Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2021-22

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Probability and Statistics
Desired Requisites:	

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

Course Objectives

1	To understand the importance of probability and statistical tools used in engineering.
2	To get the knowledge of various types of probability distributions.
3	To understand different hypothesis and types of errors.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Identify basic elements of probability and statistics	Apply
CO2	Employ use of different probability functions and distributions	Analyze
CO3	Use different statistical tools for hypothesis testing	Evaluate

Module	**Module Contents**	**Hours**
I	**Random Variable** Discrete random variable, Continuous random variable, probability mass function, cumulative distribution function, bivariate discrete random variable, joint probability distribution, joint distribution function of two dimensional discrete random variable	4
II	**Probability Distribution** Gaussian distribution, Exponential distribution, Uniform distribution	6
III	**Statistical Methods** Measure of Central tendency, Measure of dispersion, Range, Quartile deviation, Mean deviation, variance, Standard deviation, Coefficient of variance, moments, Symmetry, Skewness, Kurtosis, and Types of Kurtosis	5
IV	**Population and Sample** Introduction, Types of Characteristics: Attributes and variables, Collection and Organization of data, Population and sample, Methods of sampling	3
V	**Exact Sampling Distribution** Chi- square distribution: definition and its properties, Student t- distribution: definition and its properties	4
VI	**Test of Hypothesis** Random samples, parameter, statistic, standard error of statistic, null and alternative hypothesis, critical region, level of significance, Types of error, large sample test, Small sample test	7

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Understand meaning of different variables and probability functions.
2. Understand different types of probability distributions.
3. Use of different statistical methods.
4. Understand data collection methods, population sample.
5. Understand different sampling distribution methods.

6.	Understand different hypothesis and types of errors.
Text Books	
1	Gupta and Kapoor, "Fundamental ofMathematical Statistics"
2	Vijay Rohatgi ,"An Introduction to probability and statistics"
References	
1	S.Ross, "Probability and Statistics for Engineers and Scientists"
Useful Links	
1	https://www.youtube.com/watch?v=COI0BUmNHT8&list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE

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

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	8	20	**35**
4	Analyze	8	7	20	**35**
5	Evaluate	5	5	20	**30**
6	Create				
Total		**20**	**20**	**60**	**100**

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AY 2021-22

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Thermodynamics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 3**			

Course Objectives

1	To learn about work and heat interactions, and energy balance between system and its surroundings
2	To learn about application of I law to various energy conversion devices
3	To evaluate the changes in properties of substances in various processes
4	To understand the difference between high grade and low grade energies and II law limitations on energy conversion

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Write energy balance to systems and control volumes, in situations involving heat and work interactions	Apply
CO2	Evaluate changes in thermodynamic properties of substances	Analyze
CO3	Evaluate the performance of energy conversion devices and to differentiate between high grade and low grade energies.	Evaluate

Module	**Module Contents**	**Hours**
I	**Fundamentals and First law of Thermodynamics** Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E , Various modes of energy, Internal energy and Enthalpy	8
II	**Properties of Pure substances** Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables ; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	6
III	**First law for flow steady and unsteady processes** First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; numericals on of steady and unsteady	5

	flow processes,	
IV	**Second Law of Thermodynamics** Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	6
V	**Clausius inequality and Availability** Clausius inequality; Definition of entropy S ; entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, concept of Lost work.	7
VI	**Second law analysis for a control volume and Thermodynamic cycles** Second law analysis for a control volume. Exergy balance equation and Exergy analysis. Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	6

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Understand the fundamental terms with their significance in thermodynamics along with introduction to first law of thermodynamics.
2. Appreciate properties of pure substances through reading of charts and tables.
3. Apply first law of thermodynamics to various flow systems.
4. Interpret the need of second law of thermodynamics through studying limitations of first law of thermodynamics.
5. Understand the property entropy by its definition along with its evaluation for various processes.
6. 6. Apply the second law to control volumes and explain some basic thermodynamic cycles.

Text Books	
1	P. K. Nag "Thermodynamics", Tata McGraw Hill Publication, 3rd Edition, 2006
2	V. P. Vasandani and D. S. Kumar, "Heat Engineering", Metropolitan Book Company, 2nd Edition, 1975
3	R. Yadav, "Fundamentals of Thermodynamics", Central Publication house, Allahabad, Revised 7th Edition, 2011.

References	
1	Cengel and Boles, "Thermodynamics an Engineering Approach", Tata McGraw-Hill publication, Revised 7th Edition 2016
2	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J. "Fundamentals of Thermodynamics", John Wiley and Sons, 6th Edition, 2003.
3	Jones, J. B. and Duggan, R. E. "Engineering Thermodynamics", Prentice-Hall of India , 2nd Edition, 1996
4	Moran, M. J. and Shapiro, H. N. "Fundamentals of Engineering Thermodynamics", John Wiley and Sons. 3rd Edition 2003.

Useful Links	
1	https://nptel.ac.in/courses/112/105/112105123/

CO-PO Mapping

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

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

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

Assessment Plan based on Bloom's Taxonomy Level (Marks) For Theory Course					
Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	8	20	**35**
4	Analyze	8	7	20	**35**
5	Evaluate	5	5	20	**30**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Materials Engineering
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	4Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 4**			

Course Objectives

1	To make the students familiarize with properties of different metals and their microstructural and crystallographic relevance.
2	To describe solidification behavior of metals and its alloys and to predict their microstructure.
3	To explore different heat treatment processes, and powder metallurgy.
4	To make students to investigate various NDT methods.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Relate influence of imperfections in plastic deformation process, strengthening mechanism and show its effect over mechanical properties by conducting destructive and non-destructive tests.	Apply
CO2	Explain various phase transformations and classify various heat treatment processes.	Analyze
CO3	Apply knowledge of powder metallurgy process, special grade materials in engineering applications.	Evaluate

