(Government Aided Autonomous Institute)

Vishrambag, Sangli-416415

Course Content for F. Y. M. Tech. Mechanical (Design Engineering)

Semester-I

2023-24

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

AY 2023-24

Course Information

Program	M. Tech. All Branches
Class, Semester	First Year M. Tech., Semester I
Course Code	7IC501
Course Name	Research Methodology and IPR

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

Course Objectives

1	To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.
2	To enable student interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted–logically and analytically, conclude the research findings.
3	To impart knowledge to analyze critically the literature and publish research in conferences, journals and to expose students to research ethics, IPR and Patents

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Demonstrate** a research solution in respective engineering domain using appropriate Engineering research process and research methodology.	Apply
CO2	**Device** feasible solution to a research problem in respective engineering domain based on economic, social and legal aspects using appropriate research procedures and practices.	Analyze
CO3	**Write** research publication, Dissertation, IPR and patent document.	Create

Module	**Module Contents**	**Hours**
I	**Engineering Research Process** Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.	6
II	**Research Methodology** Problem statement formulation, resources identification for solution, Experimental and Analytical modelling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: Z-test etc.,	6
III	**Research Methods** Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spreadsheets. Processing and Analysis of Data: Processing Operations, Types of Analysis-Presentation and Interpretation of Data Editing, Classification and Tabulation-	7

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23/8/2023
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	Interpretation. Analyse your results and draw conclusions.	
IV	**Research Practices** Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Mendeley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing such as WORD, Latex etc. Presentation techniques for paper/report/seminar. Publishing article in Scopus/SCI/Web of science indexed journal or conference.	7
V	**Intellectual Property Rights (IPR)** Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Ownership of copyright, Term of copyright, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. New developments in IPR, Traditional knowledge ,Various Case Studies.	7
VI	**Patents** Patent Rights: Scope of Patent Rights. Various Patent databases. Geographical Indications. Procedure for grants of patents, Patenting under PCT. Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: WIPO, TRIPs, Patenting under PCT	6

	Textbooks
1	Kothari C. R, "Research Methodology", 2nd Edition, New Age International, 2004
2	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science & Engineering Students" Juta and Company Ltd, 2000.
3	Kumar Ranjit, "Research Methodology: A Step-by-Step Guide for beginners", SAGE Publications, 4^{th} Ed.-2014.
	References
1	Merges Robert, Menell Peter, Lemley Mark, "Intellectual Property in New Technological Age", ASPEN Publishers, 2016.
2	Ramappa T., "Intellectual Property Rights Under WTO", S. Chand, 2008
3	Mayall, "Industrial Design", McGraw Hill, 1992.
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007
5	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi
	Useful Links
1	NPTEL :: General - NOC:Introduction to Research
2	Introduction to Research - Course (nptel.ac.in)
3	Qualitative Research Methods And Research Writing - Course (nptel.ac.in)
4	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
5	https://www.scopus.com/search/form.uri?display=basic#basic
6	https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods And Research Writing
7	https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing
8	https://webofscienceacademy.clarivate.com/learn

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9	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
10	https://nptel.ac.in/courses/121/106/121106007/
11	https://www.wipo.int/about-wipo/en/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	3	4	5	6
CO1	3		1			
CO2			2	3	2	
CO3		3		2		2

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

Assessment

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

Solapure
28-8-2023
Dr. S. S. Solapure
Associate Professor (IT Dept.)

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2023-24	
Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE501
Course Name	Advanced Solid Mechanics
Desired Requisites:	Strength of Materials

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

Course Objectives	
1	To prepare the students to succeed as designer in industry/technical professions.
2	To provide students with a sound foundation in solid mechanics required to solve the problems in Industry.
3	To train the students with good design engineering breadth required for safe and efficient design, construction, installation, inspection and testing of structural parts of the mechanical system.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Verify basic field equations such as equilibrium equations, compatibility and constitutive relationship	V	Evaluating
CO2	Study basic field equations to torsion, bending and two-dimensional elasticity problems, and energy methods.	IV	Analysing
CO3	Solve problems in unsymmetrical bending and shear centre, contact stresses and pressurized cylinders and rotating discs.	III	Applying

Module	**Module Contents**	**Hours**
I	**Analysis of Stress** Assumptions, Concepts of Stress, Equality of cross shears, Cauchy's stress principle, Direction cosines, Stress components on an arbitrary plane, Stress transformation, Principal stresses, Differential equations of equilibrium in rectangular and polar coordinates, Octahedral stresses, Plane stress and Plane strain, Airy's stress function	7
II	**Strain and Stress-Strain Relations** Concept of strain, Strain-Displacement relations, Compatibility conditions, Biharmonic equation, Strain measurement, Construction of Mohr's Circle, Stress- strain relationship, Isotropy	6
III	**Energy Methods** Work done by forces and elastic strain energy, Maxwell-Betti-Rayleigh Reciprocal theorem, First and second theorem of Castigliano, expressions for strain energy when an elastic member is subjected to axial force, Shear force, Bending moment and Torsion. Theorem of virtual work	6

IV	**Torsion** Torsion of general prismatic bars of solid section, Torsion of Circular and Elliptical bars, Membrane analogy, Torsion of thin walled of open cross section and multiple cell closed sections	7
V	**Axisymmetric Problems** Stress in thick walled cylinder under internal and external pressure, stresses in rotating flat solid disk, flat disk with central hole, rotating shafts and cylinders	7
VI	**Unsymmetrical Bending and Shear Centre** Concept of shear centre in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear centre for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section.	6

	Textbooks
1	Sadd, Martin H., Elasticity: Theory, applications and Numeric, Academic Press, 2005
2	Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 2000
3	Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/McGraw Hill 1999
	References
1	Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991
2	Theory of Elasticity – Timoshenko and Goodier, McGraw Hill
3	Advanced Strength of Materials, Vol. 1,2 – Timoshenko, CBS
4	Advanced Strength of Materials – Den Harteg
	Useful Links
1	https://nptel.ac.in/courses/112/101/112101095/
2	https://nptel.ac.in/courses/112/102/112102284/
3	https://freevideolectures.com/course/2361/strength-of-materials
4	https://www.youtube.com/watch?v=4meZNc2wB4s&list=PLKZlPALGW-7TK51CrfZRyWcY8h2gaxVCy

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			1	3	2	
CO2			2	3		1
CO3	1		1	3		

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

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2023-24					
Course Information					
Programme	M. Tech. (Mechanical Design Engineering)				
Class, Semester	First Year M. Tech., Sem I				
Course Code	7DE502				
Course Name	Advanced Machine Design				
Desired Requisites:	Industrial product design, Machine design				
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To prepare the students to succeed as designer in industry /technical profession.
2	To provide students the knowledge of steps involved in design and developments of industrial product.
3	To prepare the students to use knowledge of ergonomics, aesthetics for development of industrial Product.
4	To prepare the students to use knowledge of rapid prototyping, value analysis, standardization for Development of industrial Product.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate an ability to recognize the need of society to design the products as per their requirements	III	Applying
CO2	Recommend appropriate changes to apply aesthetic and ergonomic concepts to product	V	Evaluating
CO3	Design and develop the products by using principles of DFMA, rapid prototyping, reliability and economy	VI	Creating

Module	**Module Contents**	**Hours**
I	**Product Development Process:** Development processes and organizations, Product Planning, Product development management, establishing the architecture, geometric layout development –Fundamental and incidental interactions	7
II	**Concept Generation:** Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing.	6
III	**Ergonomics and Aesthetics:** Industrial design, Human behaviour in design, design for Emotion and experience, physical, cognitive and occupational aspects, aesthetics: form, colour, texture, lines, symmetry etc.	6
IV	**Design for Manufacturing and Assembly:** Design for manufacture, assembly, maintenance, casting, forging, Estimation of Manufacturing cost, reducing the component costs and assembly costs, Minimize system complexity.	7

V	**Robust Design:** Design for Reliability, strength based reliability, parallel and series systems, robust design, Integrate process design, Managing costs, Robust design, Simulating product performance and manufacturing processes electronically,	7
VI	**Rapid Prototyping:** Rapid Prototyping Liquid based processes, Powder based processes and Solid based processes; Classes of RP systems: 3D Printers, Enterprise Prototyping centers, RP Applications	6

Textbooks	
1	Ulrich K.T. and Eppinger S., Product Design and Development, McGraw-Hill Education; 5th edition, 2011.
2	Dieter G.E., Engineering Design, McGraw-Hill Education 5th edition, 2012.
3	Prashant Kumar, Product Design, Creativity, Concepts and Usability, PHI New Delhi, 1st edition, 2011

References	
1	John J.C., Design Methods, Wiley Inter science, 2nd edition, 1970.
2	Law A. M. and Kelton W.D, Simulation, Modelling and Analysis, McGraw Hill Education, 4th edition, 2017
3	Pahl G. and W. Beitz, Engineering Design- a Systematic Approach, Springer, 2nd edition, 1996.

