Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	7ME201
Course Name	Thermodynamics
Desired Requisites:	

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

Course Objectives

1	To learn about work and heat interactions, and balance of energy between system and its surroundings
2	To learn about application of law to various energy conversion devices
3	To evaluate the changes in properties of substances in various processes

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Recall knowledge of mathematics, science, and engineering for the needs in thermodynamics	II	Understanding
CO2	Write energy balance to systems and control volumes, in situations involving heat and work interactions	III	Applying
CO3	Evaluate changes in thermodynamic properties of substances	IV	Analyzing
CO4	Evaluate the performance of energy conversion devices and to differentiate between high grade and low grade energies.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**INTRODUCTION AND BASIC CONCEPTS:** Thermodynamics and Energy, Systems and Control Volumes ,Properties of a System, State and Equilibrium, Processes and Cycles, Temperature and the Zeroth Law of Thermodynamics, Pressure Measurement **ENERGY, ENERGY TRANSFER, AND GENERAL ENERGY ANALYSIS**: Forms of Energy, Energy Transfer by Heat and Work, The First Law of Thermodynamics, Energy Conversion Efficiencies, Energy and Environment	7

II	**PROPERTIES OF PURE SUBSTANCES:** Pure Substance, Phases of a Pure Substance, Phase-Change Processes of Pure Substances, Property Diagrams for Phase-Change Processes, Property Tables, The Ideal-Gas Equation of State, Compressibility Factor—A Measure of Deviation from Ideal-Gas Behavior, Other Equations of State	6
III	**ENERGY ANALYSIS OF CLOSED SYSTEMS:** Moving Boundary Work, Energy Balance for Closed Systems, Specific Heats, Internal Energy, Enthalpy, and Specific Heats of Ideal Gases, solids and liquids. **MASS AND ENERGY ANALYSIS OF CONTROL VOLUMES:** Conservation of Mass, Flow Work and the Energy of a Flowing Fluid, Energy Analysis of Steady and Unsteady Flow Systems, Steady-Flow Engineering Devices.	7
IV	**THE SECOND LAW OF THERMODYNAMICS:** Introduction, Thermal Energy Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Perpetual-Motion Machines, Reversible and Irreversible Processes, The Carnot Cycle, The Carnot Principles, Thermodynamic Temperature Scale, Carnot Heat Engine, Carnot Refrigerator and Heat Pump	7
V	**ENTROPY:** Entropy, Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams Involving Entropy, The T ds Relations, Entropy Change of Liquids, Solids and Ideal Gases. **EXERGY** Exergy: Work Potential of Energy, Reversible Work and Irreversibility, Second-Law Efficiency, Exergy Change of a System, Exergy Transfer by Heat, Work, and Mass, The Decrease of Exergy Principle and Exergy Destruction, Exergy Balance: Closed Systems and Control Volumes.	7
VI	**GAS POWER CYCLES** Basic Considerations in the Analysis of Power Cycles, An Overview of Reciprocating Engines, Otto Cycle, Diesel Cycle, Stirling and Ericsson Cycles, Brayton Cycle **VAPOR AND COMBINED POWER CYCLES** The Carnot Vapor Cycle, Rankine Cycle: the Ideal Cycle for Vapor Power Cycles, Deviation of Actual Vapor Power Cycles From Idealized Ones. **REFRIGERATION CYCLES** Refrigerators and Heat Pumps, The Reversed Carnot Cycle, he Ideal Vapor-Compression Refrigeration Cycle, Actual Vapor-Compression Refrigeration Cycle	5

Text Books

1	P. K. Nag “Thermodynamics”, Tata McGraw Hill Publication, 20017, 6th Edition
2	Cengel and Boles, “Thermodynamics an engineering Approach”, Tata McGraw-Hill publication, Revised 9th Edition.

References

1	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.