Module	**Module Contents**	**Hours**
I	Mechanical Behaviour of Metals, Introduction to Science of metals, Properties of metals, Crystal defects, Deformation of metals, Role of dislocations in deformation, Strengthening Mechanisms, Theory behind creep.	6
II	Testing of Materials, Mechanical testing of materials (Destructive and Non - Destructive testing methods), Introduction to Fracture, failure case studies	7
III	Phase Diagram and Phase Transformations, Objectives and classification, System, phases and structural constituent of phase diagram, Iron –Carbon equilibrium diagram, Coring and dendritic segregation, Gibb's phase rule, Lever rule, Solid solutions, Eutectic, Peritectic and eutectoid system, Equilibrium diagrams for non - ferrous alloys, Experimental methods of determining phase diagrams. **Phase transformations**: - Concept of solidification of metals, Solidification of pure metals, Nucleation, Growth, Growth of the new phase, Solidification of alloys, Nucleation, growth and overall transformation rates, TTT and CCT diagrams.	7
IV	Heat Treatment Processes, Definition, Purpose and classification of heat treatment processes for various types of steels, Bainite and Martensite formation, Concept of Hardenability, Introduction and applications of various case hardening and surface hardening treatments, Precipitation Hardening, Thermo mechanical treatments. Heat treatment defects.	6
V	Powder Metallurgy, Introduction, Manufacturing route for – Tool materials, bearings and bushes, electrical contacts, brake pads etc. , failure of powder metallurgy components –case studies, Economic, Environmental and Social Issues in Materials Science and Engineering.	7
VI	Application and properties of Stainless steel, Duplex stainless steels, Nickel alloys,	

	HSLA, Maraging stainless steels, Precipitation hardenable stainless steels, Martensitic stainless steels, Carbon steels for General purpose and pressure containing parts.	6

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Classify different metals according to their physical, chemical and mechanical properties.
2. Use NDT methods to supports and services to nearby industries.
3. Describe solidification behaviour of metals and their alloys and to predict its microstructure.
4. Evaluate metals and alloys in order to estimate physical and mechanical properties.
5. Describe powder metallurgical processes.
6. Design heat treatment cycle of ferrous and non ferrous metals and alloys.

Text Books	
1	V. Raghvan, "Solid State Phase Transformations", PHI Publication, 1st Edition, 1987, Reprinted 2004.
2	V. Raghvan, "Physical Metallurgy: Principles and Practice", PHI Publication, 3rd Edition, 2015.
3	William D. Callister, "Fundamentals of Materials Science and Engineering", Wiley India Pvt. Ltd, 9th Edition, 2014.

References	
1	Sidney H. Avener, "Physical Metallurgy", Tata McGraw Hill Education Private Limited, 2nd Edition, 2017
2	George E. Dieter, "Mechanical Metallurgy", Tata McGraw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013.
3	Ashok Sharma, Rajan, "Heat Treatment: Principles & Techniques", PHI Learning Pvt. Ltd-New Delhi, 2nd edition, 2011.

Useful Links	
1	https://www.youtube.com/watch?v=KMcsjCXfLQw&list=PLyAZSyX8Qy5Am_2StOOQ5vCUE3VIcAenE
2	https://www.youtube.com/watch?v=5nBBUahtzc&list=PLyAZSyX8Qy5C8ciqBBlypbx91j4nowUbL

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	7	8	20	**35**
4	Analyze	8	7	20	**35**
5	Evaluate	5	5	20	**30**
6	Create				

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem III
Course Code	
Course Name	Strength of Materials
Desired Requisites:	Basic Engineering Mechanics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	1 Hrs/week	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 4**			

Course Objectives

1	To make the students understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2	To enable the students to calculate the elastic deformation occurring in various simple geometries for different types of loading.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand the nature of internal stresses that will develop within the components.	Understanding
CO2	Calculate the stresses in various simple components due to different loadings.	Applying
CO3	Evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading.	Analyzing

Module	**Module Contents**	**Hours**
I	**Stresses and strain** Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains, thermal stresses. True stress and true strain	6
II	**Torsion and Shear force and bending moment diagram** Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.	7
III	**Stresses in beams** Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads, for various commonly used sections	7
IV	**Deflection of beams** Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems	7
V	**Principal Stress** Normal and shear stress on oblique planes, principal stresses and planes. Mohr Circle. Combined effect of bending and shear in beams. Theories of failure	6
VI	**Buckling of Columns** Euler's formula for different end connections, concept of equivalent length, eccentric loading, Rankine formula	6

Module wise Measurable Students Learning Outcomes :

student should be able to

1. Recognize basic concepts of stress, strain and their relations based on linear elasticity.
2. Calculate stresses and deformation of a torsional bar.
3. Develop shear and bending moment diagrams. Calculate bending and transverse shear stresses.
4. Analyze deflections of beam under combined loads
5. Apply concept of Mohr's circle to compute principal stresses and angles.
6. Predict stability and buckling for a slender member under an axial compressive force.