Useful Links	
1	https://nptel.ac.in/courses/112/107/112107217/
2	https://nptel.ac.in/courses/107/103/107103084/
3	https://youtu.be/hPrQXgQ-dY8
4	https://nptel.ac.in/courses/112/104/112104265/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3		2	3	1	
CO2	1		1	2		
CO3	3					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

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

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AY 2023-24

Course Information

Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE503
Course Name	Computer Aided Design
Desired Requisites:	

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

Course Objectives

1	To introduce the students application of Geometric Dimensioning and Tolerancing
2	To impart the students modern CAD operations.
3	To prepare the students for use of modern FEA system

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Demonstrate various approaches of geometric modeling	II	Applying
CO2	Analyse geometric dimensioning and tolerancing based on ASME standard in design and generate proper engineering drawings	IV	Analysing
CO3	Design parts using a modern parametric CAD system	VI	Creating

Module	Module Contents	Hours
I	CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules	6
II	Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems	7
III	Computer Graphics, Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping	6
IV	Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation	7
V	Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation,	7
VI	Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing etc.	6

Text Books

1	Zeid Ebrahim, CAD/CAM Theory and Practice,Tata Mc.Graw Hills, 3rd edition,2009.
2	Radhakrishnan P., Subramanyan S., Raju V. ,CAD/CAM/CIM, , New Age International, 2nd edition, 2010.

References

1	Lee Kunwoo, Principles of CAD/CAM/CAE systems, , Addison Wesley, 2nd edition,1999
2	Machover Carl ,The C4 handbook: CAD, CAM, CAE, CIM, Tab Professional and Reference Books, 3rdedition, 1998
3	Taraman Khalil ,CAD-CAM: Meeting Today's Productivity Challenge, University of Michigan, 6th edition, 2012
Useful Links	
1	https://www.youtube.com/watch?v=EgKc9L7cbKc
2	https://www.youtube.com/watch?v=swtH_okidQc&list=PLUtfVcb-iqn8dG1-Cn7NTEdILR3hRVgcN&index=1
3	https://www.youtube.com/watch?v=0IgOapAtauM
4	https://www.youtube.com/watch?v=0IgOapAtauM&list=PLC3EE33F27CF14A06&index=43

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3		3		2	
CO2		3			2	
CO3		3		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 (for Theory Course)

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

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE551
Course Name	Advanced Solid Mechanics Lab
Desired Requisites:	

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

Course Objectives

1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the experiment / mini-project, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Solve field problems by using different techniques in advanced solid mechanics	III	Applying
CO2	Verify the fundamental concepts of analysis of machines by using solid mechanics.	V	Evaluating
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of advanced solid mechanics.

Textbooks

1	Suitable books based on the contents of the experiment/mini project selected.

References

1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links

1	As per the need of the experiment/mini project.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE552
Course Name	Advanced Machine Design Lab
Desired Requisites:	

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

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the experiment / mini-project, through observations, discussions and decision making process
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Solve field problems by using different techniques in advanced machine design	III	Applying
CO2	Design and develop suitable mechanical systems using concepts in advanced machine design	VI	Creating
CO3	Prepare and present a detailed technical report based on experiment/ mini project work.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of advanced machine design.

Textbooks	
1	Suitable books based on the contents of the experiment/mini project selected.

References	
1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per the need of the experiment/mini project.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE553
Course Name	Computer Aided Design Lab
Desired Requisites:	

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

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the experiment/ mini-project, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Solve field problems by using different techniques in computer aided design	III	Applying
CO2	Design and develop suitable mechanical systems using concepts in computer aided design	VI	Creating
CO3	Prepare and present a detailed technical report based on experiment /mini project work.	V	Evaluating

List of Experiments / Lab Activities/Topics

List of Lab Activities:
Creation of CAD models/ innovation of existing product/ analysis or simulation of a process/case studies/ experimental verification of principles in thrust areas of computer aided design.

Textbooks	
1	Suitable books based on the contents of the experiment/mini project selected.

References	
1	Suitable books based on the contents of the experiment/mini project selected and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per the need of the experiment/mini project.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
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Course Information					
Programme		M. Tech. (Mechanical Design Engineering)			
Class, Semester		First Year M. Tech., Sem I			
Course Code		7DE511			
Course Name		Design for Manufacturing and Assembly			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To provide the students the knowledge of different steps involved in the Product Development Cycle.
2	To prepare the students to use knowledge of the manufacturing process.
3	To prepare the students to succeed as designer in industry /technical professions.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the product development cycle.	IV	Analysing
CO2	Study the principles of assembly to minimize the assembly time.	V	Evaluating
CO3	Interpret the effect of manufacturing process and assembly operations on the cost of product.	III	Applying

Module	**Module Contents**	**Hours**
I	Introduction Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes	6
II	Properties of Engineering Materials, Selection of Materials–I, Selection of Materials–II, Case Studies–I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies-II	6
III	Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes.	6
IV	Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Co-selection of Materials and Processes, Case-Studies–III	6
V	Design for Assembly, Review of Assembly Processes, Design for Welding–I, Design for Welding–II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case- Studies-IV	9
VI	Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization	6

Textbooks	
1	Rao S. S., Engineering Optimization: theory and practice, John Wiley, 2nd edition, 1996.
2	Ashby M. F. and Johnson K, Materials and Design - the art and science of material selection inProduct design, Pearson publications, 3rd edition, 2002.

3	G Dieter, Engineering Design - a materials and processing approach, McGraw Hill, 2nd edition, 2006.
References	
1	Bralla J G, Handbook for Product Design for Manufacture, McGraw Hill, 2nd edition, 2003.
2	ASTM Design handbook
3	Courtney T H, Mechanical Behaviour of Materials, McGraw Hill, 4th edition, 2008
4	Swift K G and Booker J D, Process selection: from design to manufacture, London: Arnold,1997
Useful Links	
1	https://nptel.ac.in/courses/107/108/107108010/
2	https://nptel.ac.in/courses/112/108/112108150/
3	https://nptel.ac.in/courses/112/101/112101005/
4	https://youtu.be/LBVeK_7I0PM

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		2	2		3	
CO2	3			2	2	
CO3		2	3		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
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE512
Course Name	Robotics
Desired Requisites:	

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

Course Objectives	
1	To introduce students to fundamentals of robot working, programming and integration in a manufacturing process.
2	To make students understand basic working components of an industrial robot
3	To introduce recent technology as machine vision

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Understand basic terminologies and concepts associated with Robotics and Automation.	II	Understanding
CO2	Demonstrate comprehension of various Robotic sub-systems.	III	Applying
CO3	Analyse kinematics and dynamics to explain exact working pattern of robots.	IV	Analyzing

Module	Module Contents	Hours
I	**Introduction** Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, etc. Automation - Concept, Need, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.	7
II	**Robot Grippers** Types of Grippers, Design aspect for gripper, Sensors for Robots- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Need for sensors and vision system in the working and control of a robot.	7
III	**Drives and control systems** Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control Control Technologies in Automation:- Industrial Control Systems, Process Industries, Discrete Control.	6
IV	**Kinematics** Transformation matrices and their arithmetic, link and joint description, Denavit - Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators	6
V	**Machine Vision System** Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation, motion interpolation, branching capabilities, Programming Languages: Introduction to various types such as RAIL and VAL II etc, Features of type and development of languages for recent robot systems.	7
VI	**Modeling and Simulation for manufacturing Plant Automation**	6

	Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, robots and application of robots for automation. Introduction to Artificial Intelligence, AI techniques, Need and application of AI	

Text Books	
1	John J. Craig, Introduction to Robotics (Mechanics and Control), Addison-Wesley, 2nd Edition, 04
2	Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.
3	Shimon Y. Nof , Handbook of Industrial Robotics , John Wiley Co, 01.