2	Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
Useful Links	
1	https://archive.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
CO1														
CO2														
CO3														
CO4														
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

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

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem. III
Course Code	7ME202
Course Name	Material Science and Metallurgy
Desired Requisites:	

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

Course Objectives

1	To make the students familiarize with properties of different metals and their microstructural and crystallographic relevance.
2	To describe the solidification behavior of metals and its alloys and to predict their microstructure.
3	To explore different heat treatment processes, and NDT techniques.
4	To understand the application of Machine Learning in establishing correlations between microstructure and material properties in Materials Engineering.

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
CO 1	Identify different metals according to their physical, chemical and mechanical properties.	1	Remembering
CO 2	Describe solidification behavior of metals and its alloys and to predict their microstructure.	2	Understanding
CO 3	Measure performance of metals and its alloys based on its physical and mechanical properties.	5	Evaluating
CO 4	Design heat treatment cycle of ferrous and non-ferrous metals and alloys.	6	Creating
CO 5	Demonstrate processes of various NDT methods.	3	Applying
CO 6	Apply machine learning algorithms to effectively correlate microstructural features with material properties, enhancing their ability to predict material performance based on microstructural data.	4	Analyze

Module	Module Contents	Hours
I	Mechanical Behavior 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

I I	Testing of Materials**,** Mechanical testing of materials (Destructive and Non - Destructive testing methods), Introduction to Fracture	7
I I I	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
I V	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	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
V I	Artificial Intelligence And Machine Learning In Materials Engineering, why AI/ML in Materials Engineering, Correlation between processing with materials structure, Machine Learning Approaches for Materials Design Statistical Tools, Machine Learning, Machine Learning Approaches for Materials Design: Microstructure property correlation, Materials Knowledge and Materials Data Science: AI/ML for materials characterization	7

References	
1	Sidney H. Avener, *Physical Metallurgy,* Tata McGraw Hill Education Private Limited, 2nd Edition, 1997
2	George E. Dieter, *Mechanical Metallurgy,* Tata Mc Graw Hill Publication, Si Metric Edition, 3 Revised edition, 1989.
3	Raymond Aurelius Higgins**,** *Engineering Metallurgy: Applied Physical Metallurgy,* Krieger publishing company, 5th Edition, 1983.

Useful Links	
1	https://nptel.ac.in/courses/113107078
2	

Textbooks	
1	V. Raghvan, *Materials Science and Engineering,* PHI Publication, 5th Edition, 2009.
2	V. Raghvan, *Physical Metallurgy,* PHI Publication, 2nd Edition, 2009.
3	William D. Callister, *Fundamentals of Materials Science and Engineering,* 5th Edition, Wiley India Pvt. Ltd, 2010

CO-PO Mapping

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

O2														
CO3			**2**											
CO4		**2**		**3**								**2**		
CO5						**3**		**2**	**1**			**2**		
CO6	**2**	**3**	**1**											
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

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

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AY 2024-25

Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	7ME203
Course Name	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	Recall and define key concepts such as stress, strain, Hooke's law, and different types of stresses
2	Understand the relationships between stress, strain, and material properties
3	Apply the principles of mechanics of materials to calculate stresses, strains, and deflections in beams, shafts, and columns under various loading conditions

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 mechanics of materials principles to analyze stress, strain, and deformation in structural elements	III	Applying
CO2	Analyze and design beams, shafts, and columns for various loading conditions	IV	Analyzing
CO3	Evaluate the behavior of materials under different stress states and select appropriate failure theories	V	Evaluating
CO4	Analyze and apply energy methods to solve problems in mechanics of materials	IV	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	7
II	**Torsion and Bending of Beams** Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends. Stress induced by pure bending of beam. Radius of curvature of beam in bending. Bending under moments about more than one axis	6
III	**Analysis of beam under bending:** Shear force and bending moment diagrams for beams under various loading and support conditions. Deflection of beam under different loading conditions (double integral method). Statically indeterminate beams.	8
IV	**Transformation of stress and strain** Normal and shear stress on oblique planes, principal stresses and planes. Mohr Circle. Combined effect of bending and shear in beams. Theories of failure. Plane stress and plane strain conditions.	6