	Text Books
1	Beer and Johnson, Mechanics of Materials, McGraw Hill, 6th Edition , 2013
2	Hibbeler, R.C., Statics and Mechanics of Materials, Prentice-Hall, SI Edition , 2004
3	Ramamurthum, Strength of materials, DhanpatRai and Sons New Delhi, 3rd edition, 2009
	References
1	Den Hartog, Jacob P., Strength of Materials. Dover Publications Inc., 3rd Edidtion 1961
2	Timoshenko S., Strength of Materials,. Krieger Publishing Company, 3rd edition, 1976
3	Mott, Robert L., Applied Strength of Materials, Prentice-Hall, 4th edition, 2002
	Useful Links
1	https://nptel.ac.in/courses/112/107/112107146/
2	https://nptel.ac.in/courses/112/107/112107147/
3	https://www.coursera.org/learn/mechanics-1
4	https://ocw.mit.edu/courses/materials-science-and-engineering/3-11-mechanics-of-materials-fall-1999/

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	7	8	20	**35**
3	Apply	8	7	20	**35**
4	Analyze	5	5	20	**30**
5	Evaluate				
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem III
Course Code	
Course Name	Manufacturing Processes
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	4Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 4**			

Course Objectives

1	To motivate and challenge students to understand and develop the processes in correlation with material properties , which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.
2	To provide the students the knowledge of concepts mechanics of machining on various machine tools,rapid prototype- processing techniques.
3	To make the students to aware of fundamental principles of Unconventional Machining Processes

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Identify foundry operations,furnaces used in foundries,pattern materials, sand, casting and metal forming processes and their defects	Apply
CO2	Summarise joining ,additive manufacturing as well as other metal cutting processes and unconventional machining processes	Analyze
CO3	Select furnaces used in foundries,Weldingjoints,Rapid prototyping for patterns	Evaluate

Module	**Module Contents**	**Hours**
I	**Conventional Manufacturing processes** **Metal Casting** Casting and Moulding Methods, Metal casting processes and equipments, Heat transfer and solidification, shrinkage, riser design concepts, casting defects and residual stresses **Metal Forming** Introduction to bulk and sheet metal forming, plastic deformation and yield criteria,fundamentals of hot and cold working processes, load estimation for bulk forming (forging,rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending)	10
II	**Metal cutting** Single and multi-point cutting, Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating, Turning, Drilling, Milling and finishing processes, Introduction to CNC machining	10
III	**Joining/fastening and additive manufacturing processes** Physics of welding, brazing and soldering, design considerations in welding,Solid and liquid state joining processes, Adhesive bonding,	6
IV	**Unconventional Machining Processes** Introduction to Additive manufacturing: Rapid prototyping(3D Printing) and rapid tooling, Types of 3D printing, material used for 3D printing, Application	8
V	Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining,	

	Ultrasonic Machining, Principles and Process Parameters, comparison and application of these processes.	9
VI	Electrical Discharge Machining, Principle and processes parameters, MRR, surface finish,tool wear, dielectric, power and control circuits, wire EDM, Electro-chemical machining (ECM), etchant &maskant, process parameters. Laser Beam Machining (LBM),Plasma Arc Machining (PAM) and Electron Beam Machining (EBM)	9

Module wise Measurable Students Learning Outcomes :

Student should be able to

1. Understand the basic metal casting process.
2. Describe metal forming process and equipment/machines used.
3. Explain different metal cutting operations performed on various machine tools.
4. Identify joining processes and recognize their applications.
5. Explain basics of unconventional machining processes..
6. Classify the different conventional and unconventional manufacturing methods employed for making different products.

Text Books	
1	P.N.Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. I Tata McGraw-Hill, 4th edition, 2013, ISBN: 9781259062575
2	P.C.Sharma,"A Textbook of Production Technology(Manufacturing processes)",S. Chand & co.,8th revised edition 2014. ISBN:8121911141
3	P. L. Jain, "Principles of Foundry Technology", , Tata McGraw-Hill, New Delhi, 5th Edition,2009. ISBN: 0070151296, 9780070151291

References	
1	E. Paul DeGarmo, J.T. Black, Ronald A. Kosher, "Materials and Processes in Manufacturing", John Wiley and Sons Ltd, 9th revised edition, 2004.ISBN:,9780471656777
2	George E. Dieter, "Mechanical Metallurgy", Tata McGraw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013, ISBN : 9780070168930
3	Kalpakjian and Schmid, "Manufacturing processes for engineering materials", Pearson India Limited, 7th Edition-2008,ISBN: 9780132272711

Useful Links	
1	https://www.vlab.co.in/broad-area-mechanical-engineering
2	http://vlabs.iitb.ac.in/vlab/labsme.html

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				

3	Apply	7	8	20	**35**
4	Analyze	8	7	20	**35**
5	Evaluate	5	5	20	**30**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem III
Course Code	
Course Name	Thermodynamics Lab
Desired Requisites:	

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

Course Objectives

1	To impart the techniques to find physical properties of the oils, greases, and solid fuels used in steam generators.
2	To prepare the students for applying laws of thermodynamics to various thermodynamics devices.
3	To develop the skills of students for evaluating performance of thermodynamics systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Determine the properties of fluids used in various industrial systems such as Mechanical Power Production systems.	Apply
CO2	Calculate the calorific value of a given fuel by using Bomb calorimeter.	Analyze
CO3	Apply first law of thermodynamics to various cyclic systems.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

Fuel testing

1. Test on Grease dropping point apparatus.
2. Test on Redwood Viscometer.
3. Test on Aniline point apparatus.
4. Determination of flash and fire point of a lubricating oil.
5. A test on Bomb calorimeter.

Thermodynamics Laws application

1. Vapor compression tutor.
2. Air conditioning Tutor.
3. Mini steam power plant.
4. Cooling Tower.
5. Measurement of thermal conductivity of metal rod under steady state conditions.
6. Reciprocating compressor unit.
7. Internal combustion engine setup.

Text Books

1	P. K. Nag "Thermodynamics", Tata McGraw Hill Publication, 3rd Edition., 2012,
2	V. P. Vasandani and D. S. Kumar, "Heat Engineering", Metropolitan Book Company, 2nd Edition. 1975,
3	R. Yadav, "Fundamentals of Thermodynamics", Central Publication house, Allahabad, Revised 7th Edition,2011.

