Course Title	Applied Mathematics-III	**Semester**	III
Course Code	MM201	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	3:2:0	**Total**	100
Credits	4	**Exam. Duration**	3 Hours
Teaching Dept.	**Mathematics**		

Course objective is to:

- Use Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non periodic functions to periodic function using Fourier series.
- Analyze signals in terms of Fourier transforms.
- Find the association between attributes and the correlation between two variables.
- Acquaint the students with differential equations and their applications in engineering.
- Analyze engineering problems by applying Partial Differential Equations.

Module-1	**RBT Levels L1, L2, L3**	**10 Hours**

Fourier Series:

Introduction to infinite series, convergence and divergence. Periodic functions, Dirichlet's condition. Fourier series of periodic functions with period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Module-2	**RBT Levels L1, L2, L3**	**10 Hours**

Fourier Transform:

Introduction to Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Discrete Fourier transform (DFT), Fast Fourier transform (FFT).

Module-3	**RBT Levels L1, L2, L3**	**10 Hours**

Statistical Methods:

Correlation and Regression-Karl Pearson's coefficient of correlation and rank correlation. Regression analysis- lines of regression. Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$ *and* $y = ax^2 + bx + c$.

Module-4	**RBT Levels L1, L2, L3**	**10 Hours**

Numerical Solution of Second-Order ODEs:

Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, Hanging chain problem.

Module-5	**RBT Levels L1, L2, L3**	**10 Hours**

Numerical Solution of Partial Differential Equations

Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation.

Suggested Learning Resources: **Textbooks:**	
1	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2021.
2	R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
3	Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.
Reference Books:	
1	Glyn James & Phil Dyke – Advanced Modern Engineering Mathematics, Pearson Education,5th edition, 2018.
2	Srimanta Pal & Subobh C Bhunia - Engineering Mathematics, Oxford University Press, 3rd Reprint, 2016
3	Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines -4th edition-2012.
Web links and Video Lectures (e-Resources): M1: https://youtu.be/HoGNkZclxDU?si=29Bz9yAg2NUjbNaT M2: **https://youtu.be/n9XP6pljtw8?si=FF7QqRniWdipzIgU** M3: **https://youtu.be/Qy1YAKZDA7k?si=I952IsojPQkeIEPb** M4: https://youtu.be/loZXC_29nIY?si=_Bn8eEvaDir34f3i M5: **https://youtu.be/TMTMCZ3rXQQ?list=PLovLEjwi_wfB_Yp8fGnDfogSuBGb-PHlu**	
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning Quiz, Group Discussions, In class assignments	

Course outcomes: At the end of the course the students will be able to	
CO1	Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.
CO2	Use Fourier transforms to analyze problems involving continuous-time signals
CO3	Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data.
CO4	Understand that physical systems described by differential equations.
CO5	Demonstrate partial differential equations and their solutions for physical interpretations.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2								2
CO2	2	2		2								2
CO3	2	2		2								2
CO4	2	2		2								2
CO5	2	2		2								2

High-3, Medium-2, Low-1

Course Title	Computer Aided Machine Drawing	**Semester**	III
Course Code	ME202	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	2:2:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Equip students with the knowledge of machine drawing fundamentals and graphical representation techniques to effectively communicate engineering designs.
- Teach students how to create clear, precise, and self-explanatory technical drawings that are easily understood and executed on the shop floor.
- Familiarize students with ISO/BIS specifications, ensuring that their drawings meet global and national standards for accuracy and consistency.

Module-1	**RBT Levels L1, L2**	**10 Hours**

Systems of dimensioning: ISO and BIS Conventions in Machine Drawing. Dimensioning– Exercises on dimensioning practices with 2D.

3D Modelling and Orthographic Views: Conversion of Pictorial Views into 3D Models and converting 3D Models into Orthographic projections (Drafting) of simple machine parts with and without section, (ISO - Technical Drawings and Specifications) Hidden Lines. (3D CAD Software) **Sections of Solids:** Sections of pyramids, Prisms, cubes, Tetrahedron, cones and cylinders resting only on their bases. (No problems on axis inclinations, spheres and hollow solids). True shape of sections. (Manual Drawing)

Module-2	**RBT Levels L1, L2**	**10 Hours**

Threaded Fasteners: Thread Forms -ISO metric (internal & external). BSW, Square and acme threads. Bolts, Nuts & Screws: Hexagonal headed & square headed bolts with corresponding nuts. (Manual Drawing)

Temporary Fasteners: Cotter Joint and Knuckle joint.

Couplings: Muff coupling, Split muff coupling, Flange couplings (Solid and Protected types), Pin type flexible coupling, Universal coupling, Oldham coupling.

Module-3	**RBT Levels L1, L2, L3**	**20 Hours**

Assembly Drawings:

- Screw Jack.
- Plummer Block.
- Machine Vice.
- Connecting Rod.

Suggested Learning Resources:

Textbooks:

1	Computer Aided Machine Drawing K.R. Gopalakrishna, Subhash Publications, 2nd edition 2012.
Reference Books:	
1	Computer Aided Machine Drawing, Tryambaka Murthy.
2	Machine Drawing – N. Sidheshwar, P. Kannaiah, V.V.S. Sastry , McGraw Hill Edition 48th Reprint 2014.

Web links and Video Lectures (e-Resources):

- https://youtu.be/3j2YEuTiAOc?si=G5RdUVwTvMl-s5nv
- https://youtu.be/0RLw5EYRR7o?si=JMGKyjqIPShm2wBj
- https://youtu.be/Z29ssQf7G8I?si=WNuISksKwVjV7H68
- https://youtu.be/llRPW1q_n7A?si=ce5z1d2qUaAM4XeZ
- https://youtu.be/iXxeJOs70xc?si=aETuLvjXLV-ogQyh
- https://youtu.be/x-ewVXmRnLg?si=Vxd6EeWMPAzC3ver
- https://youtu.be/VpE5uY7iV18?si=uro2XiUoSIzq73bg
- https://youtu.be/TjAHuYZnPbE?si=vQGilnctZ6xiVqf6
- https://youtu.be/28YOW-Kh67k?si=VtSBg5fSp3o46KYH
- https://youtu.be/_h4gJm0i0iQ?si=SnHptY0m6-hmGl9n
- https://youtu.be/_h4gJm0i0iQ?si=SnHptY0m6-hmGl9n
- https://youtu.be/_h4gJm0i0iQ?si=SnHptY0m6-hmGl9n
- https://youtu.be/SQ9Gb-c4Bpw?si=_OGyQhZXrAjb_N6T
- https://youtu.be/2ombH9xTZM4?si=2vdRCWNUcfnQWFxl
- https://youtu.be/xLmF4lsqyls?si=LRCUG4rasC033JGI
- https://youtu.be/0fmtTlF6Zcw?si=Ot80WYa603i4GQou
- https://youtu.be/Ml3NylGrNJ8?si=lxyBCloSE-P31BaW

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Modeling and 3D printing simple mechanical component

Course outcomes:

CO1	Practice an Engineering drawing and convert it to orthographic/sectional views as per ISO/BIS standards.
CO2	Draw the orthographic views of threaded fasteners, joints and couplings by adopting ISO/BIS standards.
CO3	Design assembly parts by adopting ISO/BIS standards and communicate effectively among design/manufacturing/inspection personnel.

CO-PO Mapping															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		3		2		1			1		2	1	3	1
CO2	1		3		2		1			1		2	1	3	1
CO3	1		3		2		1			1		2	1	3	1

High-3, Medium-2, Low-1

Question Paper Pattern:

1. **CIE Assessment Pattern:**

SCHEME FOR INTERNAL ASSESSMENT (IA)		
	DETAILS	MAX. MARKS
Manual Sketching (20)	Sketch Book	15
	Draft Copies	05
	CIE	30
	TOTAL IA MARKS	**50**

2. **SEE Assessment Pattern:**

Scheme of Evaluation for Semester End Examination (SEE)						
Module	1		2		3	
Max. Marks	25		25		50	
Q. No.	Q1	Q2	Q3	Q4	Q5	Q6
NOTE: 1. SEE should be conducted for 100 Marks and Obtained Marks reduced to 50 Marks. 2. Two Full Questions to be set from each Unit with internal choice. 3. Each Full question shall cover all the topics of the module.						

Material Testing Lab			
Course Code	ME203	**CIE Marks**	50
L:T:P	**0:0:2**	**SEE Marks**	50
Hrs. / Week	2	**Total Marks**	100
Credits	1	**Exam Hours**	03

Course objectives: At the end of the course, the student will be able to:	
1.	To learn the concept of the preparation of samples to perform characterization such as Microstructure, volume fraction of phases and grain size.
2.	To understand mechanical behavior of various engineering materials by conducting standard tests.
3.	To learn material failure modes and the different loads causing failure.
4.	To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

Ex. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Knowledge about different mechanical properties of materials.	-	
PART-A			
1.	Specimen preparation for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys.	02	CO1
2.	To determine the hardness values of Mild Steel/ aluminum by Rockwell hardness testing machine.	02	CO2
3.	To determine the hardness values of aluminum/Brass by Brinell's hardness testing machine.	02	CO2
4.	To conduct a wear test on Mild steel/ Cast Iron/aluminum/ Copper specimen and to find the volumetric wear rate and coefficient of friction.	02	CO2
PART-B			
5.	To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Mild Steel specimen and to observe the necking.	04	CO3
6.	To determine the impact strength of the mild steel using Izod test and Charpy test.	02	CO3
7.	To determine compression strength of the given CI specimen.	02	CO3
8.	To determine shear strength of the given specimen.	02	CO3
9.	To perform bending test on wood specimen.	02	CO3

PART-C

Beyond Syllabus Virtual Lab Content

- **Failure of Materials**: Fracture- Type I, Type II and Type III

Suggested Learning Resources: **Textbooks/ Reference Books:**	
1	Callister Jr, W.D., Rethwisch, D.G., (2018), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley

Web links and Video Lectures (e-Resources):

Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/

Course outcomes: At the end of the course the student will be able to:	
CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
CO2	Understand the importance of phase diagrams and the phase transformations.
CO3	Explain various heat treatment methods for controlling the microstructure.
CO4	Correlate between material properties with component design and identify various kinds of Defects.
CO5	Apply the knowledge of testing methods in related areas.