V	**Buckling of Columns** Euler's formula for different end connections, concept of equivalent length, eccentric loading, Rankine formula	6
VI	**Energy Methods:** Strain energy, elastic strain energy in normal stress, bending, torsion and combined loading. Distortion strain energy principle	6

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	
2	

CO-PO Mapping

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

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

Assessment

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

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AY 2024-25

Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech. SEM-I
Course Code	7ME204
Course Name	Manufacturing Processes - I
Desired Requisites:	NA

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

Course Objectives

1	To understand classification of manufacturing processes and develop an interest in primary shaping processes
2	To explain the basic fundamentals in metal forming processes such as forging, rolling, extrusion, wire drawing, sheet metal working etc.
3	To gain an understanding and interpret the breadth and depth of the field of manufacturing processes (primary shaping processes).
4	To learn and apply the basic terminology associated with primary shaping processes.
5	To evaluate the number of passes / stages and forces required in forming processes.
6	To study the recent developments in metal forming processes.

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	To summarize and classify different manufacturing processes	II	Understanding
CO2	To sketch and articulate different primary shaping processes	III	Applying
CO3	To illustrate and conclude the selection of proper primary shaping process for a particular components	IV	Analysing
CO4	To investigate the effect of parameters on manufacturing processes	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Classification of Manufacturing Processes and Metal Casting** Classification of manufacturing processes, their advantages, applications, limitations etc. **Metal Casting – I:** Importance of casting, advantages, disadvantages and limitations of casting processes. Status of foundry industry at national and international level. Pattern materials, types of patterns, pattern allowances and colour codes used. Types of sand, their properties. Moulding and core making processes, Green sand Moulding, shell Moulding, CO2 Moulding. Components of gating system, functions and importance of runners and risers.	7
II	**Metal Casting – II:** Permanent mould casting processes such as Continuous casting, Gravity die casting, pressure die-casting, Centrifugal casting, Vacuum die casting, Squeeze casting. Lost foam casting investment casting. **Melting, pouring in Metal Casting:** Types of melting Furnaces-Cupola furnace, oil / gas fired furnaces, crucible furnaces, Electrical furnaces, Rotary furnaces. Furnace selection criteria, their applications. Cleaning-fettling of castings. Casting defects, their causes and remedies. Sustainable manufacturing approach.	6
III	**Metal Forming Processes:** Hot, cold and worm working. Recovery and Recrystallization. Formability	7

	and parameters affecting the yield strength of materials. Classification of various metal Forming processes, their special features with respect to other manufacturing processes. Friction and lubrication in Metal Forming processes. Stresses in Metal Forming process. **Forging:** Basic operations, types of forging, forging hammers/ presses, forging stages and force calculations, die design considerations, forging applications, Defects and remedies in forging process.	
IV	**Rolling** Classification of rolling processes, rolling mill types, condition for natural entry in rolling operation, number of passes in rolling, roll bite, elongation, reduction, rolling of sheets, plates, bars, sections and tubes, Ring Rolling and Thread Rolling operation,Case studies of products such as crank-shafts, different types of sections etc.Applications, defects and remedies in rolling process. **Extrusion:** Equipment and principles, types of extrusion, direct, indirect, impact, continuous, hydrostatic, tube extrusion, metal flow in extrusion, Die design considerations, factors affecting extrusion load, defects and remedies in extrusion.	7
V	**Drawing:** Types of Drawing, Rod/wire drawing, Die Design considerations, equipment and principles of process, Tube drawing, Seamless pipe manufacturing. defects and remedies in drawing. **Sheet Metal Forming Processes:** Introduction, press operations, types of dies, Nesting (strip layout) of sheet, Forces in blanking, Drawability of sheet metal, Deep drawing, Redrawing, Tractrix dies, Forming limit diagrams (FLD). Dieless forming of sheet metal.	6
VI	**Recent Developments in Foundry and Metal Forming:** Flaskless moulding in foundry, High energy rate forming processes such as Explosive forming, Electrohydraulic forming, Electromagnetic forming, Magnetic pulse forming. Metal forming in mashy state, forming by Laser beam / plasma arc etc. CAM and robot applications in foundries and forming industries.	6