References

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

	Revised 7th Edition,2011,
2	R. Yadav, "Thermodynamics and heat engine", Central Publication house Allahabad, Revised 7th Edition. 2016
3	R. Yadav, "Steam and Gas Turbine", Central Publication house, Allahabad, Revised 7th edition,2010
Useful Links	
1	https://www.youtube.com/watch?v=g8LrAsL4oH0&list=PLRoYs08qHtE7HDTE3KerpAWPyqfQiEq8x
2	https://www.youtube.com/watch?v=h9LeZs0N8qQ

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem III
Course Code	
Course Name	Materials Engineering Laboratory
Desired Requisites:	

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

Course Objectives

1	To demonstrate destructive and non-destructive test methods.
2	To describe solidification behavior of metals and its alloys and to predict their microstructure, and phases
3	To demonstrate methodology for metallographic sample preparation

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Examine various destructive and non destructive testing methods	Apply
CO2	Estimate effect of phases present in the microstructure over physical properties of materials.	Analyze
CO3	Perform metallographic sample preparation process.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1. Tensile test as per ASTM/IS standards.
2. Hardness test
3. Charpy Impact test.
4. Demonstration tests- Ultrasonic testing, Magnetic particle test, Dye penetrant test, Spark Test, Spectro chemical analysis, Thickness measurement test, Electrical conductivity measurement test.
5. Determination of volume fraction of phases.
6. Determination of grain size of metals and alloys.
7. Determination of intergranular attack in austenitic stainless steels.
8. Determination of hardenability of a given steel component.
9. Metallography/Microstructural examination test on ferrous and non ferrous metals and alloys as per
10. Heat treatment of steels.
11. Creep test
12. Thermal analysis

Text Books

1	V. Raghvan, "Solid State Phase Transformations", PHI Publication, 1st Edition, 1987, Reprinted 2004,
2	V. Raghvan, "Physical Metallurgy: Principles and Practice", PHI Publication, 3rd Edition, 2015.
3	William D. Callister, "Fundamentals of Materials Science and Engineering", Wiley India Pvt. Ltd, 9th Edition, 2014.

References

1	Sidney H. Avener, "Physical Metallurgy", Tata McGraw Hill Education Private Limited, 2nd Edition, 2017

2	George E. Dieter, "Mechanical Metallurgy", Tata McGraw Hill Publication, Si Metric Edition, 3rd Revised edition, 2013.
3	Ashok Sharma, Rajan, "Heat Treatment: Principles & Techniques", PHI Learning Pvt. Ltd-New Delhi, 2nd edition, 2011.
Useful Links	
1	https://sm-nitk.vlabs.ac.in/#
2	https://www.youtube.com/watch?v=D8U4G5kcpcM

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	
Course Name	Workshop I
Desired Requisites:	

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

Course Objectives

1	To demonstrate different wood machining processes and operate the wood working lathe machine
2	To explain various types and properties of sand
3	To perform simple turning operation on centre lathe machine

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Discuss the wood working processes & explain these machines, tooling devices & equipements	Apply
CO2	Demonstrate the knowledge of various sand properties of moulding sands in making of sand moulds	Analyze
CO3	Operate metal turning lathe machine for straight turning process	Evaluate

List of Experiments / Lab Activities

List of Experiments:

1.Manufacturing Process Lab:

A. One Job of Pattern making [Location : Carpentry shop/Workshop-II] **[4 Hrs]**
B. Sand Testing Lab [Location: Workshop-II] **[10 Hrs]**

1. Preparation of sand for mould at d core making with demonstration of small components
2. Tensile, Compressive and shear strength of molding sand
3. Permeability test for molding sand
4. Moisture content test for molding sand
5. Hardness test (mould/core) [Green and Dry]
6. Sand grain Size analysis (Grain Fineness No. on Sieve Shake apparatus)

2. a) Simple turning job on Lathe machine [Location: Workshop-I] **[4Hrs]**
b) Demonstration on CNC turning machine **[2Hrs]**

3. Reports on industry visits (min.Two) to ferrous and non ferrous foundries.

Module wise Measurable Students Learning Outcomes
After the completion of the course the student should be able to

1. Operate wood working lathe
2. Perform sand testing Experiments and tabulate results.
3. Carrying out simple Turning operation & inspect the job

Text Books

1	P.N.Rao, "Manufacturing Technology- Foundry, Farming and fielding", Vol. I Tata McGraw-Hill, 4* edition, 2013, ISBN: 9781259062575

2	P.C.Sharma,“A Textbook ofProduction Technology(Manufacturing processes)”,S. Chand & co.,8* revised edition 2014. ISBN:8 I -219- 1 114-1
3	K. Hajra Choudhury, Nirjhar Roy S.K,“Elements of Workshop Technology” - Vol II[Machine Toolsj”, ktedia Promoters and Publishars Pvt. Ltd. Mumbai, i O h edition, 2010. ISBN: 9788185099156, 8185099154
References	
1	George E. Dieter, "Mechanical Metallurgy", McGraw Hill Book Company, Revised 3° Indian edition, ISBN : 9780070168930, 2013
2	W.A.J. Chapman, "Workshop Ttchnology", CBS Publishing & Distributors, Delhi. Sof./,5'h Edition, 200l,book code: 9788123904016
Useful Links	
1	https://www.vlab.co.in/ba-nptel-labs-mechanical-engineering
2	https://www.vlab.co.in/broad-area-mechanical-engineering

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Applied Mathematics for Mechanical Engineers
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 3**			

Course Objectives

1	To develop mathematical skills and enhance thinking power of students.
2	To introduce fundamental concepts of mathematics and their applications in engineering fields

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understanding mathematical concepts in engineering field	Apply
CO2	Use mathematical and computational methods to solve the problems in science and engineering field	Analyze

Module	Module Contents	Hours
I	**Fourier Series** Periodic functions, Dirichlet's conditions, Definition, Determination of Fourier coefficients(Euler's formulae), expansion of functions, even and odd functions, change of interval and functions having arbitrary period, half range Fourier sine and cosine series	7
II	**Partial Differential Equations** Four Standard forms of Partial differential equations and application to one dimensional Heat equation	6
III	**Matrices and its Application** Transpose Adjoint ,General properties, rank determinant, Jacobian ,Banded Matrix Transformation Matrices Rotation Translation, mirror scaling, concept of tensor.	7
IV	**Linear differential equation with constant coefficients** Definition, complete solution, the operator D, auxiliary equation , rules for finding the complementary function, inverse operator, rules for finding the particular integrals , homogeneous linear differential equations	6
V	**Vector Differential** Concept of vector field, directional derivatives, gradient of vector field, tangent line to the curve. Velocity, acceleration, divergent and curl of vector field, conservative vector field.	7
VI	**Vector Integral** Line integrals, Surface and volume integral, Greens theorem in plane, Gauss Divergence theorem, Stokes's Theorem.	6

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

Module 1:

Solve the problems of Fourier series , expansion of function in Fourier series.