CO-PO/PSO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	2	1											2		
CO3	2	2											1		
CO4	2	2											2	1	
CO5	2	2											2		

High-3, Medium-2, Low-1

Course Title	Mechanics of Materials	**Semester**	III
Course Code	ME204	**CIE**	50
Total No. of Contact Hours	50	**SEE**	50
No. of Contact Hours/week	3:2:0	**Total**	100
Credits	4	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical		

Course objective is to:

- Provide the basic concepts and principles simple stresses and compound stresses
- Give an ability to calculate stresses and deformations of objects under external loadings.
- Give an ability to apply the knowledge principal stresses and its planes in design problems

Module-1	**RBT Levels L1, L2, L3, L4**	**10 Hours**

Simple stress and strain: Introduction to stress, strain and its types. Hooke's law, Poisson's ratio, stress-strain curve for ductile and brittle materials, mechanical properties of materials, principle of superposition, extension/shortening of bars with continuously varying cross sections (circular and rectangular) and bars with cross sections varying in steps (Deformation of simple and compound bars). Generalized Hooke's Law, Elastic constants. Volumetric strain, Elastic constants and their relations, stress in composite sections subjected to external loading. Thermal stresses (Only qualitative approach)

Module-2	**RBT Levels L1, L2, L3, L4**	**10 Hours**

Bi-axial Stress system: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, graphical method - Mohr's circle for plane stress.

Theories of failure: Maximum Principal Stress Theory, Maximum Shear stress Theory.

Module-3	**RBT Levels L1, L2, L3, L4**	**10 Hours**

Bending moment and Shear forces in beams: Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads – Point of contra flexure.

Theory of simple bending – Assumptions – Derivation of bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T and Channel sections – Design of simple beam sections. (Shear stress distribution in beams to be self-studied it is not included in SEE)

Module-4	**RBT Levels L1, L2, L3, L4**	**10 Hours**

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circularshafts.
Theory of columns – Long column and short column - Euler′s formula **–** Rankine′s formula.

Module-5	RBT Levels L1, L2, L3, L4	10 Hours

Thick and Thin cylinders: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), numerical

Suggested Learning Resources:

Textbooks:

1	Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnstan, 7th Ed, TATA McGrawHill-2014
2	Mechanics of Materials, K.V. Rao, G.C. Raju, Subhash Stores, First Edition, 2007
3	Mechanics of Materials by RC Hibbeler, Pearson, 10th edition, 2017
4	Strength of Materials by R.K. Bansal, Laxmi Publications 2010

Reference Books:

1	Mechanics of Materials, R C Hibbler, 8th edition ,2010, Pearson
2	Mechanics of Materials Gere and Timoshenko, 2nd edition, CBS ,2004
3	Strength of Materials Debabrata Nag, 2nd edition, 2012, Wiley
4	Strength of Materials, R S Khurmi, S Chand and Company

Web links and Video Lectures (e-Resources):

https://www.youtube.com/playlist?list=PLEYqyyrm-hQ3wtF34smyJSAOqUJqnf1ch
https://ocw.mit.edu/courses/2-001-mechanics-materials-i-fall-2006/
https://onlinecourses.nptel.ac.in/
https://www.youtube.com/watch?v=20D6wZbH98E&list=PLrqDfxcafc21wlI3E56IkDmRJ-33apMjv&index=18
https://www.youtube.com/watch?v=eKFXUoG4tTg
https://www.youtube.com/watch?v=SPB2El_F7QQ

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Use Mdsolids (https://web.mst.edu/mdsolids/) or any open-source software for active teaching and learning.
- Use python to solve problems

Course outcomes:

CO1	Apply the concepts of engineering mechanics, hook's law to find stress and strain in prismatic and compound bars.
CO2	Appy knowledge of principal stresses and planes to predict structural failure
CO3	Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO4	Apply basic equation of simple torsion in designing of circular shafts & Columns
CO5	Ability to analyze and design thick and thin cylindrical structures

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			3					3			3	2	
CO2	3	2			3					3			3	2	
CO3	3	2			3					3			3	2	
CO4	3	2			3					3			3	2	
CO5	3	2			3					3			3	2	

High-3, Medium-2, Low-1

Workshop Practice Lab			
Course Code	**ME205**	**CIE Marks**	**50**
L:T:P	**0:0:2**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course objectives : At the end of the course, the student will be able to:	
1.	To impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
2.	Educate students of Safe handling of machines and tools.
3.	To handle tools and instruments and use them to prepare joints of specific shape and size

Pgm. No.	**List of Experiments / Programs**	**Hours**	**COs**
	Prerequisite Experiments / Programs / Demo		
	• Use of drawing tools for measurement and development of models. • Use of color indication in the shop floor and safety precaution to be followed.	-	CO1, CO2, CO3 and CO4
	PART-A		
1	Study on use of Hand Tools: V-block, Marking Gauge, Files, Hack Saw, Drills, Taps. Minimum 3 models involving Square joint, Triangular joint and Semicircular joint.	06	CO1
2	Welding: Study of electric arc welding tools & equipment, Models: Butt Joint, Lap Joint, T joint & L-joint.	04	CO2
	PART-B		
3	Sheet Metal & Soldering Work: Development & Soldering of the models: Frustum of cone, Prism(Hexagon & Pentagon),Truncated Square Pyramid.	06	CO3
4	Preparation of drilled hole in work piece by using drilling machine and created threaded hole using tapping tool.	04	CO4
	PART-C **Beyond Syllabus Virtual Lab Content** • Demonstration of Power haw saw machine tools, Grinding machine tool and milling machine tool.		

Suggested Learning Resources:

Text Books

1.	Elements of Workshop Technology:Vol I:Manufacturing Processes, S K Hajra. Choudhury, A K. Hajra Choudhury,15th Edition Reprinted 2013,Media Promoters &Publishers Pvt Ltd., Mumbai.
2.	The Elements of Workshop Technology - Vol I & II, S.K. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, 11th edition 2001 others, Media Promoters and Publishers, Mumbai.

Reference Books

1.	Mechanical workshop practice, K.C. John, PHI.
2.	Comprehensive Workshop Technology (Manufacturing Processes), S.K. Garg, Laxmi publications

Web links and Video Lectures (e-Resources):

http://www.youtube.com/watch?v=TeBX6cKKHWY

http://www.youtube.com/watch?v=QHF0sNHnttw&feature=related

https://www.youtube.com/watch?v=NV4hh4bJxb4

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Prepare student reports as asked in experiments.
- Visit nearer fabricator. Collect the information on welding electrodes, transformers and accessories being used by them.
- Down load movies showing correct practices for fitting, sheet metal and welding.

Course outcomes:	
CO1	Demonstrate and produce different types of fitting models using hand tools.
CO2	Perform different welded joint model using electric arc welding equipment.
CO3	Gain knowledge of development of sheet metal models with an understanding of their applications.
CO4	Able to know how to perform drilled hole on solid material and create threaded hole.

CO-PO Mapping

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1				3			2	3		2
CO2	3	2			1				3			2	3		2
CO3	3	2	3		1				3			2	3		2
CO4	3	2			1				3			2	3		2

High-3, Medium-2, Low-1

Course Title	Foundry Forming and Joining Process	**Semester**	III
Course Code	ME206	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	2:0:2	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering Department		

Course objective is to:

- To provide knowledge of various casting process in manufacturing.
- To acquaint with the basic knowledge on fundamentals of metal forming processes and also to study various metal forming processes.
- To impart knowledge of various joining process used in manufacturing.
- To impart knowledge about behaviour of materials during welding, and the effect of process parameters in welding.

Module-1	**RBT Levels L1, L2**	**08 Hours**

Introduction & basic materials used in foundry: Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved – (Brief Introduction)- Not for SEE

Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance. Sand moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds.

Molding machines- Jolt type, squeeze type and Sand slinger. Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould.

Cores: Definition, need, types. Method of making cores,

Module-2	**RBT Levels L1, L2**	**08 Hours**

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace.

Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixo-casting, and continuous casting processes. Casting defects, their causes and remedies.

Module-3	**RBT Levels L1, L2**	**08 Hours**

Introduction to metal forming processes: classification of metal forming processes. Hot working & cold working of metals.
Forging: Smith forging, drop forging & press forging. Forging Equipment, Defects in forging.
Rolling: Rolling process, Angle of bite, Types of rolling mills, Variables of rolling process, Rolling defects.
Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process. Difference between drawing & extrusion. Various types of extrusion processes.

Module-4	RBT Levels L1, L2	08 Hours
Sheet Metal Operations: Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in drawing, Trimming, and Shearing. **Bending:** types of bending dies, Bending force calculation, Embossing and coining. **Types of dies:** Progressive, compound and combination dies.		
Module-5	**RBT Levels L1, L2**	**08 Hours**
Joining Processes: Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding. **Weldability and thermal aspects:** Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures); Welding defects and remedies.		

Practice Experiments:

1. Preparation of sand specimens and conduction of Compression test on Universal Sand Testing Machine.
2. Preparation of sand specimens and conduction of Shear test on Universal Sand Testing Machine.
3. Preparation of sand specimens and Tensile tests on Universal Sand Testing Machine.
4. To determine permeability number of green sand, core sand and raw sand.
5. Studying the effect of the clay and moisture content on sand mould properties.
6. Forging Operations: Use of forging tools and other forging equipment. Preparing minimum three forged models involving upsetting, drawing and bending operations.
7. Use of Arc welding tools and welding equipment Preparation of welded joints using Arc Welding equipment

Demo experiments for CIE

1. Demonstration of forging model using Power Hammer.
2. To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing.
3. Mould preparation of varieties of patterns, including demonstration.

Open ended experiments leading to guided projects:

Make a group of suitable size of students batch and assign a mini project.

Suggested Learning Resources:

Textbooks:

1	Manufacturing Technology Vol I & II, P.N.Rao Tata McGraw Hill Pub. Co. Ltd., New Delhi 1998.
2	A textbook of Production Technology Vol I and II Sharma, P.C., S. Chand & Company Ltd., New Delhi 1996
3	Manufacturing Science Amithab Gosh &A.K.Malik East-West press 2001
Reference Books:	
1	Workshop Technology Vol. I and II Chapman W. A. J. Arnold Publisher New Delhi 1998
2	Elements of Manufacturing Technology Vol II, Hajra Choudhary, S. K. and Hajra Choudhary, A. K. Media Publishers, Bombay 1988
3	Manufacturing Engineering and Technology Kalpakjian Addision Wesley Congmen Pvt. Ltd. 2000

Web links and Video Lectures (e-Resources):

- https://youtu.be/h2RiLz1-v4Q?si=ZmY3zhouo3sSlj17
- https://youtu.be/86XbAJl8Fm8?si=QSOpz31lgpCiBXaA
- https://youtu.be/LYSNER4Dnjs?si=PfaLfuZeJ8ol7mC8
- https://youtu.be/QvGI0Lzx6O4?si=Z8bx5ktuwkmciEfz
- https://youtu.be/aLFhOAbk_cI?si=s9BSg5Qd0FBKvnMK
- https://youtu.be/OWThL97tq3k?si=hqHXkrQTpeAcO2wl
- https://youtu.be/gc9fBVq9NlE?si=TnBcvGyZNhA5vtQK

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Carryout Industrial visit to understand how the manufacturing process will be done.