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 Edition, 1999, ISBN: 978-8121901116
3	P. L. Jain, “Principles of Foundry Technology”, Tata McGraw-Hill, New Delhi, 5th Edition,2009, ISBN: 0070151296, 9780070151291
4	B. L. Juneja, “Fundamentals of Metal Forming Processes”, New Age International (P) Limited, 1st Edition, 2007
5	R. K. Rajput, “ A Textbook of Manufacturing Technology”, Laxmi Publications, 2016, ISBN:9788131802441

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	Schuler GmbH, “Metal Forming Handbook”, Springer, 5th Edition, 1998
3	Kalpakjian and Schmid, “Manufacturing processes for engineering materials”, Pearson India Limited, 7th Edition-2008,ISBN: 9780132272711
4	Heinz Tschaetsch, “Metal Forming Practise, Processes, Machines, Tools”, Springer, 7th Edition, 2005
5	V. N. Danchenko, “Metal Forming”, Ministry of Education and Science of Ukraine, National Metallurgy Academy of Ukraine, First Edition, 2007

Useful Links	
1	https://www.vlab.co.in/broad-area-mechanical-engineering

2	http://vlabs.iitb.ac.in/vlab/labsme.html
3	https://youtu.be/Tx1k2xYFWQU
4	https://youtu.be/Eceb02UhvyE
5	https://www.youtube.com/watch?v=zvc5OoYPL7M
6	https://youtu.be/2CIcvB72dmk
7	https://youtu.be/748_ME0p0Ag
8	https://www.youtube.com/watch?v=y6G2eiy6X04
9	https://onlinecourses.nptel.ac.in/noc21_me30/preview
10	https://youtu.be/o3kaIwbOq1E
11	https://www.youtube.com/watch?v=PB49vko0Il0
12	https://www.youtube.com/watch?v=yGKym19qxiM&t=16s
13	https://youtu.be/XNG3ewS39Lw
14	https://www.youtube.com/watch?v=Ic8Uc41IK1I

CO-PO Mapping

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

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

Assessment

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

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AY 2024-25

Course Information

Programme	B.Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	7ME251
Course Name	Thermodynamics Lab
Desired Requisites:	

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

Course Objectives

1	To learn about work and heat interactions, and balance of energy between system and its surroundings
2	To learn about application of law to various energy conversion devices
3	To evaluate the changes in properties of substances in various processes

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Describe the experimental procedure of experiments in thermodynamics lab	II	Understanding
CO2	Determine the properties of fluids used in various industrial systems such as Mechanical Power Production systems.	III	Applying
CO3	Calculate the calorific value of a given fuel by using Bomb calorimeter.	IV	Analyzing
CO4	Apply first law of thermodynamics to various cyclic systems.	V	Evaluating

List of Experiments / Lab Activities

List of Experiments:

Course Contents:

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

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, 20017, 6th Edition
2	Cengel and Boles, "Thermodynamics an engineering Approach", Tata McGraw-Hill publication, Revised 9th Edition.

References	
1	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2	Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

Useful Links	
1	https://archive.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
CO1														
CO2														
CO3														
CO4														

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

Assessment

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

Assessment	Based on	Conducted by	Typical Schedule (for 26-week Sem)	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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

typically 8-10 experiments and related activities if any.

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Course Information	
Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech., Sem. III
Course Code	7ME252
Course Name	Material Science and Metallurgy Laboratory
Desired Requisites:	

Teaching Scheme		Examination Scheme (Marks)			
Lab	2 Hr/week	**LA 1**	**L A2**	**Lab ESE**	**Total**
Tutorial	--	30	30	40	100
		Credits: 1			