References	
1	Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, Robotic Engineering: An Integrated Approach , Prentice Hall India, 02.
2	Handbook of design, manufacturing & Automation: R.C. Dorf, John Wiley and Sons.

Useful Links	
1	https://nptel.ac.in/courses/112/104/112104298/
2	https://nptel.ac.in/courses/107/106/107106090/
3	https://nptel.ac.in/courses/112/107/112107289/
4	https://nptel.ac.in/courses/112/105/112105249/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			1	1		
CO2	1			2		1
CO3	1	2	2			2

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

Assessment (for Theory Course)

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

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Course Information

Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE513
Course Name	Mathematical Methods in Engineering
Desired Requisites:	

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

Course Objectives

1	To make students to organize systems of equations, their algebraic and graphical representations, and their use in practical applications.
2	To prepare students to outline the physical systems and formulate mathematical models for them.
3	To make students to solve differential equations using numerical techniques and transform Technique.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply statistical techniques to analyze multivariate functions.	V	Applying
CO2	Evaluate solution of engineering problems by applying the knowledge of ordinary and partial differential equations	III	Evaluating
CO3	Analyze nature of a given wave equation and obtain solution from the perspective of D"Alembert principle and/or by method of separation of variables.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Introduction to Probability Theory:** Probability Theory and Sampling Distributions. Basic probability theory along with examples.	5
II	**Probability distributions and theorems:** Standard discrete and continuous distributions like Binomial, Poisson, Normal, Exponential etc. Central Limit Theorem and its significance. Some sampling distributions like x^2, t, F.	6
III	**Testing of Statistical Hypothesis:** Testing a statistical hypothesis, tests on single sample and two samples concerning means and variances. ANOVA: One – way, Two – way with/without interactions.	8
IV	**Ordinary Differential Equations:** Ordinary linear differential equations solvable by direct solution methods; solvable nonlinear ODE"s.	6
V	**Partial Differential Equations and Concepts in Solution to Boundary Value Problems:** Solution methods for wave equation, D'Alembert solution, potential equation, properties of harmonic functions, maximum principle, solution by variable separation method.	7

VI	**Major Equation Types Encountered in Engineering and Physical Sciences:** Solution methods for wave equation, D'Alembert solution, potential equation, properties of harmonic functions, maximum principle, solution by variable separation method.	7

Textbooks	
1	Ronald E, Walpole, Sharon L. Myers, Keying Ye, Probability and Statistics for Engineers And Scientists (8th Edition), Pearson Prentice Hall, 07.
2	J. B. Doshi, Differential Equations for Scientists and Engineers, Narosa, New Delhi, 10.
References	
1	Douglas C. Montgomery, Design and Analysis of Experiments (7th Edition), Wiley Student Edition, 09.
2	S. P. Gupta, Statistical Methods, S. Chand & Sons, 37th revised edition, 08.
3	William W. Hines, Douglas C. Montgomery, David M. Goldsman, Probability and Statistics for Engineering, (4th Edition), Willey Student edition, 06.
4	Advanced Engineering Mathematics (9th Edition), Erwin Kreyszig, Wiley India (13).
Useful Links	
1	https://www.ajronline.org/doi/10.2214/ajr.180.4.1800917
2	https://www.healthknowledge.org.uk/public-health-textbook/research-methods/1b-statistical-methods/statistical-distributions
3	https://nptel.ac.in/courses/111/106/111106100/
4	https://www.math.upenn.edu/~deturck/m425/m425-dalembert.pdf

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3		1	2		3
CO2	2			1	1	2
CO3	1		1	2		

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

Assessment

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

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Course Information

Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE514
Course Name	Process Equipment Design
Desired Requisites:	

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

Course Objectives

1	To prepare the students to succeed as designer in the process industry/technical profession.
2	To provide students with a sound foundation in process equipment design required to solve the problems in the process industry.
3	To train the students with good design engineering breadth required for safe and efficient design, construction, installation, inspection, testing and certification of unfired pressure vessels.
4	To aware the students about rules and regulations related to the operational safety of process equipment

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Distinguish types of equipment used in the process industry and their general procedure of design.	IV	Analysing
CO2	Recommend the appropriate equipment for a process by considering process hazards and safety measures.	V	Evaluating
CO3	Design pressure vessels and its corresponding components using BIS and ASME codes of pressure vessels.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to Process Equipments:** Introduction, Basic process requirement of plants and projects, Types and classification of equipments used in process industry, General design procedure, Materials of construction and corrosion prevention, Design codes required in process equipment design	6
II	**Pressure Vessels:** Design parameters, Design criteria, Design of pressure vessel components – Shell, Head, Nozzle, flanged joint, Thermal stresses in cylindrical shell, Cylindrical pressure vessels under combined loading, Fabrication process, Inspection and testing of pressure vessels.	7
III	**High Pressure Vessels:** Constructional features, Stresses in thick walled shells, Multi-shell construction, Shrink fit construction, Stresses in shrink fit construction, Supports for pressure vessels.	7

IV	**Storage Vessels:** Storage vessels and its type, Fixed roof storage tanks, Variable volume tanks-vapor lift type and floating roof type, Accessories of storage tanks, column supported storage tanks, Design of rectangular tanks. Reaction vessel - Heating systems of reaction vessels, Design and construction of jackets	7
V	**Heat Exchangers:** Types of heat exchangers and constructional features, Design of shell and tube heat exchangers, Arrangements of tubes, baffles, Expansion provisions for heat exchangers. Evaporators and crystallizers – Types and its constructional features	6
VI	**Process Equipments:** Agitators, Centrifugal machines, Filters and dryers used in process industries. Process hazards and safety in the process industry	6

Textbooks	
1	Mahajani V.V. and Umbrani S.B., “Process Equipment Design”, Macmillan Publishing India Ltd., Fourth edition, 2009.
2	Bieuro of Indian standard “Code for unfired pressure vessels IS:2825”, Indian Standard Institution, Revised Edition

References	
1	Brownell L. E and Young H, “Process Equipment Design”, John Willey Publication, First Edition, 2004.
2	Harvey J. F., “Theory and Design of Pressure Vessel” CBS Publisher, Third Edition, 2004.

Useful Links	
1	https://www.nptel.ac.in/courses/103/107/103107143/
2	https://nptel.ac.in/courses/103/107/103107207/
3	https://youtu.be/WG4l8jpYXKc
4	https://nptel.ac.in/courses/112/105/112105248/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1					2
CO2			2			
CO3	3		2			3

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

Assessment

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2023-24					
Course Information					
Programme	M. Tech. (Mechanical Design Engineering)				
Class, Semester	First Year M. Tech., Sem I				
Course Code	7DE501				
Course Name	Optimization Techniques in Design				
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To 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 operations research techniques and tools for necessary engineering practice.
3	To use mathematical methods and computers to make rational decisions in solving a variety of optimization problems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Develop algorithms for design optimization.	III	Applying
CO2	Evaluate and interpret solution of an optimization problem.	V	Evaluating
CO3	Formulate and construct the optimum solution of the problems using optimization techniques.	VI	Creating

Module	**Module Contents**	**Hours**
I	Introduction to optimization, classification of optimization problems, classical optimization techniques.	7
II	Linear programming, simplex method and Duality in linear programming, sensitivity or post-optimality analysis	7
III	One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods.	6
IV	Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts, etc.	6
V	Introduction to Genetic Algorithms, Operators, applications to engineering optimization Problems.	6
VI	Optimum selection of material and processes in mechanical design using material selection charts and optimization.	7

Textbooks	
1	S. S. Stricker, "Optimising performance of energy systems" Battelle Press, New York, 1985.
2	R.C. Johnson, "Optimum Design of Mechanical Elements", Willey, New York, 1980.
3	J. S. Arora, "Introduction to Optimum Design", McGraw Hill, New York, 1989.