Module 2:

Solve differential equations and Application to Heat equation

Module 3:

Solve examples in transformation of Matrices as translation, rotation, scaling etc

Module 4:

Solve examples in linear differential equation with constant coefficients.

Module 5:

Solve example and understand the problems of fluid mechanic by using vector calculus and the problems of conservation of mass.

Module 6:

Solve and understand the problems of surface integral , line integral

Volume integral , and understand concept of Greens theorem , Stokes ‘s theorem.

Text Books	
1	“Advanced Engineering Mathematics”, Erwin Kreyszig, Wiley Eastern Limited Publication, 1978, 1st Edition.
2	“A Text Book o[Applied Mathematics, Vol I and II”, P. N. and J. N. Wartikar, Vidyarthi Griha Prakashan, Pune, 2006.
3	"Higher Engineering Maths”, B.S. Grewal, Khanna Publication, 2005, 39th Edition
References	
1	“Advanced Engineering Mathematics ”, Wylie C.R., Tata McGraw Hill Publication, 1999, 8th Edition.
2	“Advanced Engineering Mathematics ”, H. K. Dass, S. Chand & Company Ltd., 1988, I " Edition
Useful Links	
1	https://www.youtube.com/watch?v=Na6N2DwdL_k&list=PLp6ek2hDcoNB3jiva0_CRJ-1wmTOo98E0
2	https://www.youtube.com/watch?v=W3HXK1Xe4nc&list=PLbPn3CUduj5TPQtrwfI70F1SW4LvPf90d

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

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

Assessment Plan based on Bloom’s Taxonomy Level (Marks) For Theory Course					
Bloom’s Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	30	**50**
4	Analyze	10	10	30	**50**
5	Evaluate				
6	Create				

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem IV
Course Code	
Course Name	Fluid Mechanics and Fluid Machines
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 3**			

Course Objectives

1	To learn about the application of mass and momentum conservation laws for fluid flows
2	To understand the importance of dimensional analysis
3	To obtain the velocity and pressure variations in various types of simple flows
4	To analyze the flow in water pumps and turbines.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Explain the basics of fluid properties, pressure measurement, fluid statics, kinematics, dynamics, and dimensional analysis.	Apply
CO2	Summaries the basic expressions and theory related to: fluid statics, kinematics, dynamics, dimensional analysis, boundary layer theory and its applications.	Analyze
CO3	Analyze roto dynamic machines for their performance.	Evaluate

Module	**Module Contents**	**Hours**
I	**Properties of Fluids** Fluid Properties: viscosity, vapour pressure, compressibility, surface tension, Mach number. Pressure at a point, variation in pressure, Pascal law, and Pressure measurement by using different manometers.	4
II	**Fluid Kinematics** Different approaches to study fluid mechanics, Reynolds transport Theorem, Flow visualization, types of flow, strain rate, stream line, streak line, path lines, stream tubes, continuity equation in Cartesian coordinates in three dimensional forms, velocity and acceleration of fluid particles. Velocity potential function and stream function.	7
III	**Momentum equation and Viscous Flows** Momentum equation, Nervier Stoke equation, Development of Euler's equation, Integration of Euler's equation i.e. Bernoulli's equation, Application of Bernoulli's equation, Steady and unsteady flow through orifice. Orifice placed in pipe, Venturimeter, flow over triangular and rectangular notches, pitot tube. **Viscous/Laminar flow:** Plane poissullie flow and coutte flow, Laminar flow through circular pipes, Loss of head due to friction in viscous flow, Power absorbed in viscous flow. **b) Turbulent flow**: Reynolds experiment, frictional losses in pipe flow, shear stress in turbulent flow, major and minor losses (Darcy's and Chezy's equation), HGL, TEL, Flow through siphon pipes, Branching pipes and equivalent pipe.	7
IV	**Dimensional analysis and Boundary layers** **a) Dimensional analysis:** Dimensionally homogeneous equations, Buckingham's π Theorem, calculation of dimensionless parameters. Similitude complete similarity, model scales **b) Introduction to boundary layer theory and analysis.**	7

V	**Rotodynamic machines** Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle	7
VI	**Classification and Performance of hydro turbines.** Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles –draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	7

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Explain fundamentals of fluid properties and pressure measurement.
2. Derive expressions of fluid statics and conditions of equilibrium of floating and submerged bodies,
3. Summarize characteristics of fluid motions and mass conservation equations.
4. Analyze various forces acting on fluid particles and momentum equations with different forms
5. Understand theory of rotodynamic machines.
6. Analyze rotodynamic machines for their performance.

Text Books

1	S K Som, Gautam Biswas, SumanChakraborty, "Introduction to Fluid Mechanics and Fluid Machines" Tata McGraw – Hill Publication. 3rd Edition 2012.
2	M. Potter, D.Wiggert "Fluid Mechanics" Schaum's Outline Series Mcgraw-Hill New York Second edition 2008.
3	R.K.Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd. New Delhi 9th edition, 2005.