Course outcomes:	
CO1	Describe the casting process and prepare different types of cast products. Acquire knowledge on Pattern, Core, Gating, Riser system and to use Jolt, Squeeze, and Sand Slinger Moulding machines.
CO2	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces. Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.
CO3	Understand the concepts of different metal forming processes.
CO4	Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components
CO5	Describe the methods of different joining processes and thermal effects in joining process

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		3				1					1	2	1	3
CO2	1		3				1					1	2	1	3
CO3	1		3				1					1	2	1	3
CO4	1		3				1					1	2	1	3
CO5	1		3				1					1	2	1	3

High-3, Medium-2, Low-1

Course Title	Material Science and Metallurgy	**Semester**	III
Course Code	ME221	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	03	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Explain the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids.
- Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
- Identify the heat treatment, cooling method for controlling the microstructure and plastic deformation to modify their properties.
- Explain the powder metallurgy process, types and surface modifications.
- Selections of different composite materials for various applications.

Module-1	**RBT Levels L1, L2, L3**	**08 Hours**

Structure of Materials

Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding: Ionic Bonding and Metallic bonding.

Crystal Structure: Crystal Lattice, Unit Cell, Planar Atomic Density, Coordination number, atomic Packing Factor of BCC, FCC and HCP structure.

Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, plastic deformation by Slip and Twinning.

Module-2	**RBT Levels L1, L2, L3**	**08 Hours**

Physical Metallurgy

Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules.

Diffusion: Diffusion Mechanisms: Vacancy Diffusion and Interstitial Diffusion, Factors affecting diffusion.

Phase Diagrams: Gibbs Phase, Binary phase diagram, Invariant Binary Reactions: Eutectic reaction, Eutectoid reaction and Peritectic reaction, Lever Rule, steel, Iron-Carbon phase diagram. Numerical on Lever rule.

Module-3	RBT Levels L1, L2, L3	08 Hours
Nucleation and growth: Solidification, melting of pure metals, solidification of pure metals**,** mechanism of solidification, Nucleation, undercooling of pure metals, homogeneous and heterogeneous nucleation, significance of critical radius for nucleation. **Heat treatment of metals:** Annealing, normalizing, hardening, tempering, Induction Hardening and Flame Hardening, TTT diagram for plain carbon steel, applications.		
Module-4	**RBT Levels L1, L2, L3**	**08 Hours**
Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical methods: Ball Milling, Physical method: Atomization, Chemical method: Chemical reduction method. **Characterization of powders (Particle Size & Shape Distribution), Powder Shaping:** Particle Packing Modifications, Lubricants & Binders, Powder Compaction, Sintering and Application of Powder Metallurgy.		
Module-5	**RBT Levels L1, L2, L3**	**08 Hours**
Composite Materials: Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, laminated composites, Fundamentals methods of production of PMC by using open and closed mould process, hybrid composites. Applications of composite materials.		

Suggested Learning Resources:

Textbooks:

1.	Callister Jr, W.D., Rethwisch, D.G., (2018), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley.
2.	Ashby, M.F. (2010), Materials Selection in Mechanical Design, 4th Edition, Butterworth-Heinemann.
3.	Azaroff, L.V., (2001) Introduction to solids, 1st Edition, McGraw Hill Book Company.
4.	Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.
Reference Books:	
1.	Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials 1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.
2.	Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials 2: An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
3.	Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4th Edition, Cengate Learning.
4.	P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI,

Web links and Video Lectures (e-Resources):

- Bhattacharya, B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
- Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials 27 27 Science and Engineering, Indian Institute of Technology Delhi, http://nptel.ac.in/courses/113102080/

- Subramaniam, A., Structure of Materials, NPTEL Course Material, Department of Material Science and Engineering, Indian Institute of Technology Kanpur, https://nptel.ac.in/courses/113104014/
- https://archive.nptel.ac.in/courses/113/106/113106098/
- https://www.youtube.com/watch?v=ty02EpPN2y0
- https://www.youtube.com/watch?v=LHHAPJbakEc (NPTEL)

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Flipped classroom.
- PPT presentations.

Course outcomes:	
CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
CO2	Understand the importance of phase diagrams and the phase transformations.
CO3	Understand various heat treatment methods for controlling the microstructure.
CO4	Understand the powder metallurgy process, types and surface modifications.
CO5	Acquire the Knowledge of composite materials and their production process as well as applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1											2	1	
CO2	2	2											2	2	
CO3	2		1										2		
CO4	1	2	1										2		
CO5	1	1	2										2		

High-3, Medium-2, Low-1

Course Title	Smart Materials & Systems	**Semester**	III
Course Code	ME222	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	03	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- To make the students understand about smart materials
- To make students to know about making of material smart
- To enable the students to appreciate the material properties

Module-1	**RBT Levels L1, L2**	**08 Hours**
Smart materials and structures: System intelligence- components and classification of smart structures, common smart materials and associated stimulus-response, Application areas of smart systems		
Module-2	**RBT Levels L1, L2**	**08 Hours**
Electrically Activated Materials: Piezoelectricity, Piezoresistivity, Ferroelectricity, Piezoelectric materials- piezoelectric effect, Piezoceramics, Piezopolymers, Piezoelectric materials as sensors, Actuators and bimorphs, nanocarbon tubes		
Module-3	**RBT Levels L1, L2**	**08 Hours**
Thermally activated materials: Shape memory materials; Shape memory alloys (SMAs), Classification - Transformation - Ni-Ti Alloys, Shape memory effect, Martensitic transformation, One way and two-way SME, binary and ternary alloy systems, Functional properties of SMAs, Shape memory ceramics - Shape memory polymers – Applications		
Module-4	**RBT Levels L1, L2**	**08 Hours**
Smart polymers: Thermally responsive polymers, Electroactive polymers microgels, Synthesis, Properties and Applications, Protein-based smart polymers, pH-responsive and photoresponsive polymers, Self-assembly, Drug delivery using smart polymers.		
Module-5	**RBT Levels L1, L2**	**08 Hours**
Chemically Activated Materials - Chemical Gels - Self healing materials Optically Activated Materials - Optically activated polymers - Azobenzene - Liquid Crystal, Smart materials for space applications: Elastic memory composites, Smart corrosion protection coatings, Sensors, Actuators, Transducers.		

Suggested Learning Resources:

Textbooks:

1.	D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007.
2.	M. Addington, D.L. Schodek, Smart Materials and New Technologies in Architecture, Elsevier 2005.
3.	Donald R. Askeland and Pradeep P. Fulay, Essentials of Materials Science and Engineering, 2009, Cengage Laerning.

Reference Books:

1.	Gandi, M.V. and Thompson, B.S., "Smart Materials and Structures," Chapman & Hall, UK, 1992,
2.	Culshaw, B., "Smart Structures and Materials," Artech House, Inc., Norwood, USA, 1996.
3.	Dimitris C. Lagoudas, Shape Memory Alloys: Modelling and Engineering Applications, Springer, 2008.
4.	T. Yoneyama & S. Mayazaki, Shape memory alloys for biomedical applications, CRCPress, 200
5.	Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/112/104/112104251/ Smart materials and Intelligent Design System**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Flipped classroom.
- PPT presentations.

Course outcomes:	
CO1	Explain the fundamentals of smart materials and structures, including their components, classification, and applications in various fields.
CO2	Analyze the behavior and properties of electrically activated materials, such as piezoelectric materials, and their applications as sensors, actuators, and in other technologies.
CO3	Understand and describe the properties and applications of thermally activated materials, including shape memory alloys, shape memory ceramics, and polymers.
CO4	Investigate and apply the principles of smart polymers, including thermally responsive, electroactive, and pH-responsive polymers, as well as their uses in drug delivery and other fields.
CO5	Explore the properties and applications of chemically and optically activated materials, including self-healing gels, optically activated polymers, and coatings for space applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1										2	1	
CO2	2	2	1				2						2	2	
CO3	2	1	1										2	1	
CO4	2	2	1										2	1	
CO5	2	1	2										2	2	

High-3, Medium-2, Low-1

Course Title	Waste handling and Management	**Semester**	III
Course Code	ME223	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	03	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Waste generation & effects
- Solid waste management & challenges
- Hazardous waste management & challenges
- Innovative methods in practice to handle waste & its effects
- Laws governing the waste management

Module-1	**RBT Levels L1,L2**	**08 Hours**

Introduction to waste management: Importance, methods of logistics, human components, technological components- waste handling equipment and technology, steps in waste management logistics. Waste collection system and organization: Environmental aspects of waste collection, role of public authority and private sector in waste collection, organizing collection of residential waste, fee schemes, public awareness programs.

Module-2	**RBT Levels L1,L2**	**08 Hours**

Engineering Systems for Solid Waste Management: Characteristics of solid waste, types of solid waste, Processing and Treatment of Solid Waste; Mechanical Treatment Material Recovery Facility, Recycling and Recovery, Types of Material Recovery Facilities, Biological Treatment & Biological methods for waste processing; Composting & methods. Biomethanation, Biodiesel, Biohydrogen, Mechanical Biological Stabilization, Thermal Treatment Incineration, Residues and its utilisation, co-combustion, Pyrolysis, Gasification, Refuse Derived Fuel, solid recovered fuel. Engineering Disposal of SW: Dumping of solid waste; sanitary landfills – site selection.

Module-3	**RBT Levels L1,L2**	**08 Hours**

Hazardous Waste Management: Introduction, Hazardous waste definition, sources, identification and classification, Characteristics, Industrial waste & Plastic Waste; sources, environmental effects, challenges in handling Biomedical waste; Introduction to biomedical wastes, sources, classification, collection, segregation, treatment and disposal, E-waste; characteristics, generation, collection, transport, recycling and disposal, Effects on the society and environment, Transportation and Disposal, recycling and reuse, Nuclear waste; Characteristics, Types, Power reactors, Refinery and fuel fabrication wastes, Health and environmental effects, Decommissioning of Nuclear power reactors Hazardous waste landfills, Site selections.