4	Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India, New Delhi, 05

References

1	Rao S, "Engineering optimization, Theory and Practice, New Age International Publishers, 1996.
2	R.J. Duffin, E.L. Peterson and C.Zener "Geometric Programming-Theory and Applications", Willey, New York, 1967.
3	G.B. Dantzig "Linear Programming and Extensions Princeton University Press", Princeton, N. J., 1963.

Useful Links

1	https://www.youtube.com/watch?v=_awAywLKuEQ&list=PLvfKBrFuxD065AT7q1Z0rDAj9kBnPnL0l
2	https://www.youtube.com/watch?v=wIAOApE0Q3o
3	https://www.youtube.com/watch?v=GBheyaICuGQ
4	https://www.youtube.com/watch?v=Z_8MpZeMdD4

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		2	1	1	3
CO2	3		1		3	
CO3	2	1	2		1	

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

Assessment

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

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	7DE516
Course Name	Product Lifecycle Management
Desired Requisites:	Concept knowledge of product design, management

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

Course Objectives	
1	To prepare students to develop products by technical and managerial and software skills.
2	To make the students familiar with increased product complexity and to maintain product quality.
3	To develop skills to identify the gaps between current product development process.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Discuss the importance and the concept of Product Lifecycle Management and its need.	II	Understanding
CO2	Exploit the methodology to set the Product Lifecycle Management Vision and Develop Product Lifecycle Management strategy	III	Applying
CO3	Analyze the recent developments to perform product structure modelling with relationship	IV	Analysing

Module	**Module Contents**	**Hours**
I	Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle, Management-Definition & Overview, Background for Product Lifecycle Management-corporate challenges, Need of Product Lifecycle Management, Components/Elements of Product Lifecycle Management, Emergence of Product Lifecycle Management, Significance of Product Lifecycle Management - life cycle problems to be resolved.	6
II	Product Lifecycle Management Life cycle model- plan, design, build, support & dispose. Threads of Product Lifecycle Management computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM). Weaving the threads into Product Lifecycle Management, comparison of Product Lifecycle Management to Engineering resource planning (ERP). Product Lifecycle Management characteristics - singularity, cohesion, traceability, reflectiveness, Information Mirroring Model. External drivers- scale, complexity, cycle times, globalization & regulation. Internal drivers - productivity, innovation, collaboration & quality. Boardroom drivers – income, revenues & costs	7

III	Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing.	6
IV	Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of Product Lifecycle Management systems.	6
V	Product Data issues – Access, applications, Archiving, Availability, Change, Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's Product Lifecycle Management vision, The Product Lifecycle Management Strategy, Principles for Product Lifecycle Management strategy, Preparing for the Product Lifecycle Management strategy.	7
VI	Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management. Human resources in product lifecycle.	7

Textbooks	
1	Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006. ISBN 0071452303.
2	Antti Sääksvuori, Anselmi Immonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3	Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer- Verlag, 2004. ISBN 1852338105.
4	Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International Edns, 1999.
References	
1	Product Design & Process Engineering, McGraw Hill – Kogalkusha Ltd., Tokyo, 1974.
2	Effective Product Design and Development – by Stephen Rosenthol, Business One Orwin, Homewood 1992 ISBN 1-55623-603-4.
3	Clement, Jerry; Coldrick, Andy; & Sari, John. Manufacturing Data Structures, John Wiley & Sons, 1992. ISBN 0471132691
4	Clements, Richard Barrett. Chapter 8 ("Design Control") and Chapter 9 ("Document Control") in Quality Manager's Complete Guide to ISO 9000, Prentice Hall, 1993. ISBN 013017534X.
Useful Links	
1	https://www.youtube.com/watch?v=MsnbqLWjlmA&list=PLeL2LKQLdbQvCnx
2	https://nptel.ac.in/courses/112/107/112107217/
3	https://www.youtube.com/watch?v=NDcaDUKQutE&list=PLSGws_74K018yZOnbSaqW
4	https://www.youtube.com/watch?v=m-OMvTWf9mE

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1				1	2
CO2			2	3		1
CO3			2	3		1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

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

Walchand College of Engineering

(Government Aided Autonomous Institute)

Vishrambag, Sangli-416415

Course Content for F. Y. M. Tech. Mechanical (Design Engineering)

Semester-II

2023-24

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE521
Course Name	Advanced Vibration and Acoustics
Desired Requisites:	

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

Course Objectives	
1	To teach the fundamental concept of dynamic analysis of machines.
2	To train students to prepare mathematical model of discrete and continuous mass system and to find response of models for different types of excitations
3	To introduce students to fundamental concepts of acoustics and its measurement.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Evaluate response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitation.	V	Evaluating
CO2	Apply technique of decoupling and orthogonal properties of natural modes to solve differential equations of motion for MDOF system.	III	Applying
CO3	Explain various terminologies used in acoustics and acoustic wave transmission, derive plane and spherical wave equations, and obtain sound pressure level at a given distance from a simple sound source of known strength.	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Transient Vibrations** Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function.	6
II	**Two Degree of Freedom System** Free, damped and forced vibrations of two degrees of freedom systems, Co-ordinate coupling and principal coordinates, Dynamic vibration absorbers, vibration dampers and isolators, Use of Lagrange's equations to derive the equations of motion.	7
III	**Multi Degree of Freedom System** Modelling of multi-DOF systems, Influence coefficients, Natural frequencies and mode shape determination, Eigen value and eigen vector problem, Dunkerley's methods, Rayleigh Method, Matrix iteration method, Holzer's method	7
IV	**Vibration of Continuous System** Lateral vibration of a string, Longitudinal vibration of rods, Torsional vibration of uniform shaft, Euler's equation of beams Vibration Control, Methods of vibration control	7

V	**Acoustics** Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source	6
VI	**Psychoacoustics** Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise.	6

Textbooks	
1	Thomson W. T., "Theory of Vibrations with applications", George Allen and Unwin Ltd. London, 1981.
2	S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.
3	Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition

References	
1	S. Timoshenko, "Vibration Problems in Engineering", Wiley, 1974.
2	Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.
3	Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II., Chemical Publishing Co., New York, 1977
4	S. Timoshenko, "Vibration Problems in Engineering", Wiley, 1974.