Course Objectives	
1	Understand Fundamental Principles and Procedures of Material Testing
2	Develop Proficiency in Experimental Techniques and Instrumentation
3	Interpret Test Results and Analyze Material Properties
4	Apply Knowledge to Solve Materials Engineering 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
CO 1	To demonstrate proficiency in material testing techniques	3	Apply
CO 2	To analyze and interpret data from material tests	4	Analyze
CO 3	To apply experimental knowledge in solving materials engineering problems	3	Apply
CO 4	To develop critical thinking skills in evaluating material testing processes	5	Evaluate
CO 5	To communicate effectively about experimental procedures and findings	4	Communicate
CO 6	To understand and apply ASTM and other standards in material testing	2	Understand

	List of Experiments	

1. Tensile test of Steel,and non ferrous metals and alloys
2. Hardness test: Rockwell and Brinell
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 as per ASTM E 562.
6. Determination of grain size of metals and alloys as per ASTM E112 and IS 4748.
7. Determination of hardenability of a given steel component.
8. Metallography test on ferrous and nonferrous metals and alloys as per ASTM E407/ASM Handbook Vol.9.
9. Heat treatment of steels.
10. Correlation Analysis Between Processing Parameters and Materials Structure.
11. Machine Learning for Materials Characterization.

References	
1	Sidney H. Avener, *Physical Metallurgy,* Tata McGraw Hill Education Private Limited, 2nd Edition, 1997
2	George E. Dieter, *Mechanical Metallurgy,* Tata Mc Graw Hill Publication, Si Metric Edition, 3 Revised edition, 1989.
3	Raymond Aurelius Higgins**,** *Engineering Metallurgy: Applied Physical Metallurgy,* Krieger publishing company, 5th Edition, 1983.

Useful Links	
1	https://nptel.ac.in/courses/113107078
2	

Textbooks	
1	V. Raghvan, *Materials Science and Engineering,* PHI Publication, 5th Edition, 2009.
2	V. Raghvan, *Physical Metallurgy,* PHI Publication, 2nd Edition, 2009.
3	William D. Callister, *Fundamentals of Materials Science and Engineering,* 5th Edition, Wiley India Pvt. Ltd, 2010

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**											**2**	1	2
CO2	**2**					**3**							1	2
CO3			**2**											
CO4		**2**		**3**								**2**	1	2
CO5						**3**		**2**	**1**			**2**	1	2
CO6	**2**	**3**	**1**										1	2

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

A ssessment

There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. LA1, LA2 together is treated as In-Semester Evaluation.				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 5 Marks Submission at the end of Week 5	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 6 to Week 9 Marks Submission at the end of Week 9	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 10 to Week 12 Marks Submission at the end of Week 12	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	B. Tech. (Mechanical Engineering)
Class, Semester	Second Year B. Tech. SEM-I
Course Code	7VSME251
Course Name	Workshop Practice
Desired Requisites:	Manufacturing Processes-I

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

Course Objectives

1	To demonstrate different wood working processes, types of pattern, demonstration and hands on experience of pattern making
2	To explain various types and properties of molding sand
3	To classify and study different metal forming processes and process parameters
4	To acquire knowledge of number of passes and stages required in metal forming operations
5	To acquire the knowledge of press tools, strip layout, deep drawing and number of draws required.

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	Show the types of patterns, demonstrate and hands on experience of pattern making	II	Applying
CO2	Compare different types of metal forming Process	III	Analysing
CO3	Recommend the properties of sand, number of passes in rolling, die angle in wire drawing, number of draws and strip layout in sheet metal working	IV	Evaluating
CO4	Compose reports based on industrial visits	V	Creating

List of Experiments / Lab Activities/Topics

List of Experiments:

A. Demonstration of types of patterns and hands on experience of Pattern making [4 Hrs]

B. Sand Testing [8 Hrs]

1. Preparation of sand for mould and 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)

C. Metal forming (Any four) [10 Hrs]

1. Simulation of open, closed and precision die forging using forming simulation software.
2. Simulation of rolling process by using forming simulation software and evaluation of number of passes in rolling operation.
3. Simulation of metal extrusion process using forming simulation software.
4. Simulation of wire drawing process and evaluate optimum die angle for wire drawing using forming simulation software.
5. Simulation of various types of press tools and analysis of strip layout in sheet metal working using forming simulation software.
6. Simulation of deep drawing process and evaluate number of draw and force required for deep drawing using forming simulation software.
7. Casting Simulation for simulating end-to-end casting process, filling, solidification, heat stress and heat treatment simulation