Module-4	**RBT Levels L1,L2**	**08 Hours**

Innovations in waste management: Global and Indian Context, recycling, reuse, energy production, land filling, remediation of hazardous waste contaminated sites. Revenue models, Developing Networks, Entrepreneurship activities, Best practices in India and Abroad- Case studies, Waste management and waste handling entrepreneurs in India and other countries, Case studies of different municipalities waste handling techniques, domestic composting, medium & large scale composting, Centralised composting**.**

Module-5	RBT Levels L1,L2	08 Hours
Waste Management Laws in India: The Environmental Protection Act, The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008, The Plastic Waste (Management and Handling) Rules, 2011, Bio-Medical Waste (Management and Handling) Rules, 1998, The E- Waste (Management and Handling) Rules, 2011, The Batteries (Management and Handling) Rules, 2001. Duties of constitutional bodies and Ministries.		

Suggested Learning Resources:

Textbooks:

1.	Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition
2.	Hazardous Wastes - Sources, Pathways, Receptors, Richard J. Watts, John Wiley and Sons, 1998, 1st Edition.

Reference Books:

1.	Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel (2014)., 2nd Ed., CRC Press, USA.
2.	Waste: A Handbook for Management, Letcher, T.M., Vallero, D.A. (2011)., 1st Ed, Academic Press, USA.
3.	Waste Management Strategy and Action Plan,IGES, UNEP, CCET. (2018), Phnom Penh 20182035. Phnom Penh, Cambodia.
4.	National Environment Policy, 2006, Ministry of Environment and Forests, Government of India, Approved by the Union Cabinet on 18 May, 2006
5.	Innovation and Entrepreneurship, Peter Drucker, (2012)., Routledge Publishers, England UK
6.	Strategic Management, Hitt, M.A.,Hoskisson, R.E., Ireland, R.D., (2016)., Cengage Learning, India.
7.	Waste Management Practices: Municipal, Hazardous and Industrial, John Pichtel, CRC Press, 2014, 2nd Edition
8.	Handbook of Solid Waste Management, Tchobanoglous G and Kreith F, McGraw-Hill Education, 2002, 2nd Edition

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/content/storage2/courses/105106056/Introduction.pdf

https://nptel.ac.in/courses/105/103/105103205/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Flipped classroom.
- PPT presentations.

Course outcomes:

CO1	Explain the fundamental concepts of waste management, including different methods of waste collection, handling technologies, and the roles of various stakeholders.
CO2	Explain the different methods of processing and treatment for solid waste, including mechanical, biological, and thermal techniques, and assess their effectiveness in waste management.
CO3	Describe the types and characteristics of hazardous waste, and apply appropriate management strategies for different categories, including biomedical and e-waste.
CO4	Explain innovative waste management practices and technologies, including recycling, energy production, and remediation techniques, drawing on global and local case studies.
CO5	Describe the key provisions of Indian waste management laws and regulations, including the Environmental Protection Act and various specific waste management rules.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				1	2					2	2		2
CO2	2	1				2	2					2	2		2
CO3	2	1				2	2					2	2		2
CO4	2	1	2		2	2	2					2	2		2
CO5	2	1	2			2	2	2				2	2		2

High-3, Medium-2, Low-1

Course Title	Internet of Things	**Semester**	III
Course Code	ME224	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	03	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Understand the basics of Internet of things and protocols.
- Understand some of the application areas where Internet of Things can be applied.
- Learn about the middleware for Internet of Things.
- Understand the concepts of Web of Things

Module-1	**RBT Levels L1,L2**	**08 Hours**
IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.		
Module-2	**RBT Levels L1,L2**	**08 Hours**
IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security		
Module-3	**RBT Levels L1,L2**	**08 Hours**
IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.		
Module-4	**RBT Levels L1,L2**	**08 Hours**
WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.		
Module-5	**RBT Levels L1,L2**	**08 Hours**
IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.		

Suggested Learning Resources:

Textbooks:

1.	Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3.	David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

Reference Books:

1.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3.	CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH8RC_N3bpVn-e8QzOAHziEgmjQ2qE
- https://www.coursera.org/learn/beginning-custom-projects-with-raspberry-pi
- https://www.edx.org/course/introduction-to-the-internet-of-things-3

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Flipped classroom.
- PPT presentations.

Course outcomes:	
CO1	Explain the definition and usage of the term "Internet of Things" in different contexts
CO2	Understand the key components that make up an IoT system
CO3	Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
CO4	Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis
CO5	Understand where the IoT concept fits within the broader ICT industry and possible future trends and Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			2	3							2			1
CO2	1			2	3							2			1
CO3	1			2	3							2			1
CO4	1		2	2	3							2			1
CO5	1		2	2	3							2			1

High-3, Medium-2, Low-1

Course Title	Universal Human Values	**Semester**	III
Course Code	HV207	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/Week	2:0:0	**Total**	100
Credits	2	**Exam. Duration**	3 Hours
Teaching Dept	Any Department		

Course objective is to:

- This course is intended to:
- To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
- This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Module – 1	**RBT Levels L1,L2**	**06 Hours**

Introduction to Value Education :Introduction to Value Education :Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module – 2	**RBT Levels L1,L2**	**06 Hours**

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Module-3	**RBT Levels L1,L2**	**06 Hours**

Harmony in the Family and Society : Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

Module-4	RBT Levels L1,L2	06 Hours
Harmony in the Nature/Existence : Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence		
Module-5	**RBT Levels L1,L2**	**06 Hours**
Implications of the Holistic Understanding – a Look at Professional Ethics :Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession		

Suggested Learning Resources:

Textbooks:

1	The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93-87034- 47-1
2	The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books:

1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book).
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5	Small is Beautiful - E. F Schumacher
6	Slow is Beautiful - Cecile Andrews

Web links and Video Lectures (e-Resources):

Value Education websites,

- https://www.uhv.org.in/uhv-ii,
- http://uhv.ac.in,
- http://www.uptu.ac.in
- Story of Stuff,
- http://www.storyofstuff.com
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- https://www.youtube.com/watch?v=8ovkLRYXIjE
- https://www.youtube.com/watch?v=OgdNx0X923I
- https://www.youtube.com/watch?v=nGRcbRpvGoU
- https://www.youtube.com/watch?v=sDxGXOgYEKM

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. In addition to the traditional lecture method, different types of innovative teaching methods may

be adopted so that the activities will develop students' theoretical and applied skills.

3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.
4. Support and guide the students for self-study activities. 5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous self-evolution.
6. Encourage the students for group work to improve their creative and analytical skills.

Course outcomes:

Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature);

Expected to positively impact common graduate attributes like:

1. Ethical human conduct
2. Socially responsible behavior
3. Holistic vision of life
4. Environmentally responsible work
5. Having Competence and Capabilities for Maintaining Health and Hygiene
6. Appreciation and aspiration for excellence (merit) and gratitude for all

CO1	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO2	They would have better critical ability
CO3	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1
CO4			1			1	1					1

Course Title	NSS – Phase 1	**Semester**	III
Course Code	NS208	**CIE**	50
Total No. of Contact Hours	25	**SEE**	0
No. of Contact Hours/week	0:2:0	**Total**	50
Credits	-----	**Exam. Duration**	-----
Teaching Dept	Any Department		

- **Course objective is to:** National Service Scheme (NSS) will enable the students to:
- Understand the community in which they work
- Identify the needs and problems of the community and involve them in problem-solving
- Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems
- Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes
- Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony.

Module:1	**RBT Levels L1,L2**	**4 Hours**

Youth population in India and its characteristics:

Introduction to India: Physical, Socio-Economic and Demographic Background, Study on Indian Population Composition (Age composition), Youth composition, Youth policy, Importance of Youth Policy, Youth population in India, NSS as a Youth Organization.

Module:2	**RBT Levels L1,L2**	**3 Hours**

Fundamentals of NSS:

Introduction to NSS, Origin of NSS, Aims and Objectives of NSS, NSS Motto, NSS Emblem, NSS Badge, NSS Day.

Module:3	**RBT Levels L1,L2**	**3 Hours**

NSS Songs:

NSS Anthem (Hindi & Kannada), National Integration song, Rastriya sevayojane Madiharu. Uteh samajkeliye Uteh Uteh. Navellaru Ondagi Balona Banni. Hum Sab Mil ka rDeshka Apani.

Module:4	**RBT Levels L1,L2**	**15 Hours**

Activity Based Programmes:

A. Campus Activities:
Shramadhan – Plantation, Cleaning, Watering, Weeding, Any other activities.
Awareness Programmes – Seminar, Workshops, celebration of National and International days, Personality Development Programmes, Group Activities, etc
B : Off Campus Activities:
Rally, Jatha, Visit to Adopted villages, Swatchatha Programme, Visit and Conserving Ancient monuments and heritage site, Socio Economic Survey of village/slum, Nature Camp, Environmental Education

Course outcomes: **At the completion of the course. The student shall be able to**	
CO1	Describe the concept of Youth and compare the international definitions of the term Youth.
CO2	Students will be able to appreciate our demographic advantage and its role in nation building.
CO3	Know the growth and evolution of NSS and its role in Nation building through community service
CO4	Visualize the signs, symbols, logo of NSS and understand their broader meaning.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	1					1
CO2						1	1					1
CO3						1	1					1
CO4						1	1					1

High-3, Medium-2, Low-1

Course Title	Physical Education (PE) (Sports and Athletics) – Phase 1	**Semester**	III
Course Code	PE208	**CIE**	50
Total No. of Contact Hours	25	**SEE**	0
No. of Contact Hours/Week	0:2:0	**Total**	50
Credits	--	**Exam. Duration**	------
Teaching Dept	Sports		

Course objective:

Physical education aims to develop all aspects of the human personality through physical and sports activities. Being a subject of science, it has its own value in society and human life. Physical Education is a form of one of the most effective means of education imparted through exercises, fun activities and sports. It is an integral part of the education system. It caters to the need for development of the students on physical, mental and social aspects.