Useful Links	
1	https://nptel.ac.in/courses/112/104/112104114/
2	https://nptel.ac.in/courses/112/103/112103112/
3	https://nptel.ac.in/courses/112/103/112103111/
4	https://nptel.ac.in/courses/112/104/112104026/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			2	1	1	3
CO2	1			1	2	3
CO3	1		2			3

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

Assessment

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

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE522
Course Name	Finite Element Method
Desired Requisites:	

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

Course Objectives	
1	To teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues
2	To provide hands on experience using finite element software to model, analyze and design mechanical systems

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the concepts of finite element method for solving problems in the mechanical design.	III	Applying
CO2	Solve the problems in one dimensional structural systems involving bars, trusses, beams.	V	Evaluating
CO3	Develop two dimensional FE formulations involving triangular, quadrilateral elements and higher order elements.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction** Historical Background, Application of FEM to mechanical engineering design problems, Initial and Boundary value problems, Weighted Residual Methods, Variational Formulation, Ritz Technique, Basic concepts of the Finite Element Method	6
II	**One Dimensional Problems** Basic steps, Discretization, Element types, Derivation of Shape functions and Stiffness matrices and force vectors, Assembly of Matrices, Solution of problems from solid mechanics and heat transfer	7
III	**Trusses** Plane truss, local and global coordinate systems, stress calculations, temperature effect on truss members, solutions of practical problems	6
IV	**Two Dimensional Scalar Variable Problems** Second Order 2D Equations involving Scalar Variable Functions, Variational formulation, Finite Element formulation, Triangular elements, Shape functions and element matrices and vectors. Application to Field Problems, Thermal problems, Quadrilateral elements, Higher Order Elements	6
V	**Two Dimensional Vector Variable Problems** Equations of elasticity, Plane stress, plane strain and axisymmetric problems, Body forces and temperature effects, Stress calculations, Plate and shell elements.	6

VI	**Isoparametric Formulation** Natural co-ordinate systems, Isoparametric elements, Shape functions for iso parametric elements, One and two dimensions, Serendipity elements Eigen-value problems, Natural vibration of bars and beams, Methods to find eigen-values and eigen-vectors.	7

Textbooks	
1	Klaus Jurgen Bathe, "Finite Element Procedures" Print ice Hall of India Pvt. Ltd. Fourth Print,2008
2	J.N. Reddy. "Introduction to Finite Element", Tata McGraw Hill Publishing Co. Ltd,1998
3	O.C. Zienkiewicz, "The Finite Element Method", Tata McGraw Hill Publishing Co. Ltd, 5th revised edition ,2000

References	
1	T.R. Chandrupatla. "Introduction to Finite Element in Engineering", Prentice Hall, New Delhi, 2nd Edition-1997
2	David V. Hutton, Fundamentals of finite element analysis, Tata McGraw Hill Publishing Co. Ltd Second edition 2005
3	S. S .Rao. "Introduction to Finite Element in Engineering", Elsevier, 5th edition, 2012.
4	Cook R.D. "Concepts and applications of finite element analysis" Wiley, New York, 4th Ed. 02.
5	Logan Deryl L., "A First Course in Finite Element Method", Thomson Brook/Cole,5th Ed.

Useful Links	
1	https://www.youtube.com/watch?v=KR74TQesUoQ&list=PLbMVogVj5nJRjnZA9oryBmDdUNe7lbnB0
2	https://www.youtube.com/watch?v=qwQcGruUGwI
3	https://www.youtube.com/results?search_query=+Boundary+Value+problems+in+fea+nptel
4	https://www.youtube.com/watch?v=oz0bUB44LDg

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3					
CO2				3	2	2
CO3		2	2			3

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

Assessment

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

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE523
Course Name	Advanced Engineering Materials
Desired Requisites:	

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

Course Objectives	
1	To demonstrate understanding Mechanical properties of materials and influence of imperfections over mechanical properties.
2	To demonstrate understanding phase diagrams and their use in predicting phase transformation and microstructure also understand and predict various types of failures using concept of fracture mechanics, creep and effect of impact.
3	To recognize Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composites and understand the economic considerations in usage and recycling of materials in human use.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply knowledge of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites and imperfections and their effects on mechanical properties of materials and cause of failure.	III	Applying
CO2	Examine phase diagrams in predicting phase transformation and microstructure	V	Evaluating
CO3	Recognize Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composite.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction, Atomic Structure, Interatomic Bonding and Structure of Crystalline Solids:** Historical perspective of Materials Science. Why study properties of materials? Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and noncrystalline materials. Miller indices. Anisotropic elasticity. Elastic behaviour of composites. Structure and properties of polymers. Structure and properties of ceramics.	6

II	**Imperfections in Solids and Mechanical Properties of Metals, Diffusion, Dislocations and Strengthening Mechanisms:** Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Interpretation of tensile stress-strain curves Yielding under multiaxial stress. Yield criteria and macroscopic aspects of plastic deformation. Property variability and design factors, Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. Mechanisms of strengthening in metals. Recovery, recrystallization and grain growth. Strengthening by second phase particles. Optimum distribution of particles. Lattice resistance to dislocation motion.	7
III	**Phase Diagrams:** Equilibrium phase diagrams. Particle strengthening by precipitation. Precipitation reactions. Kinetics of nucleation and growth. The iron-carbon system. Phase transformations. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system.	7
IV	**Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile** brittle transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep Generalized creep behaviour. Stress and temperature effects.	7
V	**Applications and Processing of Metals and Alloys, Polymers, Ceramics, and composites:** Types of metals and alloys. Fabrication of metals. Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics, Mechanical behaviour of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types. Polymer synthesis and processing, Particle reinforced composites. Fibre reinforced composites. Structural composites.	7
VI	**Electrical, Thermal, Optical and Magnetic Properties and economic Considerations:** Electrical conduction. Semi conductivity. Super conductivity. Dielectric behaviour. Ferroelectricity. Piezoelectricity Heat capacity. Thermal expansion. Thermal conductivity. Thermal stresses Diamagnetism and Para magnetism. Ferromagnetism. Antiferromagnetism and ferrimagnetism. Influence of temperature on magnetic behaviour. Economic, Environmental and Social Issues of Material Usage - Economic considerations. Environmental and societal considerations. Recycling issues. Life cycle analysis and its use in design	5
Textbooks		
1	Materials Science and Engineering, William D. Callister, Jr, John Wiley & sons, 07.	
2	Modern Physical Metallurgy and Material Engineering, Science, Process, application, Smallman R.E., Bishop R J, Butterworth Heinemann, Sixth Ed., 1999.	
3	Essentials of Materials Science &Engineering, Donald R. Askeland, Wendelin J. Wright,PradeepFulay	
References		
1	Sidney H. Avener, Physical Metallurgy, Tata McGraw Hill Education Private Limited, 2nd Edition, 1997.	

2	George E. Dieter, Mechanical Metallurgy, Tata McGraw Hill Publication, Si Metric Edition, 3rdRevised edition, 2013.
3	Ashok Sharma, Rajan, Heat Treatment: Principles & Techniques, Phi Learning Pvt. Ltd-New Delhi, 2nd edition, 2011.
Useful Links	
1	https://nptel.ac.in/content/storage2/courses/112108150/pdf/PPTs/MTS_02_m.pdf
2	https://www3.nd.edu/~amoukasi/CBE30361/Lecture_Defects_2014.pdf
3	https://youtu.be/7x3c8trbtQs
4	https://nptel.ac.in/courses/112/108/112108150/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2	3	1	2
CO2			2	3	1	
CO3		1	2		3	1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

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

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Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE571
Course Name	Advanced Vibration and Acoustics Lab
Desired Requisites:	

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

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process to help student to get confidence by successfully completing the experiment/mini-project, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Solve field problems by using different techniques in advanced vibration and acoustics	III	Applying
CO2	Verify the fundamental concepts of dynamics of machines.	V	Evaluating
CO3	Prepare and present a detailed technical report based on experiments/mini project work	V	Evaluating

Course Content

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of advanced vibrations and acoustics

Text Books	
1	Suitable books based on the contents of the experiments/ mini project

References	
1	Suitable books based on the contents of the experiments/ mini project and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per the need of the experiments/mini project.

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

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

Each CO of the course must map to at least one PO.

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.				

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Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE572
Course Name	Finite Element Method Lab
Desired Requisites:	

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

Course Objectives	
1	To provide an opportunity to student to do work independently on a topic/ problem experimentation selected by him/her and encourage him/her to think independently on his/her own to bring out the conclusion under the given circumstances and limitations.
2	To encourage creative thinking process by successfully completing the experiments/mini-project, through observations, discussions and decision making process.
3	To enable student for technical report writing and effective presentations.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Solve field problems by using different techniques in finite element method	III	Appling
CO2	Design and develop suitable mechanical systems using finite element method	VI	Creating
CO3	Prepare and present a detailed technical report based on experiment/mini-project work	V	Evaluating

Course Content

Creation of FEM models/ innovation of existing product/ analysis or simulation of a process/case studies experimental verification of principles in thrust areas of finite element method.

Text Books	
1	Suitable books based on the contents of the experiments/ mini project.