D. Report on industry visits related to Foundry and metal forming industries.

Textbooks	
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:8 I -219- 1 114-1
3	R. K. Rajput, “ A Textbook of Manufacturing Technology”, Laxmi Publications, 2016, ISBN:9788131802441
4	B.L.Juneja,“ Fundamentals of Metal forming processes”, New Age International (P) Ltd., Publishers, 2018, 978-8122430899
5	R. K. Jain ,“Production technology”, Khanna Publishers, Delhi, 17th Edition,2001, ISBN: 9788174090997

References	
1	George E. Dieter, "Mechanical Metallurgy", McGraw Hill Book Company, Revised 3rd Indian edition, ISBN : 9780070168930, 2013
2	W.A.J. Chapman, "Workshop Technology", CBS Publishing & Distributors, New Delhi, Vol. I [ISBN13:9788123904016]2001, Vol. II [ISBN:9788123904115] 2007 and Vol. III [ISBN:9788123904122] 1995
3	P. H. Joshi,“Press Tools-Design and Construction”, S. Chand & Company Ltd.,2010, ISBN:81-219-2938-5

Useful Links	
1	https://www.vlab.co.in/ba-nptel-labs-mechanical-engineering
2	https://www.vlab.co.in/broad-area-mechanical-engineering
3	https://www.youtube.com/watch?v=gOms0cwsK3Y
4	https://www.youtube.com/channel/UC7MhW1yD_wun48LBtBojtzw
5	https://www.youtube.com/watch?v=yGKym19qxiM
6	https://www.youtube.com/watch?v=AiBnWJD0HIc
7	https://www.youtube.com/watch?v=wtj_GhWb_jQ
8	https://youtu.be/HSn3G3r69QE

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1			1	2									2	
CO2	2												2	
CO3	2			2										2
CO4			2			2							1	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.														

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	All WCE Programme
Class, Semester	SY BTech 1st & 2nd Sem
Course Code	7VE201
Course Name	Value Education
Desired Requisites:	Open mind and a willingness to learn

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

Course Objectives

1	Develop holistic personal and professional skills by enhancing communication, emotional intelligence, and resilience to foster positive relationships and sustainable living practices.
2	Promote ethical and sustainable leadership through the application of integrity, teamwork, and a growth mindset to navigate success and failure while mastering effective presentation and communication skills.
3	Empower lifelong learning and contribution by reflecting on personal values, engaging in critical thinking, and committing to continuous self-assessment and professional development for addressing global challenges.

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 Descriptor**
CO1	Learn effective communication, empathy, and relationship- building skills to foster positive interactions in personal and professional settings.	I	Remembering
CO2	Incorporate sustainable habits into daily life and build resilience through mindfulness and stress management to handle challenges and support environmental stewardship.	II	Understanding
CO3	Develop goal-setting and achievement strategies, manage success and failure, and deliver impactful presentations for overall personal and professional development.	III	Applying
CO4	Strengthen analytical skills and creative problem-solving techniques to make informed decisions and tackle complex issues in various contexts.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Interpersonal skills** Introduction to Relationships, Communication Skills, Emotional Intelligence, Conflict Resolution, Maintaining Healthy Relationships	5
II	**Sustainable Living** Introduction to Sustainability, Environmental Impact, Sustainable Practices, Community Involvement, Personal Action Plan	5
III	**Inner Peace and Resilience** Understanding Inner Peace, Mindfulness and Meditation, Stress Management, Building Resilience, Positive Mindset	5

IV	**The Art of Winning** Winning Mindset, Goal Setting, Perseverance and Adaptability, Teamwork and Leadership, Case Studies and Real-life Examples	5
V	**Success and Failure Management** Understanding Success and Failure, Learning from Failure, Growth Mindset, Balancing Success and Failure, Personal Development Plan	5
VI	**The Art of Presentation** Introduction to Presentations, Content Organization, Verbal and Non-Verbal Communication, Practice and Delivery, Feedback and Improvement	5