Module – 1	**RBT Levels L1,L2**	**5 Hours**

Orientation:

Introduction of Physical Education and sports, Importance of Physical fitness and healthy life style

A. Lifestyle
B. Fitness
C. Food & Nutrition
D. Health & Wellness
E. Pre-Fitness test

Module – 2	**RBT Levels L1,L2**	**15 Hours**

General Fitness & Components of Fitness:

A. Warming up (Free Hand exercises)
B. Strength – Push-up / Pull-ups
C. Speed – 30 Mtr Dash
D. Agility – Shuttle Run
E. Flexibility – Sit and Reach
F. Cardiovascular Endurance – Harvard step Test.

Module - 3	**RBT Levels L1,L2**	**10 Hours**

Recreational Activities:

A. Postural deformities.
B. Stress management.
C. Aerobics.
D. Traditional Games.

Course outcomes: At the completion of the course. The student shall be able to	
CO1	Understand the fundamental concepts and skills of Physical Education, Health,Nutrition and Fitness.
CO2	Familiarization of health-related Exercises, Sports for overall growth anddevelopment.
CO3	Create a foundation for the professionals in Physical Education and Sports.
CO4	Participate in the competition at regional/state / national / internationallevels..
CO5	Create consciousness among the students on Health, Fitness and Wellness indeveloping and maintaining a healthy lifestyle.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1
CO4			1			1	1					1
CO5			1			1	1					1

High-3, Medium-2, Low-1

Course Title	Yoga for a Better Life - Phase 1	**Semester**	III
Course Code	YG208	**CIE**	50
Total No. of Contact Hours	25	**SEE**	0
No. of Contact Hours/week	0:2:0	**Total**	50
Credits	-----	**Exam. Duration**	-----
Teaching Dept	**Any Department**		

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

Semester III	**RBT Levels L1,L2**	**25 Hours**

Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, Aim and Objectives of yoga, importance of prayer Yogic practices for common man to promote positive health Rules to be followed during yogic practices by practitioner Yoga its misconceptions, Difference between yogic and non yogic practices.

Suryanamaskar prayer and its meaning, Need, importance and benefits of Suryanamaskar12 count, 2 rounds.

Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana Different types of Asanas

a. Sitting

1. Padmasana
2. Vajrasana

b. Standing

1. Vrikshana
2. Trikonasana

c. Prone line

1. Bhujangasana
2. Shalabhasana

d. Supine line

1. Utthitadvipadasana
2. Ardhahalasana

Suggested Learning Resources:

Textbooks:

1. Yogapravesha in Kannada by Ajitkumar
2. Light on Yoga by BKS Iyengar
3. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4. Yoga Instructor Course hand book published by SVYASA University, Bengaluru
5. Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e-Resources):
Refer links

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as;

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcohol abuse). If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- **Physical**
  1. Improved body flexibility and balance
  2. Improved cardiovascular endurance (stronger heart)
  3. Improved digestion
  4. Improved abdominal strength
  5. Enhanced overall muscular strength
  6. Relaxation of muscular strains
  7. Weight control
  8. Increased energy levels
  9. Enhanced immune system
- **Mental**
  1. Relief of stress resulting from the control of emotions
  2. Prevention and relief from stress-related disorders
  3. Intellectual enhancement, leading to improved decision-making skills
- **Spiritual**
  1. Life with meaning, purpose, and direction
  2. Inner peace and tranquility
  3. Contentment

Course outcomes:
At the completion of the course. The student shall be able to

CO1	Understand the meaning, aim and objectives of Yoga.
CO2	Perform Suryanamaskar and able to Teach its benefits.
CO3	Understand and teach different types of Pranayama, Asanas by name, its importance, methods and benefits.
CO4	Instruct Kapalabhati and its need and importance.
CO5	Coach different types of Kriyas , method to follow and usefulness.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1
CO4			1			1	1					1
CO5			1			1	1					1

High-3, Medium-2, Low-1

Course Title	Additional Mathematics (Common for all branches)	**Semester**	III
Course Code	DM209	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	2:0:0	**Total**	100
Credits	0	**Exam. Duration**	3 Hours
Teaching Dept	**MATHEMATICS**		

Course objective is to:

- Develop the knowledge of numerical methods and apply them to solve transcendental and differential equations.
- Study the fundamental concepts of vector calculus viz. Gradient, curl and divergence
- Familiarize the importance of Integral calculus and Linear Algebra.

Module-1 Numerical Analysis	**RBT Levels L1,L2,L3**	**6 Hours**

Solution of algebraic and transcendental equations –Newton-Raphson methods. Finite differences, Interpolation and extrapolation using Newton's forward and backward difference formulae, Newton's divided difference Numerical integration: Trapezoidal rule, Simpson's $(1/3)$rd and $(3/8)$th rules, Weddle's rule.

Numerical Solution of Ordinary Differential Equations: Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order

Module-2 Ordinary Differential Equations	**RBT Levels L1,L2,L3**	**6 Hours**

Introduction to first-order ordinary differential equations pertaining to the applications for Computer Science & Engineering. Linear and Bernoulli's differential equations. Exact and reducible to exact differential equations - Integrating factors on $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$.

Higher -order linear ordinary differential equations with constant coefficients - Inverse differential operator,

Module-3 Integral Calculus	**RBT Levels L1,L2,L3**	**6 Hours**

Multiple Integrals: Evaluation of double and triple integrals, evaluation of double integrals by change of order of integration

Module-4 Vector Calculus	**RBT Levels L1,L2,L3**	**6 Hours**

Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrational vector fields.

Module-5 Linear Algebra	**RBT Levels L1,L2,L3**	**6 Hours**

Row reduction and echelon forms- Consistency of System of Equations. Solution sets of linear equations by Gauss Seidel, Gauss Jordan,. Eigenvalues and eigenvectors Rayleigh's power method.

Suggested Learning Resources:	
Textbooks:	
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2.	Erwin Kreyszig - Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015
3	David C Lay: "Linear Algebra and its Applications", Pearson Publishers, 4th Ed., 2018
Reference Books:	
1.	Srimanta Pal & Subodh C Bhunia - Engineering Mathematics, Oxford University Press, 3rd Reprint, 2016.
2.	James Stewart: "Calculus" Cengage Publications, 7thEd., 2019.
3.	Gilbert Strang, Linear Algebra and its Applications, 5th Edition (2016).
4.	N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Ed., 2022. 4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics"
Web links and Video Lectures (e-Resources): **https://youtu.be/Y7VWyyZ6B0g?si=rhxgG4vvrs3VS7mw** **https://youtu.be/zT83sJ5IrEE?si=Crb9_cIWw4tTJxmj** **https://youtu.be/9_m36W3cK74?si=h-bd19yVCgLF3VvW** **https://youtu.be/2DX8Vp1Q2-0?si=rQ76vQyXPATricZz** **https://youtu.be/AuUi_bUeTS4**	
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning: Course Seminars, Quiz, In class assignments.	

Course outcomes: At the end of the course students will be able to	
CO1	Apply numerical methods to find the solution of algebraic and transcendental equations.
CO2	Apply numerical methods to find the solution of ordinary differential equations.
CO3	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing area and volume.
CO4	Use fundamentals of vectors to find gradient, curl and divergence.
CO5	Test the consistency and solve the system of liner equations.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2								2
CO2	3	2		2								2
CO3	3	2		2								2
CO4	3	2		2								2
CO5	3	2		2								2

High-3, Medium-2, Low-1

Course Title	Applied Mathematics - IV	**Semester**	IV
Course Code	MM251	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	2:2:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mathematics		

Course objective is to:

- To illustrate the concepts of complex variables, complex functions, differentiation and evaluation of complex integrals in solving complex engineering problems.
- To enable students to become familiar with probability distribution.
- Understand the concept and well conversant with testing the hypothesis and sampling.

Module-1	**RBT Levels L1,L2,L3**	**8 Hours**

Complex Analysis:
Complex Variables: Review of a function of a complex variable, limits, continuity, differentiability. Analytic Functions-Cauchy-Riemann equations in Cartesian and polar forms. Properties and construction of analytic functions.

Module-2	**RBT Levels L1,L2,L3**	**8 Hours**

Complex Integrals:
Complex line Integrals - Cauchy's theorem and Cauchy's integral formula, Residue, poles, Cauchy's Residue theorem. Transformations: Conformal transformations-Discussion of transformations: $w=z^2, w=e^z, w=z+\left(\frac{1}{z}\right)\ (z\neq 0)$. Bilinear transformations.

Module-3	**RBT Levels L1,L2,L3**	**8 Hours**

Probability Distributions:
Random variables: Discrete and continuous, probability mass/density functions. Binomial distribution, Poisson distribution. Exponential and Normal distributions.

Moule-4	**RBT Levels L1,L2,L3**	**8 Hours**

Joint Probability Distribution:
Joint Probability distribution for two discrete random variables, expectation, covariance, correlation coefficient.
Stochastic process: Probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability .

Module-5	**RBT Levels L1,L2,L3**	**8 Hours**

Transportation and Assignment Problems:
Formulation of transportation problems, Methods of finding initial basic feasible solutions by North-West corner method, least cost method, Vogel approximation method. Optimal Solutions-Problems. Formulation of assignment problems, Hungarian Method-Problems

Suggested Learning Resources: **Textbooks:**	
1.	B.S. Grewal – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2021.
2.	R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9th edition – 2012.
3.	Kanti Swarup, P.K. Gupta and Man Mohan -Operations Research-Sultan Chand & Sons Publishers–2014.
Reference Books:	
1.	Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum's outlines-4nd edition-2012.
2.	Kishore S. Trivedi – Probability & Statistics with Reliability, Queuing and Computer Science Applications – John Wiley & Sons – 2nd edition – 2008.
3.	Erwin Kreyszig –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015.
Web links and Video Lectures (e-Resources): **M1: https://youtu.be/jm0JLx9cT5c?list=PLVCBPCYGv7bBYULot9GNR0AW8ukryUplx** **M2: https://youtu.be/Q7ynQ9qgENo?list=PL2C56LrxJmW4Yo-8MDh8yijh5cFHMWAup** **M3: https://youtu.be/V8F8We_-nuo?list=PLhSp9OSVmeyLB62_-fT9VNbjRkDEzJzzp** **M4: https://youtu.be/frAu2PIxKjI** **M5: https://youtu.be/qNqrHO3woyE**	
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning Quiz, Group Discussions, In class assignments.	