References	
1	Suitable books based on the contents of the experiments/ mini project and research papers from Reputed national and international journals and conferences.

Useful Links	
1	As per the need of the experiments/ mini project.

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			1		
CO2			3			
CO3					3	1

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

<table>
<tr><th colspan="5">Assessment</th></tr>
<tr><td colspan="5">There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.</td></tr>
<tr><th>Assessment</th><th>Based on</th><th>Conducted by</th><th>Typical Schedule (for 26-week Sem)</th><th>Marks</th></tr>
<tr><td>LA1</td><td>Lab activities, attendance, journal</td><td>Lab Course Faculty</td><td>During Week 1 to Week 6
Marks Submission at the end of Week 6</td><td>30</td></tr>
<tr><td>LA2</td><td>Lab activities, attendance, journal</td><td>Lab Course Faculty</td><td>During Week 7 to Week 12
Marks Submission at the end of Week 12</td><td>30</td></tr>
<tr><td>Lab ESE</td><td>Lab activities, attendance, journal</td><td>Lab Course Faculty</td><td>During Week 15 to Week 18
Marks Submission at the end of Week 18</td><td>40</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

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Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE545
Course Name	Seminar
Desired Requisites:	

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

Course Objectives	
1	To review and increase student's understanding of the specific topics.
2	To induce Learning management of values.
3	To teach how research papers are written and read such papers critically and efficiently and to summarize and review them to gain an understanding of a new field, in the absence of a textbook.
4	To teach how to judge the value of different contributions and identify promising new directions in specified area.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Apply the existing knowledge on real life problems	III	Applying
CO2	Investigate the selected topic/ system.	IV	Analysing
CO3	Verify the outcomes of the work have solved the specified problems.	V	Evaluating

List of Experiments / Lab Activities/Topics

Contents:

The seminar work should preferably be a problem with research potential, involve scientific research review, design, generation, collection, and analysis of data, determine a solution, and preferably bring out the individual contribution. The seminar should be based, preferably, on the area in which the candidate is interested to undertaking the dissertation work. The candidate has to be in regular contact with their guide, and the topic of the seminar must be mutually decided. The examination shall consist of the preparation of a report consisting of a literature review, a detailed problem statement, case studies, etc., according to the type of work carried out. The work has to be presented in front of the examiner panel formed by department for evaluation.

Textbooks	
1	Suitable books based on the contents of the seminar topic selected.

References	
1	Suitable books based on the contents of the seminar topic selected and research papers from reputed national and international journals and conferences.

Useful Links	
1	As per the need of the seminar topic.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1			
CO2	3				1	
CO3		3			2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE531
Course Name	Fracture Mechanics
Desired Requisites:	

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

Course Objectives

1	To describe the near field equations to determine the stress-strain and load-displacement fields around a crack tip for linear elastic cases.
2	To recognize and formulate the stress intensity factor ((K) for typical crack configurations.
3	To identify and formulate the strain energy release rate (G).

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Relate the basic concepts regarding solid materials	III	Applying
CO2	Check the procedures to carryout analysis of failure	V	Evaluating
CO3	Design of Failure analysis template	VI	Creating

Module	**Module Contents**	**Hours**
I	Introduction to Material Behavior, overview of dislocation theory and plastic deformation	6
II	Overview of Engineering Fracture Mechanics: Kinds of failures, Historical aspects, Fracture, Fatigue, Creep, Modes of fracture failure	7
III	Surface energy, Griffith's realization and analysis, Energy release rate, Energy release rate of DCB specimen, inelastic deformation at crack tip, Crack resistance stable and unstable crack growth, R curve, thin and thick plate, Critical energy release rate. Stress intensity factor, relation between GI and KI	7
IV	Anelastic deformation at the crack tip, modelling of Plastic Deformation, effective crack length, effect of plate thickness.	6
V	Elastic plastic analysis, J-integral, definition and engineering approach of J-integral, applications. Fracture Toughness Testing	7
VI	Crack tip opening displacement, relationship between CTOD, KI and GI for small scale yielding, Failure analysis- Spectacular Failures case studies.	6

Text Books

1	Prashant Kumar, "Elements of Fracture Mechanics", Tata McGraw Hill, New Delhi, India,2009.
2	K. Ramesh, e-Book on Engineering Fracture Mechanics, IIT Madras, 2007. URL: http://apm.iitm.ac.in/smlab/kramesh/book_4.htm
3	K. R.Y. Simha, "Fracture Mechanics for Modern Engineering Design", Universities Press (India) Limited, 2001.

References

1	D. Broek, "Elementary Engineering Fracture Mechanics", Kluwer Academic Publishers, Dordrecht, 1986.
2	T.L. Anderson,"Fracture Mechanics - Fundamentals and Applications", 3rd Edition, Taylor and Francis Group, 2005.

Useful Links	
1	https://www.youtube.com/watch?v=hnkFR5J_Ifw&list=PLfIFNJ1DPG4nwAQAY8aEi2-1JPwCRj9Gq
2	https://www.youtube.com/watch?v=9lwnE77utoo
3	https://www.youtube.com/watch?v=rKi6_ibjVPA
4	https://www.youtube.com/watch?v=eGwqCwgFBlw

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		1	3	2	1	2
CO2		2	1	3	2	
CO3	1	2	1		1	2

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

Assessment (for Theory Course)

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

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Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE532
Course Name	Tribology in Design
Desired Requisites:	

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

Course Objectives	
1	To create an awareness of the importance of tribology in design.
2	To describe the material selection for minimizing friction and wear in machinery.
3	To select bearing and bearing arrangement in machines

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.	IV	Applying
CO2	Select materials and lubricants to suggest a tribological solution to a particular situation.	V	Evaluating
CO3	Design a hydrodynamic bearing using various bearing charts.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Lubrication Theory** Introduction to Tribology, Tribology in design, Bearing materials - its properties, Bearing construction and Bearing Terminology, Tribology in industry, Lubrication – introduction, basic modes of lubrication, Lubricants properties, Lubricant classification, Lubricants standards, Types of additives	6
II	**Friction and Wear** Friction - Laws of friction, Friction classification, Causes of friction, Theories of dry friction, Friction measurement, Stick-Slip motion and friction instabilities. Wear - Wear classification, Wear between solids, Wear between solid and liquid, Factors affecting wear, Measurement of wear, Theories of Wear.	6
III	**Lubrication of Bearings** Theory of hydrodynamic lubrication, Mechanism of pressure development in oil film, Two dimensional Reynold's equation and its limitations, Designing of journal bearing by using Raimondi and Boyd method, Petroff's solution, Parameters of bearing design - Unit bearing pressure, Temperature rise, Length to diameter ratio, Radial clearance, Minimum oil-film thickness.	8
IV	**Hydrodynamic Thrust Bearing** Introduction, Types of hydrodynamic thrust bearing, Analysis of flat plate thrust bearing, Tilting pad thrust bearing and Rayleigh step bearing.	6
V	**Hydrostatic and Squeeze Film Lubrication** Hydrostatic Lubrication – Basic concept, Advantages and limitations, Viscous flow through rectangular slot, Load carrying capacity and flow requirement, Energy losses, Optimum design. Hydrostatic conical thrust bearing Squeeze Film Lubrication - Basic concept, Squeeze action between circular	7

	and rectangular plates.	
VI	**Applications of Tribology** Rolling contact bearing, gear teeth, Journal bearing, Gas (Air-) lubricated bearings, Case studies in tribology	6

Text Books	
1	Basu, Sengupta and Ahuja, "Fundamentals of Tribology", PHI Learning, First edition, 2011.
2	Sushil Kumar Srivatsava, "Tribology in Industry", S. Chand Publisher, Revised edition, 2001

References	
1	Majumdar B.C., "Introduction to Tribology of Bearings", S. Chand and Company Ltd., First Edition, 2010.
2	Bharat Bhushan, "Handbook of Tribology", Krieger Publishing Company, First Edition, 1997.
3	Mervin H. Jones and Douglas Scott, "Industrial Tribology - The Practical Aspects of Friction, Lubrication and Wear", Elsevier Scientific Publishing Company Amsterdam-Oxford-New York, 1991.
4	PrasannaSahoo, "Engineering Tribology", PHI Learning Pvt. Ltd., First Edition, 2011.