Textbooks	
1	Stephen R. Covey, *The 7 Habits of Highly Effective People*, Free Press, 25th Anniversary Edition, 2013.
2	Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ*, Bantam Books, 10th Anniversary Edition, 2005.
3	Carol S. Dweck, *Mindset: The New Psychology of Success*, Ballantine Books, Updated Edition, 2016.
4	William McDonough and Michael Braungart, *Cradle to Cradle: Remaking the Way We Make Things*, North Point Press, 1st Edition, 2002.
5	Garr Reynolds, *Presentation Zen: Simple Ideas on Presentation Design and Delivery*, New Riders, 2nd Edition, 2011.

References	
1	Covey, S. R. (1989). *The 7 Habits of Highly Effective People*. Simon & Schuster.
2	Rosenberg, M. B. (2015). *Nonviolent Communication: A Language of Life*. PuddleDancer Press.
3	Carnegie, D. (1998). *How to Win Friends and Influence People*. Simon & Schuster.
4	Covey, S. R. (1989). *The 7 Habits of Highly Effective People*. Simon & Schuster.
5	Rosenberg, M. B. (2015). *Nonviolent Communication: A Language of Life*. PuddleDancer Press.

Useful Links	
1	https://ideas.ted.com/how-to-build-closer-relationships/
2	https://www.nationalgeographic.com/environment/article/sustainable-living
3	https://www.lexisnexis.in/blogs/family-law-in-india/
4	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8937019/
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8710473/

CO-PO Mapping

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

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

Assessment

The assessment is based on LA1, LA2 and ESE.
LA1 shall be typically on modules 1 to 3.
LA2 shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be Tests, assignments, oral, seminar etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 30 - 40% weightage on modules 1 to 3 and 60 - 70% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (LA1+LA2+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	B.Tech. (Civil /Mech)
Class, Semester	S.Y.B.Tech Mechanical, SEM-I
Course Code	7EM201
Course Name	Understanding Incubation and Entrepreneurship
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	03Hrs/week	LA1	LA2	ESE	Total
Tutorial	-	30	30	40	100

Credits: 3 (Select any one evaluation pattern)

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	3 Hrs/week				

Course Objectives

1	To familiarize the entrepreneurial framework and the start-up projects which help students to navigate through their own entrepreneurial journey.
2	To develop an entrepreneurial mind-set thereby encouraging the journey of transformation to convert an idea or a solution into a business
3	

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 Descriptor**
CO1	Translate creative ideas into a sustainable business opportunity	II	Understand
CO2	Apply principles and practice of new entrepreneurial venture planning to assess a business idea	III	Apply
CO3	Differentiate among types of Business Models	IV	Analyze
CO4	Evaluate decision making towards establishing enterprises in real life situations	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction to Entrepreneurship** Hand holding for Entrepreneurship GDC start-up stories, The Entrepreneurial Mind-Set , Corporate Entrepreneurship , Generating and Exploiting New Entries	7
II	**Innovation and Entrepreneurship Types** Methodology for Innovation, Team Building, Problem Statement Presentation	6

III	**The Innovation Process** Innovation and Entrepreneurship, Solar Oven case-study Paradigm shift from Design to Entrepreneurship, Bio- Med Innovation and Entrepreneurship, Healthcare and Innovation, Human Centered Innovation, Success Stories	7
IV	**Introduction to Incubators** Business Model Canvas, Technology led Entrepreneurship, Introduction to SINE Incubator, Lean Model Canvas SINE, Start-up Stories:	7
V	**From Corporate to Entrepreneurship** Creativity and Generating Product Ideas, From Idea to Proof of Concept, Network Entrepreneurship	7
VI	**Case Study** Learning from examples Start-up PITCHES - Using Lean Canvas Model	6

Textbooks	
1	Disciplined Entrepreneurship: 24 Steps to a Successful Startup by Bill Aulet
2	The Essence of Medical Device Innovation by B Ravi
3	THE FORTUNE AT BOTTOM OF PYRAMID: Eradicating Poverty Through Profits by C.K.Prahalad Stay Hungry