Course outcomes: At the end of the course students will be able to	
CO1	Use the basics of complex numbers and functions in finding the solutions of engineering problems.
CO2	Solve complex integration problems arising in engineering problems.
CO3	Understand and apply a wide range of probability distributions to solve problems.
CO4	Understand and apply Stochastic process as mathematical models of systems and phenomena that appear to vary in a random mannerto solve problems.
CO5	Design and implement appropriate sampling methods based on sample data.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2								2
CO2	2	2		2								2
CO3	2	2		2								2
CO4	2	2		2								2
CO5	2	2		2								2

High-3, Medium-2, Low-1

Course Title	Thermal Science and Engineering	**Semester**	IV
Course Code	ME252	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	2:2:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Provide the basic concepts thermodynamics and apply laws of thermodynamics in engineering.
- Apply the knowledge of air standard cycles to analyze IC Engines, Gas turbines, Compressor
- Apply the knowledge of pure substances and analyze vapor power cycles.

Module-1	**RBT Levels L1,L2,L3**	**08 Hours**

Introduction and Review of fundamental concepts: Macroscopic and Microscopic approaches, Thermodynamic system, control volume, properties (intensive and extensive), state and process, cycles, Thermodynamic Equilibrium, Quasi-static process, Temperature, Thermal Equilibrium and Zeroth Law **(The topics are Only for Self-study and not to be asked in SEE. However, may be asked for CIE).**

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention.

Module-2	**RBT Levels L1,L2,L3**	**08 Hours**

First Law of Thermodynamics: First law for cyclic and non-cyclic processes, concept of total energy and energy as the property of a system, various modes of energy, internal energy and enthalpy, Steady Flow Energy Equation (SFEE), Examples of steady flow processes, PMM-1, Limitations of the First Law.

Module-3	**RBT Levels L1,L2,L3**	**08 Hours**

Second Law of Thermodynamics: Definition of direct and reversed heat engine (Refrigerator and heat pump), definition of thermal efficiency and COP, Kelvin-Planck and Clausius statements, Equivalence of Kelvin-Planck and Clausius statements, Reversibility and Irreversibility, Causes for Irreversibility, Carnot cycle.

Entropy: Clausius inequality, Definition of entropy, entropy as a property, two reversible adiabatic paths cannot intersect each other, Entropy change in reversible and Irreversible process, Principle of increase of entropy, Illustration of process on T-s diagram.

Module-4	**RBT Levels L1,L2,L3**	**08 Hours**

Ideal gases and Real gases: (This topic meant for Self-study and not to be asked in SEE. However, may be asked for CIE)

Air standard cycles: Carnot, Otto and Diesel cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. **(Only for CIE**).

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles.

Jet Propulsion cycles: Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket.

Module-5	RBT Levels L1,L2,L3	08 Hours

Pure substances: Formation of steam: Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of a pure substance with water as example. Latent heat & dryness fraction. Representation on P-T, P-v, T-s and H-s diagrams. Property calculations using steam tables and Mollier diagram

Vapor Power Cycles: Simple Rankine cycle, effects of pressure and temperature in Rankine cycle. Actual vapor cycle. Reheat Rankine cycle.

Suggested Learning Resources:

Textbooks:

1	Basic and Applied Thermodynamics P.K. Nag, Tata McGraw Hill 2nd Ed., 2002.
2	Basic Engineering Thermodynamics A. Venkatesh Universities Press, 2008
3	Applied thermodynamics by Kestoor Praveen
4	Thermal Engineering Data Handbook, Revised edition 2019, Sreenivasa Reddy, K Hemachandra Reddy

Reference Books:

1	"Fundamentals of Engineering Thermodynamics" by Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey
2	"Principles of Engineering Thermodynamics" by John R. Reisel
3	"Thermodynamics: Principles and Applications" by Jean-Philippe Ansermet and Sylvain D. Brechet
4	"Thermodynamics: An Engineering Approach" by Yunus A. Çengel and Michael A. Boles

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=4OSZ3wYo6-Y
- https://www.youtube.com/watch?v=d64219dEwXk&list=PLF_7kfnwLFCFPfN4TGeJt1PQpJd3MG6Zz
- https://www.youtube.com/watch?v=-dUXWLzgE6Q
- https://www.youtube.com/watch?v=UABFOI1sb7A
- https://www.youtube.com/watch?v=LUQyX22CjxY

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Energy transfer demonstrations (conduction, convection and radiation)
- Demonstration of petrol and diesel engines
- Demonstration of air compressors
- Simulation of Rankine cycle and Carnot cycle
- Simulation of Gas Turbines

Course outcomes:

CO1	Apply thermodynamic principles to analyze work and heat in Engineering Systems.
CO2	Apply the first law of thermodynamics to analyze engineering systems.
CO3	Apply and analyze the Second Law of Thermodynamics and Entropy Concepts.
CO4	Analyze and evaluate the performance of internal combustion engines and gas power cycles using thermodynamic principles.
CO5	Analyze vapor power cycles using properties of pure substances.

CO-PO Mapping															
CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3												3	2
CO2	3	3												3	2
CO3	3	3												3	2
CO4	3	3												3	3
CO5	3	3												3	3

High-3, Medium-2, Low-1

Energy Conversion Lab			
Course Code	**ME253**	**CIE Marks**	**50**
L:T:P	**0:0:2**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course objectives: At the end of the course, the student will be able to:	
1	Measure and analyze key fuel properties using various devices to assess fuel quality for internal combustion engines.
2	Apply thermodynamic principles to understand energy conversion processes in internal combustion engines, optimizing performance and efficiency.
3	measure exhaust emissions from engines, compare them with safety standards, and apply methods to reduce pollution.

Pgm. No.	**List of Experiments / Programs**	**Hours**	**COs**
Prerequisite Experiments / Programs / Demo			
	Students should have studied basic thermodynamics and applied thermodynamics. Also, should have knowledge in engineering mathematics, engineering physics and basics of mechanical engineering	-	-
PART-A			
1	Determination of flash point and fire point	2	1
2	Determination of calorific value of fuel	2	1
3	Determination of viscosity of lubricating oil	2	1
4	Valve timing diagram	2	2,3
5	Vapor compression refrigeration system	2	2,3
6	Visit automobile industry	2	2,3
PART-B			
7	Performance of IC engine – Petrol Engine -4S	2	2,3
8	Performance of IC engine – Petrol Engine -2S	2	2,3
9	Performance of IC engine -Diesel engine – 4 S	2	2,3
10	Variable compression ratio engine	2	2,3
PART-C			

Beyond Syllabus Virtual Lab Content:

- Finding IMEP of Petrol and Diesel Engines
- Simulation of IC Engines
- Simulation of Vapor Compression Refrigeration
- Simulation of Air Cycles
- Simulation of Gas Turbine Power Plant

Suggested Learning Resources: Textbooks/ Reference Books:	
1	Internal combustion engines, V Ganeshan, Tata McGraw-Hill
2	Basic Engineering Thermodynamics A. Venkatesh Universities Press, 2008
3	Applied thermodynamics by Kestoor Praveen
4	Thermal Engineering Data Handbook, Revised edition 2019, Sreenivasa Reddy, K Hemachandra Reddy

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=YAWBEmIH7yQ

https://www.youtube.com/watch?v=Atot1pQG-IQ

https://www.youtube.com/watch?v=5iVfwyoXKr0

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- **Visit automobile industry**
- **Visit vehicle garage and see how maintenance and repair done of two wheeler and four wheeler**

Course outcomes:	
CO1	Understand and determine the flash and fire points of various fuels for safety assessment.
CO2	Evaluate the calorific value of different fuels and analyze their energy content and efficiency
CO3	Analyze the operation and performance of vapor compression refrigeration systems
CO4	Measure the viscosity of fluids and understand their flow characteristics for different applications
CO5	Evaluate the performance of internal combustion engines and understand their operational characteristics

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	2	2							3		
CO2	3	2	3	2	1	1							3		
CO3	3	2	2	3	2	1							3		
CO4	3	2	1	2	3	1							3		
CO5	3	3	2	3	2	2							3		

High-3, Medium-2, Low-1

Course Title	Theory of Machines	**Semester**	IV
Course Code	ME254	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	03	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- To understand the concept of machines, mechanisms and to analyze a mechanism for displacement, velocity and acceleration at any point in a moving link.
- To understand the theory of gears and gear trains.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the principles in mechanisms used for speed control and stability control.
- To compute the natural and damped frequencies of free 1-DOF mechanical systems and to analyze the vibrational motion of 1-DOF mechanical systems under harmonic excitation conditions.

Module-1	**RBT Levels L1,L2,L3**	**08 Hours**

Introduction: Mechanisms and machines, Kinematic pairs-types, degree of freedom, Kinematic chains and their classification, Kinematic inversions, Velocity and Acceleration analysis of planar mechanisms Graphical method

Velocity and Acceleration Analysis of Mechanisms: Velocity and acceleration analysis of four bar mechanism, slider crank mechanism. Mechanism illustrating Corioli's component of acceleration. Angular velocity and angular acceleration of links, velocity of rubbing.

Module-2	**RBT Levels L1,L2,L3**	**08 Hours**

Static force analysis: Static equilibrium, analysis of four bar mechanism, slider crank mechanism.

Dynamic force analysis: D'Alembert's principle, analysis of four bar and slider crank mechanism.

Flywheel: Introduction to Flywheel and calculation of its size for simple machines.

Module-3	**RBT Levels L1,L2,L3**	**08 Hours**

Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear. Interference in involute gears, methods of avoiding interference, condition and expressions for minimum number of teeth to avoid interference.

Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains, torque calculation in epicyclic gear trains. Discussions on applications of gear trains.

Module-4	RBT Levels L1,L2,L3	08 Hours

Balancing of Rotating Masses: Static and Dynamic Balancing, Balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Discussions on applications.

Balancing of Reciprocating Masses: Inertia Effect of crank and connecting rod, Single cylinder Engine,

Governors: Types of Governors; Force Analysis of Porter and Hartnell Governors. Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power. Discussion on applications.

Module-5	RBT Levels L1,L2,L3	08 Hours

Free vibrations: Basic elements of vibrating system, Types of free vibrations, Longitudinal vibrations-Equilibrium method, D'Alembert's principle, Determination of natural frequency of single degree freedom systems, Damped free vibrations: Under damped, over damped and critically damped systems. Logarithmic decrement.

Forced vibrations: Undamped forced vibration of spring mass system, Damped forced vibrations, Rotating unbalance, Reciprocating unbalance, Vibration isolation, Discussions on applications.