References

1	Streeter, Wylie and Bedford, "Fluid Mechanics", Tata McGraw – Hill Publication. 9th Edition 2000.
2	Franke and White, "Fluid Mechanics", Tata Mcgraw-Hill New Delhi. 5th Edition 2003
3	CengelYunus A. And Cimbala John M. "Fluid Mechanics and Fundamental and applications", Tata Mcgraw-Hill New Delhi. 1st Edition 2006.

Useful Links

1	https://www.youtube.com/results?search_query=fluid+mechanics+nptel
2	https://www.youtube.com/watch?v=HGbbdXNcIQA&list=PLbMVogVj5nJQEgL1sHuY24d6omOqXInnt

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				
3	Apply	10	10	30	**50**
4	Analyze	5	5	20	**30**
5	Evaluate	5	5	10	**20**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Metal Forming
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 3**			

Course Objectives

1	To familiarize students with various Bulk and Sheet Metal forming processes
2	To introduce students with various machine tools and their peculiars used for Metal Forming
3	To train the students to identify main variables of Metal Forming processes and to judge their effect on as formed product
4	To instil deformation pattern, residual stresses and various defects encountered during Metal Forming

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Summarize the various metal forming processes, necessary machine tools and main process-variables	Apply
CO2	Illustrate the deformation patterns and benefits of metal forming processes	Analyze
CO3	Investigate the defects and residual stresses of metal forming processes	Analyze

Module	**Module Contents**	**Hours**
I	Classification of Metal Forming Processes, General Mechanics of Metal Forming, Ideal Work for Plastic Deformation and Deformation Efficiency, Friction in Metal Forming, Causes for Residual Stresses in Metal Forming, Basic Equations Methods of Solutions for Metal-Forming Analysis.	7
II	Major Forging Operations, Main variables, Deformation and Metal Flow, Benefits by Economic Aspects and Work piece properties, Die Design, Defects, Residual Stresses, Case studies	6
III	Geometrical relationships in rolling mill, Main Variables in rolling, Forward Slip, Backward Slip, Neutral Point, Raw material natural entry to deformation zone, Roll camber, Deformation and Metal Flow, Defects, Residual Stresses, Benefits, Ring Rolling and Thread Rolling, Case studies	7
IV	Classification of Extrusion Processes, Die Materials and Die Design, Main Variables, Ugine — Sejournet Process, Deformation and Metal Flow, Defects, Residual Stresses, Benefits, Case Studies	6
V	Wire and Rod Drawing Process, Tube Drawing Processes, Tube Sinking, Tube Drawing with stationary and moving Mandrel, Main Variables, Die Design, Defects, Residual Stresses in Wire, Rod and Tube Drawing, Drawing benefits over extrusion, Case studies.	7
VI	Classification of Sheet Metal Forming Processes, Formability Tests, Forming Methods, Shearing and Blanking, Bending and Springback, Stretch Forming and	6

	Stretch Wrap Forming, Spinning, Deep Drawing and Redrawing, Ironing and Sinking, Defects in formed parts, Brief description of Explosive Forming, Case studies	

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Summarize the Metal Forming Processes and know their general mechanics
2. Summarize various forging operations, main variables and benefits. Investigate deformation pattern, residual stresses, die design and defects.
3. Illustrate geometrical parameters of rolling mill, and main variables. Inspect deformation pattern and metal flow, residual stresses, benefits and defects
4. Discuss types of extrusion processes. Describe die design, main variables, deformation pattern, residual stresses, benefits and defects
5. Investigate Wire, Rod and Tube Drawing processes, main variables, deformation pattern, residual stresses, die design, benefits and defects
6. Investigate the Formability Test and its importance. Distinguish various sheet metal operations, and defects in sheet metal forming

Text Books	
1	George E. Dieter Jr., Mechanical Metallurgy', Mc-Graw H ill, Third Edition, 1989
2	Serope Kalpakjian, Steven R. Schmid, Manufacturing Engineering and Technology', Pearson (Prentice Hall), Fifth Edition, 2005
3	B. L. Juneja, 'Fundamentals of Metal Forming Processes', New Age International (P) Limited, Publishers, First Edition, 2007
References	
1	Schuler GmbH, Metal Forming Handbook', Springer, Fifth Edition, 1998
2	Heinz Tschaetsch, Metal Forming Practise, Processes, Machines, Tools', Springer, Seventh Edition, 2005
3	V. N. Danchenko, 'Metal Forming', Ministry of Education and Science of Ukraine, National Metallurgy Academy of Ukraine, First Edition, 2007
Useful Links	
1	https://youtu.be/HSn3G3r69QE
2	https://onlinecourses.nptel.ac.in/noc19_me52/preview

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand				
3	Apply	10	10	30	**50**
4	Analyze	5	5	20	**30**

5	Evaluate	5	5	10	**20**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Kinematics and Theory of Machines
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	-	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 3**			

Course Objectives

1	To make the students understand the kinematics and rigid- body dynamics of kinematically driven machine components
2	To make the students understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3	To enable the students to design linkage mechanisms and cam systems to generate specified output motion
4	To make the students understand the kinematics of gear trains

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Identify mechanism that should be used according to application and find degrees of freedom of different mechanisms.	Understand
CO2	Analyse various linkage mechanisms for optimal functioning	Analyze
CO3	Develop various linkage mechanism for different applications	Evaluate

Module	**Module Contents**	**Hours**
I	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	7
II	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity acceleration analysis, instantaneous centers, velocity and acceleration analysis using loop closure equations, Coincident points- Coriolis component of acceleration	8
III	Introduction to linkage synthesis three position graphical synthesis for motion and path generation kinematic analysis of simple mechanisms slider crank mechanism dynamics	7
IV	Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	7
V	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics	6
VI	Surface contacts- sliding and rolling friction- friction drives, belt and rope drives bearings and lubrication, friction clutches and brakes	5

	Module wise Measurable Students Learning Outcomes : **After the completion of the course the student should be able to:** 1. Identify the mechanism that should be used according to application and find degree of freedom of different mechanisms. 2. Analyze the given mechanism for its velocity and acceleration . 3. Synthesize slider crank mechanism and four bar mechanism for given input positions. 4. Understand basics of cams and develop cam profile. 5. Understand principle of gear drive. 6. Understand concept of friction and its applications.	