References	
1	Stay Foolish by Rashmi Bansal
2	The Entrepreneurial Connection: East Meets West in the Silicon Valley by Gurmeet Naroola
3	Innovation By Design: Lessons from Post Box Design & Development by B. K. Chakravarthy , Janaki Krishnamoorthi
4	
5	

Useful Links	
1	

CO-PO Mapping

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

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

Assessment

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

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information	
Programme	B.Tech.
Class, Semester	Second Year (Civil Engineering and Mechanical Engineering), Sem III
Course Code	7MA202
Course Name	Applied Mathematics for Civil Engineering and Mechanical Engineering
Desired Requisites:	Engineering Mathematics I&II

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

Course Objectives

1	To impart 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,

CO	**Course Outcome Statements**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Descriptor**
CO1	**Use** Laplace Transform and Inverse Laplace Transform to solve linear differential equation.	II	Understanding
CO2	**Understand** Fourier series of periodic functions.	II	Understanding
CO3	**Apply** PDEs for solving Engineering problems.	III	Applying
CO4	**Apply** various discrete & continuous distributions to solve real life problems.	III	Applying
CO5	**Apply** basic concepts of Vector calculus to solve problems with conditions arising in engineering field.	III	Applying

Module	**Module Contents**	**Hours**
I	**Laplace Transform and Its Applications:** Definition, Transform of Standard functions, Properties, Transform of derivative and Integral, Inverse Laplace Transform, Convolution Theorem, Applications to solve linear differential equations.	**8**
II	**Fourier Series:** Periodic functions, Dirichlet's conditions, Definition, determination of Fourier coefficients (Euler Formulae), Expansion of functions, Even and odd functions, change of interval and functions having arbitrary period, Half range Fourier sine and cosine series.	**7**

III	**Partial Differential Equations and its application:** Standard forms of partial differential equations i) $f(p,q)=0$ ii) $f(p,q,z)=0$ iii) $f_1(x,p)=f_2(y,q)$ iv) Lagrange's Form application to one dimensional heat equation.	**6**
IV	**Probability Distribution:** Random Variable, Discrete random variable, Continuous random variable, Probability mass function, Probability density function, Poisson distribution, Normal distribution, Examples.	**5**
V	**Vector Differentiation:** Concept of vector field, directional derivatives, gradient of vector field, tangent line to the curve, velocity, acceleration, divergent and curl of vector field.	**6**
VI	**Vector Integral:** Line integrals, surface integral, Green's theorem in plane, Stoke's Theorem.	**7**

	Textbooks
1	*"A Text Book of Applied Mathematics",* P. N. and J. N. Wartikar, Vol I and II", Vidyarthi Griha Prakashan, Pune, 2006.
2	*"Higher Engineering Mathematics"*, B .S. Grewal, Khanna Publication, 44th Edition , 2017.
	References
1	*"An Introduction to probability and Statistics"*, V.K. Rohatgi , Wiley Publication, 2nd Edition, 2008.
2	"*Advanced Engineering Mathematics",* Wylie C.R, Tata McGraw Hill Publication, 8th Edition, 1999.
3	*"Higher Engineering Mathematics",* H. K. Dass , S. Chand & Company Ltd., 1st Edition 2014.
4	*"Higher Engineering Mathematics",* B. V. Ramana, McGraw Hill Publication, 2018.
5	*"Advanced Engineering Mathematics"*, Erwin Kreyszig, Wiley Eastern Limited Publication, 10th Edition, 2015.
	Useful Links
1	https://www.youtube.com/watch?v=Na6N2DwdL_k&list=PLp6ek2hDcoNB3jiva0_CRJ1wmTOo98E0
2	https://www.youtube.com/watch?v=W3HXK1Xe4nc
3	

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1													
CO2	2	1												
CO3	2	1												
CO4	1	1												
CO5	2	1												
The strength of mapping is to be written as 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO.														

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