Useful Links	
1	https://nptel.ac.in/courses/112/102/112102015/
2	https://nptel.ac.in/courses/112/102/112102014/
3	https://nptel.ac.in/courses/112/106/112106137/
4	https://nptel.ac.in/courses/113/108/113108083/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		1			2
CO2			2			2
CO3	1	2	2			3

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

Assessment (for Theory Course)

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

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE533
Course Name	Experimental Stress Analysis
Desired Requisites:	Strength of material, Material Science

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

Course Objectives	
1	To make the student familiar with techniques of experimental stress analysis.
2	To study strain gauge bridge configurations and related instrumentation to take readings.
3	To use different polariscope arrangements along with auxiliary equipment required for photoelasticity.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	Course Outcome Statement/s	Bloom's Taxonomy Level	Bloom's Taxonomy Description
CO1	Analyze the photoelastic data by various methods.	III	Analysing
CO2	Determine the strains and stresses in photoelastic coating by using reflection polariscope.	V	Evaluating
CO3	Apply various methods and instrumentation for strain measurement.	III	Applying

Module	Module Contents	Hours
I	**Introduction to ESA:** Introduction to ESA, Advantages of ESA techniques, Necessity of various ESA methods, methodology of problem solving by ESA. Introduction of few concepts of Mechanics of materials	6
II	**Photo Elasticity:** Theory of Photo Elasticity, Optics related to photo elasticity- Ordinary light, Monochromatic light, polarized light, natural and artificial birefringence, Stress optic law in two dimensions atnormal incidence, material fringe value in terms of stress function, Effect of stressed model in plane polariscope–Isoclinics, Isochromatics, Criterion for selection of model materials, Properties of commonly employed photo elastic materials, Casting technique and machining of model, Conclusions pertaining to material	7
III	**Methods of Analysis:** Determination of direction of Principal stresses at given point, Determination of exact fringe order N and the principal stress difference (σ1- σ2) at the given point, Separation methods: Method based on Hook's Law, Electrical analogy method, Oblique incidence method, Shear difference method. Scaling model results to prototype.	7

IV	**Strain Measurement Using Strain Gauges:** Introduction, types, construction and material, Gauge factor, cross or transverse sensitivity, correction for transverse strain effect, semiconductor strain gauge. Selection and Mountings of Strain Gauges: Grid, backing, adhesive, mounting methods, checking gauge installation, Moisture proofing. Strain Gauge/Circuitry: Measurement of force or load, Measurement of torque	7
V	**Application of Strain Gauges:** Introduction, Analysis of strain gauge data by analytical and graphical methods, Analysis when principal stress directions are known, Analysis when principal stress directions are unknown, Delta rosette, Tee-rosette, Four element rectangular rosette, Rectangular rosette – Two and three element	6
VI	**Brittle Coating and Moir Method:** Brittle coating method - merits, demerits and applications, Moiré fringe method - merits, demerits and applications, Birefringent coating-principle and working of reflection polariscope.	6

Textbooks	
1	Dally J. W., Riley W. F. “Experimental Stress Analysis”, McGraw Hill, Third Edition 1991.
2	Dr.Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, Fourth Edition, 2015.

References	
1	Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B.,Ramachandra, K., “Experimental Stress Analysis”, Tata McGraw-Hill, New Delhi, 1984.
2	Abdul Muben, “Experimental Stress Analysis”, DhanpatRai& Co, First edition, 1987.
3	Window A. L., “Strain Gauge Techniques”, Springer Publications, Second edition, 1992.

Useful Links	
1	https://www.youtube.com/watch?v=Ujtv5NY4Sq8
2	https://www.youtube.com/watch?v=n5oP5CswTAY&list=PL16JJHgYPkvMyabXO3RVs0YoqwSdMo4YT&index=8
3	https://www.youtube.com/watch?v=ZTXYwdPznkA&list=PL16JJHgYPkvMyabXO3RVs0YoqwSdMo4YT&index=27
4	https://www.youtube.com/watch?v=OUSDiI8UOJA&list=PL16JJHgYPkvMyabXO3RVs0YoqwSdMo4YT&index=30

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		2			3
CO2	2		2			3
CO3	2		2			3

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

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2023-24	
Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE534
Course Name	Condition Monitoring of Machines
Desired Requisites:	

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

Course Objectives	
1	To make students aware of some methods and procedures applied for general Condition Monitoring.
2	To make students appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration-based condition monitoring, know the general stages of CM
3	To prepare students capable to apply some basic techniques for analysis of random and periodic signals
4	To prepare students aware of some basic instrumentation used for machinery and structural vibration-based monitoring

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Calculate the characteristic of problems related to vibrations	V	Evaluating
CO2	Apply knowledge for preventive maintenance	III	Applying
CO3	Investigate the data for troubleshooting vibration problems in the mechanical machines	IV	Analysing

Module	**Module Contents**	**Hours**
I	**Types of Maintenance** Types of maintenance, basic idea of health monitoring and condition monitoring of structures and machines. Critical speed of shafts, Some basic techniques.	6
II	**Signal Processing** Study of periodic and random signals, probability distribution, statistical properties, power spectral density functions of commonly found systems, spectral analysis	7
III	**Fourier Transform** Fourier transform: the basic idea of Fourier transform, interpretation and application to real signals, resonant frequencies, modes of vibration	6
IV	**Vibration Based Fault Diagnosis** Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments	7
V	**Applications of Condition Monitoring** Typical applications of condition monitoring using vibration analysis to rotating machines, unbalance, misalignment, faulty gears and bearings, vibration problem related to the foundation. Transmissions of vibration and its isolation	7
VI	**Other Health Monitoring Techniques** Other health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications	6

Text Books	
1	Adams M. L., Rotating Machinery Analysis - from Analysis to Troubleshooting, CRC Press, 2nd edition, 2009
2	Cornelius S., Paresh G., Practical Machinery Vibration Analysis and Predictive Maintenance, Newnes, 1st edition, 2004
3	Mohanty A. R., Machinery Condition Monitoring-Principles and Practices, CRC Press, 1st edition, 2015
References	
1	William J. H., Davis N., Drake P. R., Condition Based Maintenance and Machine Diagnostics, Springer Netherlands , 2nd edition, 1994
2	L.L. Faulkner, Handbook of Industrial Noise Control, Industrial press, 1st edition 1976
3	Rao S. S., Mechanical Vibrations, Pearson education, 5th edition, 2010
Useful Links	
1	https://www.youtube.com/watch?v=aKcDBg8c4hk
2	https://www.youtube.com/watch?v=6dFnpz_AEyA
3	https://nptel.ac.in/courses/112/105/112105232/
4	https://nptel.ac.in/courses/112/105/112105048/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			3		2	3
CO2	2					1
CO3				2	3	

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

Assessment

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7DE535
Course Name	Analysis and Synthesis of Mechanisms
Desired Requisites:	Kinematics and theory of machines

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

Course Objectives	
1	To provide students with a sound foundation in kinematic and synthesis of machines and mechanisms.
2	To train the students to apply complex number, matrices and algebra for analysis of mechanisms.
3	To prepare the students to use modern software for kinematic and dynamic analysis of the mechanisms

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Select, configure, and synthesize mechanical components into complete systems. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.	V	Evaluating
CO2	Formulate analytical equations describing the relative position, velocity and acceleration of all moving links.	VI	Creating
CO3	Analyze and animate the movement of planar and spherical four-bar linkages. Students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.	IV	Analysing

Module	**Module Contents**	**Hours**
I	Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.	7
II	Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.	7
III	Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider- crank mechanisms.	6

IV	Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.	7
V	Coupler Curves: Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry.	6
VI	Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms.	6

	Textbooks
1	R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
2	Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition.
3	Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery", John Wiley and sons New York.