Text Books	
1	Ratan S.S, "Theory of Machines", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2	Sadhu Singh,"Theory of Machines", Pearson Education, 2nd Edition, 2009
3	H. G. Phakatkar,"Theory of Machines I", Nirali Publication, 5th Edition 2009.

References	
1	Thomas Bevan, "Theory of Machines", CBS Publishers, New Delhi, 1st Edition, 2010.
2	J. E. Shigley,"Theory of Machines and Mechanism", , McGraw Hill, New York. 4th Edition, 2011
3	G.S. Rao and R.V. Dukipatti, "Theory of Machines and Mechanism", New Age International Publications Ltd. New Delhi. 2011

Useful Links	
1	Kinematics of Mechanisms and Machines - YouTube
2	Module 1 Lecture 1 Kinematics Of Machines - YouTube
3	Lecture 01 | Introduction to Kinematics of Machines | KOM - YouTube

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				
2	Understand	5	5	15	**25**
3	Apply				
4	Analyze	10	10	20	**40**
5	Evaluate	5	5	25	**35**
6	Create				
Total		**20**	**20**	**60**	**100**

Walchand College of Engineering, Sangli

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B.Tech., Sem IV
Course Code	
Course Name	Instrumentation & Control
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**T1**	**T2**	**ESE**	**Total**
Tutorial	1Hrs/week	20	20	60	100
Practical	-	-			
Interaction	-	**Credits: 4**			

Course Objectives

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

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Select the suitable instrumentation systems for monitoring and control of Industrial processes.	Apply
CO2	Measure mechanical quantities using instruments, their accuracy & range, and use the techniques for controlling devices automatically.	Analyze
CO3	Analyze system and its mathematical model for standard input responses.	Evaluate

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

	error, Error coefficients, Steady state analysis of different type of systems using step, ramp and parabolic inputs.	7
VI	Introduction to concepts of stability, The Routh criteria for stability, Experimental determination of frequency response, Stability analysis using Root locus, Bode plot and Nyquist Plots, State space modeling, Process control systems, ON-OFF control, P-I-D Control.	7
	Module wise Measurable Students Learning Outcomes : **After the completion of the course the student should be able to:** 1. Explain the use and principles of measuring devices and error measurements. 2. Demonstrate the use of various working instruments of displacement, strain, velocity, vibration measurement. 3. Describe the working of various measuring instruments for pressure, flow and temperature. 4. Construct a simple mathematical model for physical systems. 5. Analyze control system under different time domain. 6. Identify the suitable techniques for analyzing the response time and stability of the control systems	

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

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

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

CO-PO Mapping

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

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

Assessment (for Theory Course)

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

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

Bloom's Taxonomy Level		T1	T2	ESE	Total
1	Remember				
2	Understand				
3	Apply	10	10	30	**50**
4	Analyze	5	5	20	**30**
5	Evaluate	5	5	10	**20**
6	Create				
Total		**20**	**20**	**60**	**100**

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Fluid Mechanics and Fluid Machines Lab
Desired Requisites:	

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

Course Objectives

1	To introduce the students about basic principles and laws through conducting experiments in laboratory.
2	To enable the students to analyze the fluid turbo machines.
3	To develop skills in the evaluation of fluid turbo machines.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand basic principles and laws and conduct the experiments for validation.	Apply
CO2	Investigate the performance parameters of fluid turbo machines.	Analyze
CO3	Interpret the performance of fluid turbo machines.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

STUDY and demonstration.

1. Study of similarity principles.

Experiments and Trials. (All are compulsory)

1. Experiment on impact of Jet.
2. Experiment on Prandtl type pitot type apparatus.
3. Verification of Bernoulli's Equation.
4. Calibration of Venturi meter and Orifice meter.
5. Determination of Minor losses in pipe fittings.
6. Determination of loss of friction in series of pipes.
7. Trial on Pelton Turbine.
8. Trial on Kaplan Turbine.
9. Trial on Francis Turbine.
10. Trial on Centrifugal Pump.
11. Trial on Multistage pump.
12. Trial on series and parallel pump.

In case of mini-projects, drawing, presentations etc, write the relevant details of the same.

Text Books

1	Modi and Seth," Fluid mechanics and hydraulic machines", Standard book house, third edition 2012
2	N.S. Govindrao, "Fluid flow machines", Tata Mc Hill, Second edition 1983.
3	Jagdish Lal, "Fluid and Turbo machines", New Age publisher, Second edition 1982.
4	S K Som, Gautam Biswas, Suman Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines" Tata McGraw – Hill Publication. 3rd Edition, 2012.

References	
1	P.L. Balleny, "Thermal Engg.", Khanna pub. New delhi, third edition, 2002.
2	Cohen and Rogers, "Gas turbines and Compressor", Pearson Ed, second edition, 1996.
3	3. R. Yadav, "Thermodynamics and Heat Engines – Vol-II",CPH Allahabad , third edition 1999.