Suggested Learning Resources:

Textbooks:

1	Theory of Machines Kinematics and Dynamics Sadhu Singh Pearson Third edition 2019
2	Mechanism and Machine Theory G. Ambekar PHI 2009
3	Theory of Machines RS Khurmi JK Gupta S. Chand Publishing, 2005

Reference Books:

1	Theory of Machines Rattan S.S Tata McGraw-Hill Publishing Company 2014
2	Mechanisms and Machines- Kinematics, Dynamics and Synthesis Michael M Stanisic Cengage Learning 2016
3	Shigley. J. V. and Uickers, J.J., "Theory of Machines & Mechanisms" OXFORD University press.2004

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/
- E- learning
- MOOCS

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quiz
- Topic Seminar presentation
- Assignments
- Case studies

Course outcomes:	
CO1	Understand the mechanisms and their motion and the inversions of mechanisms
CO2	Solve the velocity, acceleration of links and joints of mechanisms.
CO3	Apply the mechanisms for static and dynamic equilibrium.
CO4	Compute the balancing of rotating reciprocating masses and design identify types of governors used in real life situation.
CO5	Apply the concepts of free and forced vibration to determine the dynamic response of mechanical systems

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1									3	1	
CO2	2	3	2	2									3	1	
CO3	2	3	2	2									3	1	
CO4	2	3	2	1									3	1	
CO5	3	3	2	1									3	1	

High-3, Medium-2, Low-1

Machine Shop Lab			
Course Code	**ME255**	**CIE Marks**	**50**
L:T:P	**0:0:2**	**SEE Marks**	**50**
Hrs. / Week	**2**	**Total Marks**	**100**
Credits	**1**	**Exam Hours**	**03**

Course objectives : At the end of the course, the student will be able to:	
1.	To provide an insight to different machine tools, accessories and attachments
2.	To impart students into machining operations to enrich their practical skills
3.	To inculcate team qualities and expose students to shop floor activities

Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Basic knowledge on measurements, workshop practice and safety	1	1
PART-A			
1.	To study the tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system.	1	1
2.	Preparation of three models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning	6	2,3
3.	Formation of cutting parameters of single point cutting tool using bench grinder / tool & cutter grinder.	2	2,3
4.	One Job on Lathe machine with simple operations (turning, facing, Thread cutting and tapering) on low carbon steel and/or heat-treated low carbon steel, and Demonstration of tungsten carbide cutting tool inserts.	2	2,3
PART-B			
5.	Experiment using milling Indexing fixtures.	2	2,4
6.	Cutting of Gear Teeth using Milling Machine	2	2,4
7.	Operations and One Job each on shaping/milling machine	2	2,4,5
8.	Demonstration of surface milling /slot milling	2	2,4,5

PART-C

Beyond Syllabus Virtual Lab Content

- Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations.
- Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool with different depth of cut, speed, and feed rate.
- Demonstration/Experimentation of simple programming of CNC machine operations.

Suggested Learning Resources:
Textbooks/ Reference Books:

1.	Hajra Choudhury S.K., Hajra Choudhury A.K.and Nirjhar Roy S.K., "Elements of Workshop Technology Volume 2", Media promoters and publishers private limited, Mumbai, Vol. I 2008 and Vol. II 2010.
2.	Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 4thedition, 2002.
3.	Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
4.	McGeough, J A, (1988), Advanced Methods of Machining, Springer.
5.	Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.

Web links and Video Lectures (e-Resources): https://www.youtube.com/@AniMechEdu/playlists https://www.youtube.com/@manufacturingie-purdue2790/playlists
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Course outcomes:	
CO1	Understand the formation of cutting tool parameters of single point cutting tool using bench grinder / tool and cutter.
CO2	Demonstrate the Conventional machining process operations.
CO3	Perform turning , facing , knurling , thread cutting, tapering , eccentric turning and allied operations
CO4	Perform gear tooth cutting using milling machine and understand Surface Milling/Slot Milling
CO5	Perform keyways / slots , grooves etc using shaper

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2	2	2											2		
CO3	2	2											2		
CO4	2	2											2		
CO5	2	2											2		

High-3, Medium-2, Low-1

Course Title	Mechanical Measurements and Metrology	**Semester**	IV
Course Code	ME256	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	2:0:2	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- To understand the concept of metrology and standards of measurement.
- To equip with knowledge of limits, fits, tolerances and gauging
- To acquire knowledge of linear and Angular measurements, Screw thread and gear measurement & comparators.
- To understand the knowledge of measurement systems and methods with emphasis on different Transducers, intermediate modifying and terminating devices.
- To understand the measurement of Force, Torque, Pressure, Temperature and Strain.

Module-1	**RBT Levels L1, L2, L3**	**08 Hours**

Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples.

Liner measurement and angular measurements: Slip gauges-Indian standards on slip gauges, Adjustable slip gauges, Wringing of slip gauges, Problems on building of slip gauges (M87, M112), Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements.

Module-2	**RBT Levels L1, L2, L3**	**08 Hours**

System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly. Class & grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance. Hole base system & shaft base system. Taylor's principle, Types of limit gauges (GO and NO-GO), Numerical on limit gauge design.

Module-3	**RBT Levels L1, L2, L3**	**08 Hours**

Measurement of screw thread and gear: Terminology of screw threads, Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods, Best size wire. Screw thread gauges, Toolmaker's microscope.

Module-4	**RBT Levels L1, L2, L3**	**08 Hours**

Measurement system and basic concepts of measurement methods: Definition, Significance of measurement, Generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold, Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors.

Transducers: Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical, Electronic transducers, Relative comparison of each type of transducers.

Module-5	RBT Levels L1, L2, L3	08 Hours

Applied mechanical measurement: Measurement of force, Torque, Pressure, Types of Dynamometers, Absorption dynamometer, Prony brake and Rope brake dynamometer, and Power Measuring Instruments.

Measurement of strain and temperature: Theory of strain gauges, Types, Electrical resistance strain gauge, Preparation and mounting of Strain gauges, Resistance thermometers, Thermocouple, Law of thermocouple.

Practice Experiments:

Experiments will be conducted in practical component of IPCC.

1. Calibration of Pressure Gauge.
2. Calibration of Thermocouple.
3. Calibration of LVDT.
4. Calibration of Load cell.
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges.
6. Measurements using Optical Projector / Toolmaker Microscope.
7. Measurement of angle using Sine Center / Sine bar / bevel protractor.
8. Measurements of Screw Thread Parameters using two wire or Three-wire methods.
9. Measurement of gear tooth profile using gear tooth Vernier.
10. Calibration of Micrometer using slip gauges.

Suggested Learning Resources:

Textbooks:

1.	Mechanical Measurements by Beckwith Marangoni and Lienhard Pearson Education 6th Ed., 2006
2.	Instrumentation, Measurement and Analysis by B C Nakra, K K Chaudhry McGraw–Hill 4th Edition
3.	Engineering Metrology by R.K. Jain Khanna Publishers 2009
Reference Books:	
1.	Engineering Metrology and Measurements by Bentley, Pearson Education
2.	Theory and Design for Mechanical Measurements, III edition by Richard S Figliola, Donald E Beasley, WILEY India Publishers
3.	Engineering Metrology by Gupta I.C, Dhanpat Rai Publications
4.	Engineering Metrologyand Measurements by N.V.Raghavendra and L. Krishnamurthy ,Oxford University Press.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/104/112104250/ introduction to measurements and metrology.
- https://archive.nptel.ac.in/courses/112/106/112106138/
- http://www.digimat.in/nptel/courses/video/112106138/L21.html

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Flipped class room.
- Seminars.

Course outcomes: At the end of the course, the student will be able to:	
CO1	Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters.
CO2	Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
CO3	Understand the working principle of different types of comparators.
CO4	Explain measurement systems, transducers, intermediate modifying devices and terminating devices.
CO5	Describe functioning of force, torque, pressure, strain and temperature measuring devices

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2												2	1	
CO2	2		2										2	1	
CO3	2	2											2	1	
CO4	2												2	1	
CO5	2		2										2	1	

High-3, Medium-2, Low-1

Course Title	Machining Science and Jigs & Fixtures	**Semester**	IV
Course Code	ME261	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- To know the various subtractive machining processes in industries.
- To calculate the values of various forces involved in the machining operations.
- To understand and determine tool wear and tool life of different machining processes.
- To know various non-conventional machining and hybrid machining processes.
- To know the design of jigs and fixtures for various industrial/ machining members.

Module-1	**RBT Levels L1, L2**	**08 Hours**

Introduction to Machining Processes and Machine Tools: Subtractive manufacturing processes and classifications.

Construction, specification operations of machine tools: Lathe, Shaping, Milling, Drilling, Grinding Machine.

Introduction to CNC machines: CNC Lathe, Milling, Drilling, Machine Center.

Module-2	**RBT Level L1, L2, L3**	**08 Hours**

Mechanics of Metal Cutting: Single point turning tool geometry (SPTT) influences the chip formation mechanisms of the Orthogonal and Oblique cutting process. Cutting Force Analysis (Orthogonal Cutting): Analysis of machining forces and power requirement, 'Merchant's model of Orthogonal Cutting and Theory of Lee & Shaffer' Chip Velocity, Velocity relationships (simple numerical); the influence of cutting temperature on machinability.

Cutting Fluids: Characteristics of Cutting fluids, Selections, and applying methods of cutting fluids.

Module-3	**RBT Levels L1, L2**	**08 Hours**

Machinability and Tool Life: Process of cutting tool failure wears and time relationship, tool wear index, feed marks, the effect of tool wear on the machined surface, surface finish, machinability, machinability index/rating, tool life & variables affecting tool life, tool materials.

Finishing Process: Importance of surface finishing processes, Grinding, Abrasive Flow Machining, and Honing. Sanding, Abrasive blasting, Polishing, and Lapping.

Surface Finishing and Protection: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing.

Module-4	RBT Levels L1, L2	08 Hours

Advanced Machining Process: Importance and classification of advanced machining process; Process principal, process parameters, and application of: - Abrasive Jet Machining (AJW), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM); Ultrasonic Machining (USM);Electrical Discharge Machining (EDM); Wire Electrical Discharge Machining (WEDM); Electro Chemical Machining (ECM). Laser Beam Machining (LBM), Electron Beam Machining (EBM), and Plasma Arc Machining (PAM).