	References
1	A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988. Prentice Hall India, 1988.
2	A.G. Erdman and G.N. Sandor, "Mechanism Design–Analysis and Synthesis", (Vol. 1 and 2)
3	A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India
4	J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill

	Useful Links
1	https://eg4.nic.in/govpoly/DFILES/EBOOKS/IR/ebookTOM_Mechanisms_and_Machines_83b6.pdf
2	https://s.goessner.net/articles/CubicOfStationaryCurvature.html
3	https://mech.iitm.ac.in/meiitm/wp-content/uploads/2016/08/Design-Stream-Course Contents.pdf
4	https://eg4.nic.in/govpoly/DFILES/EBOOKS/IR/ebookTOM_Mechanisms_and_Machines_83b6.pdf

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2	3		1
CO2	1			3		
CO3	1		1	3		

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

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*					
AY 2023-24					
Course Information					
Programme		M. Tech. (Mechanical Design Engineering)			
Class, Semester		First Year M. Tech., Sem II			
Course Code		7DE536			
Course Name		Reliability Engineering			
Desired Requisites:					
Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To prepare the students to compute reliability engineering parameters and estimates for applications in mechanical devices.
2	To provide knowledge of reliability and maintainability of machines and systems
3	To train the students to apply knowledge of probability for reliability analysis of machines and mechanisms.
4	To teach use reliability theory for product life calculation and for maintenance of machines and mechanical systems

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply various probability distributions theory for reliability analysis.	III	Applying
CO2	Evaluate reliability analysis of mixed and complex systems.	V	Evaluating
CO3	Design a machine element based on reliability theory.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Fundamental Concepts:** Introduction to reliability, History, Reliability terminologies, Failure, Failure density, Failure Rate, Hazard Rate, Mean Time To Failure, MTBF, Maintainability, Availability, PDF, CDF, Safety and reliability, Quality, Cost and system effectiveness, Life characteristic phases, Modes of failure, Areas of reliability, Quality and reliability assurance rules, Product liability, Importance of reliability.	6
II	**Probability and Reliability:** Basic probability concepts, Laws of probability, Introduction to independence, mutually exclusive, conditional probability, Discrete and continuous probability distributions, Comparison of probability distributions - Binomial, Normal, Lognormal, Poisson, Weibull, Exponential. Standard deviation, Variance, Mean, Mode and Central limit theorem.	7
III	**System Reliability and Modelling:** Series, Parallel, Mixed configuration, k- out of n structure, Complex systems-enumeration method, Conditional probability method, Cut set and tie set method, Redundancy, Element redundancy, Unit redundancy, Standby redundancy and its types, Parallel components, Single redundancy, Multiple redundancy.	7

IV	**Maintainability and Availability:** Objectives of maintenance, Types of maintenance, Maintainability, Factors affecting maintainability, System down time, Availability - inherent, achieved and operational availability. Introduction to Reliability Centered Maintenance	6
V	**Reliability in Design & Development**: Failure mode effects analysis, Severity/Criticality analysis, FMECA examples, RPN, Ishikawa diagram for failure representation, Fault tree construction, Basic symbols development of functional reliability Block diagram, Fault tree analysis, Fault tree evaluation techniques, Minimal cut set method, Delphi methods, Monte Carlo evaluation.	7
VI	**Reliability Testing:** Introduction to reliability testing, Stress strength interaction, Introduction to Markov model. Testing for Reliability and Durability- Accelerated Life Testing and Highly Accelerated Life Testing (HALT), Highly Accelerated Stress Screening (HASS).	6

Textbooks	
1	Balagurusmy E., "Reliability Engineering", Tata McGraw-Hill Publishing Co. Ltd., 1984.
2	Birolini Alessandro, "Reliability Engineering", Springer, Seventh Edition, 2013
3	Modarres M, Kaminskiy M, "Reliability Engineering and Risk Analysis-A Practical Guide", CRC Press, Second Edition, 2010.

References	
1	Ebiting Charles E., "Introduction to Reliability and Maintainability Engineering", Waveland Pr Inc., Second edition, 2009.
2	Kapoor K.C., Lamberson L.R., "Reliability in Engineering Design", John Wiley & Sons, First edition, 1977.
3	Rao S.S., "Reliability Based Design", Tata McGraw Hills, 1st edition, 1980.

Useful Links	
1	https://www.tce.edu/sites/default/files/PDF/Reliability-Engg.pdf
2	https://nptel.ac.in/courses/111/104/111104079/
3	https://nptel.ac.in/courses/112/105/112105232/
4	https://nptel.ac.in/content/storage2/courses/112101005/downloads/Module_5_Lecture_3_final.pdf

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		2			2
CO2	3		2			2
CO3	3		2			3

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

Assessment

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

Walchand College of Engineering, Sangli *(Government Aided Autonomous Institute)*	
AY 2023-24	
Course Information	
Programme	M. Tech. (Mechanical Design Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	7OE503
Course Name	OE: Industrial Product Design
Desired Requisites:	

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

Course Objectives	
1	To prepare the students to succeed as designer in industry /technical profession.
2	To provide students the knowledge of steps involved in design and developments of industrial Product.
3	To train the students to generate the idea for new product development based on the needs of Society.
4	To prepare the students to use knowledge of ergonomics , aesthetics for development of industrial Product.
5	To prepare the students to use knowledge of materials, economics, value analysis, standardization For development of industrial Product.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate an ability to recognize the need of society to design the products as per their requirements.	III	Applying
CO2	Recommend appropriate process to apply aesthetical concepts to product.	V	Evaluating
CO3	Design and develop the products by using standardization.	VI	Creating

Module	**Module Contents**	**Hours**
I	Approach to industrial product based on idea generation and innovations to meet the creative process involved in idea marketing, designers, mind-criticism, design process, creation needs of the developing society. Design and development process of industrial products, various steps such as Ergonomics and aesthetic requirements of product design, quality and maintainability consideration in product design, Use of modelling technique, prototype designs, conceptual design.	8
II	General design situations, setting specifications, requirements and ratings, their importance in the design, Study of market requirements and manufacturing aspects of industrial designs. Aspects of ergonomic design of machine tools, testing equipment's, instruments, automobiles, process equipment etc. Convention of style, from and colour of industrial design.	8
III	Design of Consumer Product, Functions and use standard and legal requirements, body dimensions. Ergonomic considerations, interpretation of information, conversions for style, forms, colours.	6
IV	Aesthetic Concepts Concept of unity and order with variety, concept of purpose, style and environment, Aesthetic expressions of symmetry, balance, contrast and continuity, proportion, rhythm, radiation. From and style of product: visual effect of line and from, mechanics of seeing', psychology of seeing, influence of line and form, Components of style, Basic factors, Effect	7

	of colour on product appearance, colour composition, conversion of colours of engineering products.	
V	Economic Considerations Selection of material, Design for production, use of standardization, value analysis and cost reduction, maintenance aspects in design.	5
VI	Design Organization Structure, Designer position, Drawing office procedure, Standardization, record keeping, legal procedure of Design patents.	5

Text Books	
1	W. H. Mayall, “Industrial Design for Engineers”, Illife, 1967.
2	Hearn Buck. “Problems of Product Design and Development”, Pergamon press, Jan 1, 1963.
3	Charles H. Flueriche, “Industrial Designs in Engineering”, Design council, 1983.
References	
1	Ezia Manzim “Material of Invention”, Cambridge Mass: MIT press, 1989.
2	Percy H. Hill “The Science of Engineering Design”, Holt McDougal, 1970
Useful Links	
1	https://www.youtube.com/watch?v=ANBqFUrUfOY
2	https://www.youtube.com/watch?v=0W_wGUf59UU
3	https://www.youtube.com/watch?v=HN9GtL21rb4&list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu
4	https://youtu.be/oUeK6ZsCo8I

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3					
CO2	3			1		
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 (for Theory Course)

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