Useful Links	
1	https://www.youtube.com/watch?v=HGQM913rI10&list=PLkUEX3IbW7lclZ9jK-thjumHM2-meHGjF
2	https://nptel.ac.in/courses/112/103/112103290/

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Metal Forming and Manufacturing Lab
Desired Requisites:	

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

Course Objectives

1	To Demonstrate different wood machining processes and operate the wood working lathe machine.
2	To Evaluate various types and properties of sand.
3	To Perform simple turning operation on centre lathe machine.
4	To Understanding of importance of I igs and Fixtures design in mass production.
5	To acquire the knowledge of press tools working and their desi aspects.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Defining the wood working as well as the handle the machine, tooling devices and equipment's	Apply
CO2	Apply the knowledge of various Sand properties of moulding sand	Analyze
CO3	Describe the working of Die-Punch set, Metal Strip layout, 3D Printing and Non-Conventional Processes	Evaluate

List of Experiments / Lab Activities

List of Experiments:

[1] Study and demonstration of **any one** of following experiments on Rolling **(02 Hrs)**
- 1a)Basic rolling process by using model or chart
- 1b)Analyze the various process parameters for different number of passes
- 1c)The rolling types and techniques for different materials

[2] Study and demonstration of **any one** of following experiments on Forging **(02 Hrs)**
- 2a)Basic process of Open die and closed die forging
- 2b)Analyze open or closed die forging process
- 2c)Demonstration on open or closed die forging by using models

[3] Study and analyze metal extrusion process **(02 Hrs)**

[4]Study of various types of Press Tools and design aspects of Sheet Metal Die Set [on drawing sheet] or design of strip layout for die punch assembly **(04 Hrs)**

[5]Learn the forming characteristics of sheet metal specimens with deep drawing operation **(02 Hrs)**

[6]Prepare sheet metal job like container [square],coke can [round] **(02 Hrs)**

[7] Study and Demonstration of 3D Printing process. **(02 Hrs)**

[8] Study and demonstration of various Non-Conventional Machining Processes. **(04 Hrs)**

Text Books

1	P.N.Rao, "Manufacturing Technology- Foundry, Forming and Welding", Vol. 1 Tata McGraw-Hill, 3rd edition, 2009.
2	P.C.Sharma,"A Textbook of Production Technology(Manufacturing processes) ",S. Chand & co,2006.
3	P.H.Ioshi,"Press Tools-Design and Construction" ,S.Chand & Company Ltd.,2010, ISBN:81-219-

	2938-5
References	
1	W.A.J. Chapman ,"Workshop Technology "— Vol I, II & III, CBS Publ.& Dist.N.Delhi
2	B.L.Juneja,"Fundamentals of Metal forming processes",New Age International (P) Ltd.,Publishers, First edition ,2007
3	HMT, "Production Technology", Tata McGraw-Hill Pub. Ltd.,N.Delhi
Useful Links	
1	http://msvs-dei.vlabs.ac.in/msvs-dei/ [http://vlabs.iitb.ac.in/vlab/labsme.html]
2	https://www.vlab.co.in/broad-area-mechanical-engineering

CO-PO Mapping

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

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.

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

Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

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

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Kinematics and Theory of Machines Lab
Desired Requisites:	

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

Course Objectives

1	To develop skills of generation of gear tooth and cam profiles.
2	To prepare the students to perform the analysis of gear drives and mechanisms.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Apply principles of kinematics to plot velocity and acceleration diagrams of mechanisms.	Apply
CO2	Investigate gear trains for various power transmission systems.	Analyze
CO3	Evaluate various types of gears and belt drives .	Evaluate

List of Experiments / Lab Activities

List of Experiments:

Term Work contains following:-

1. To plot displacement, velocity and acceleration curves for two types of cam follower systems.
2. To verify angular displacement ratio of shafts connected by Hooke's joint
3. To find out Coriolis component of acceleration.
4. To develop computer program for velocity and acceleration analysis of four bar chain and single slider crank mechanism.
5. To generate involute gear tooth profile.
6. To solve problems on epicyclic gear train by tabular method.
7. To determine moment of inertia by Bi-filler suspension, Tri-filler suspension or compound pendulum method.
8. To study different mechanisms and analyse them with respect to links, joints, Degrees of freedoms.
9. To analyse gear trains in lathe, drilling, milling machine etc
10. To study any one automobile gearbox.

In case of mini-projects, drawing, presentations etc, write the relevant details of the same.

Text Books

1	Ratan S.S, "Theory of Machines", Tata McGraw Hill, New Delhi, 3rd Edition, 2011.
2	V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill, 3rd Edition, 2011
3	Sadhu Singh,"Theory of Machines", Pearson Education, 2nd Edition, 2009

References

1	Thomas Bevan, "Theory of Machines", CBS Publishers, New Delhi, 1st Edition, 2010.
2	J. F. Shigley,"Mechanical Engineering Design", , McGraw Hill, New York. 4th Edition, 2011

Useful Links

1	Virtual Labs (vlabs.ac.in)

2	Kinematics and Dynamics of Mechanisms (iitkgp.ac.in)

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

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

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

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Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	
Course Name	Presentation and Report Writing
Desired Requisites:	

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

Course Objectives

1	To review and increase student's understanding of the specific topics.
2	To read, summarise and review research articles and gain an understanding of a new field, in the absence of text book
3	To judge the value of different contributions and identify promising new directions.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Review and increase their understanding of the specific topics	Apply
CO2	Read research papers critically and efficiently	Analyze
CO3	Summarize and review the topics in absence of textbooks.	Evaluate

List of Experiments / Lab Activities

List of Experiments:

Based on any recent subject student should choose the topic for report writing and presentation. (Subcomponents: Introduction, Literature review, modeling (if any), case study, applications, advantages, disadvantages, future scope and conclusions etc.)

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
1. Student will be able to learn about new technology areas from literature available in various engineering areas.

Text Books

1	As per topic chosen by student.

References

1	As per topic chosen by student.

Useful Links

1	As per the topic chosen by the student.

CO-PO Mapping

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

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

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule (for 26-week Sem)**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	40
Week 1 indicates starting week of a semester. The typical schedule of lab assessments is shown, considering a 26-week semester. The actual schedule shall be as per academic calendar. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.				

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