Hybrid Machining Process: Importance of hybrid machining process; Process principal, process parameters, and application of: - Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted Electric Discharge Machining (UAEDM), Electrochemical Discharge Grinding (EDG), Powder Assisted Electric Discharge Machining (PAEDM)

Module-5	RBT Levels L1, L2	08 Hours

Jigs and Fixtures: Importance of jigs and fixtures; the difference between jigs and fixtures; types of jigs and fixtures; essential features of jigs and fixtures, Materials used. Factors to be considered for the design of Jigs and Fixtures.

Jigs: Template, Plate, Channel, Diameter, Leaf, Rung, Box.

Fixtures: Turning, Milling, Broaching, Grinding, Boring, Indexing, Tapping, Duplex, Welding, and Assembly fixtures.

Suggested Learning Resources:

Textbooks:

1.	Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2.	McGeough, J A, (1988), Advanced Methods of Machining, Springer.
3.	Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.

Reference Books:

1.	Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications.
2.	Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.
3.	Rao P. N., Manufacturing Technology II, Tata McGraw Hill

Web links and Video Lectures (e-Resources):

- V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: *http://nptel.ac.in/courses/112104028/*.
- U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: *http://nptel.ac.in/courses/112103248/*.
- A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, *https://nptel.ac.in/courses/112/105/112105126/*

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Visit any one machining center or machining industry and/or Case study on process parameter influence on anyone advanced machining process and hybrid machining process.

Course outcomes:	
CO1	Demonstrate the Conventional CNC machines and advanced manufacturing process operations.
CO2	Determine tool life, cutting force, and economy of the machining process.
CO3	Analyse the influence of various parameters on machine tools' performance.
CO4	Select the appropriate machine tools and process, the Jigs, and fixtures for various applications.

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		2
CO2	3	3											3		2
CO3	3	3											3		2
CO4	3	3											3		2

High-3, Medium-2, Low-1

Course Title	Micro Electro Mechanical Systems	**Semester**	IV
Course Code	ME262	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- expose to the MEMS technology & Miniaturization.
- understand the Process of Micro Fabrication Techniques.
- understand the principles of system modelling.
- describe the working principles of Mechanical sensors and actuators.
- Explain the working principles of Micro-Opto-Electro Mechanical Systems.

Module-1	**RBT Levels L1, L2**	**08 Hours**
MEMS: Introduction, Production Engineering, Precision Engineering and Ultra- Precision Engineering, Integrated circuits, Micro Electro Mechanical Systems.		
Module-2	**RBT LevelsL1, L2**	**08 Hours**
Micromachining: Introduction, Photo Lithography, Structural and Sacrificial Materials, Etching, Surface Micromachining, Bulk versus Surface Micromachining, Wafer Bonding, LIGA.		
Module-3	**RBT Levels L1, L2**	**08 Hours**
System Modelling: Introduction, Need for Modelling, System types, Basic Modelling Elements In Mechanical System, Basic Modelling Elements In Electrical Systems, Basic Modelling Elements In Fluid Systems and Thermal Systems.		
Module-4	**RBT Levels L1, L2**	**08 Hours**
Mechanical sensors and actuators: Introduction, Principles of Sensing and Actuation, Beam and Cantilever, Micro Plates, Capacitive Effects, Piezo Electric Material as Sensing and Actuating Elements.		
Module-5	**RBT Levels L1, L2**	**08 Hours**
Micro-Opto-Electro Mechanical Systems: Introduction, Fundamental Principles of MOEMS Technology, Review on Properties of Light, Light Modulators, Micro mirrors, Digital Micro mirror Device.		

Suggested Learning Resources: **Textbooks:**	
1.	MEMS- Nitaigour Premchand Mahalik, TMH 2007.
2.	Micro and Smart Systems: G.K.Ananthasuresh, K.J.Vinoy, S.Gopalakrishnan, K.N.Bhat,V.K.Aatre,Wiley India 2010.
Reference Books:	
1.	Design and Development Methodologies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Goplakrishnan, Wiley.
2.	MEMS & Microsystems: Design and Manufacture, Tai-Ran Hsu, Tata Mc-Graw-Hill.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Gaining hands on Knowledge to work on ANSYS Tool
- Simulation of Cantilever Beam For Different Loads On ANSYS Tool.

Course outcomes:	
CO1	Understand the working of MEMS technology & Miniaturization.
CO2	Explain the Process of Micro fabrication Techniques.
CO3	Explain the principles of system modelling.
CO4	Understand the working principles of Mechanical sensors and actuators.
CO5	Describe the working principles of Micro-Opto-Electro Mechanical Systems

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1		2								2		
CO2	2		1		2								2		
CO3	2		1		2								2		
CO4	2		1		2								2		
CO5	2		1		2								2		

High-3, Medium-2, Low-1

Course Title	Solar Energy	**Semester**	IV
Course Code	ME263	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- explain the various available forms of energy.
- understand the methods of generating non-conventional energy.
- describe the various applications of solar energy and their economic analysis.

Module-1	**RBT Levels L1, L2**	**08 Hours**

Introduction to Energy Sources: World and India9s Energy production and its reserves, Basics of Alternative Energy Sources like Wind energy, Biomass, OTEC, Tidal, Waves, Fuel cells, Energy from Hydrogen, Nuclear and Geothermal. Solar Radiation Thermal conversion of solar energy, its collection and storage, Solar radiation outside the Earth9s atmosphere, Radiation at the Earth9s surface, Instruments to measure radiation and sun shine, Solar radiation data, Solar radiation geometry, Availability of solar radiation, Radiation on tilted surface.

Module-2	**RBT Levels L1, L2**	**08 Hours**

Liquid Flat Plate collector: Performance Analysis, Transmissivity - absorptivity product, Overall Loss Coefficient, Heat transfer correlation, Collector efficiency factor, Heat removal factor, Parameters affecting performance, Testing procedure. Problems.

Module-3	**RBT Levels L1, L2**	**08 Hours**

Concentrating collectors: FPC with plane reflectors, Cylindrical Parabolic collectors, Compound Parabolic Collectors, Central Receiver Collector. Advantages and disadvantages of concentrating collectors. Selective Absorber Coating.

Module-4	**RBT Levels L1, L2**	**08 Hours**

Photovoltaic Cells: Solar cell Principle, Conversion efficiency and Power output, Basic system for power generation, Photovoltaic Arrays, Advantages and Disadvantages, Applications of Solar Cells. **Thermal Energy Storage System:** Sensible Heat storage, Latent Heat Storage, Thermo chemical Storage, Solar Ponds, Description, Performance analysis, Experimental studies, Operational Problems.

Module-5	**RBT Levels L1, L2**	**08 Hours**

Applications of Solar Energy: Solar Water Heating, Heating and Cooling of Buildings, Thermo Electric conversion, Power generation, PV cells, Solar distillation, Pumping, Cooking, Hydrogen production. Hybrid system: Solar energy with other types of energy for production and transport. **Economic Analysis:** Net present value concept, Life Cycle Cost method, Cost-benefit Comparison method, Payback Period method.

Suggested Learning Resources: **Textbooks:**	
1.	S.P.Sukhatme Solar Energy,Tata McGraw-Hill Publishing Co. Ltd.
2.	G.D.Rai, Non-conventional energy sources, Khanna Publishers
Reference Books:	
1.	G.D.Rai Solar Energy, Khanna Publishers
2.	H.P.Garg, and J.Praksh Solar Energy Fundamentals and Applications, Tata McGraw-Hill, Publishing Co. Ltd.
3.	D. Mukherjee and S. Chakrabarti Fundamentals of Renewable Energy Systems, New Age International Publishers.
4.	D.S. Chauhan and S.K.Srivastava Non-Conventional Energy Resources, New Age International Publishers.
Web links and Video Lectures (e-Resources): • https://nptel.ac.in/courses/112/105/112105051/	
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning	
Course outcomes:	
CO1	Identifying and formulating types of Solar radiation.
CO2	Designing a solar collector and its performance evaluation with environmental considerations.
CO3	Using research-based knowledge and research methods to distinguish different types of concentrating collectors.
CO4	Selecting and applying appropriate techniques to evaluate the conversion efficiency and power output of a photovoltaic cell and solar thermal energy storage system.
CO5	Applications of solar energy in the context of societal, health, safety, legal and cultural issues.

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2				2	2					2	3		3
CO2	3	2				2	2					1	3		3
CO3	3	2				2	2					2	3		3
CO4	3	2				2	2					2	3		3
CO5	3	2				3	3					1	3		3

High-3, Medium-2, Low-1

Course Title	Composite Materials	**Semester**	IV
Course Code	ME264	**CIE**	50
Total No. of Contact Hours	40	**SEE**	50
No. of Contact Hours/week	3:0:0	**Total**	100
Credits	3	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- Understand the behavior of constituents in the composite materials and different types of reinforcement.
- explain different types of matrices and develop the student skills in understanding the different manufacturing methods available for composite material.
- understand the various characterization techniques
- acquire the knowledge and analysis skills in applying basic laws in mechanics to the composite materials.

Module-1	**RBT Levels L1, L2**	**08 Hours**

Introduction to Composite Materials: Definition, classification & brief history of composite materials.

Constituent of composite materials: Reinforcements, Matrix, Coupling agents, coatings & fillers.

Reinforcements: Introduction, Glass Fibers, Boron Fibers, Carbon Fibers, Organic Fibers, Ceramic Fibers, Whiskers, Other Non-Oxide Reinforcements, Comparison of Fibers

Matrix Materials: Polymers, Metals and Ceramic Matrix Materials.

Interfaces: Wettability, Crystallographic nature of interface, types of bonding at the interface and optimum interfacial bond strength.

Module-2	**RBT Levels L1, L2**	**08 Hours**

Polymer Matrix Composites (PMC): Processing of PMC's; Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Moulding Compound and carbon reinforced polymer composites. Interfaces in PMC's, Structure & Properties of PMC's, applications

Metal Matrix Composites: Types of metal matrix composites, Important Metallic Matrices, Processing, Interfaces in Metal Matrix Composites, Properties & Applications.

Module-3	**RBT Levels L1, L2**	**08 Hours**

Ceramic Matrix Composites (CMC): Processing of CMC's; Cold Pressing & Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Directed Oxidation, In Situ Chemical Reaction Technique, Sol-Gel, Polymer Infiltration & Pyrolysis, Electrophoretic Deposition, Self-Propagating High Temperature Synthesis. Interfaces, properties and applications of CMC's.

Carbon Fiber/Carbon Matrix Composites: Processing of Carbon/Carbon Composites, Oxidation protection of Carbon/Carbon Composites, Properties of Carbon/Carbon Composites, and application of Carbon/Carbon Composites.

Multi-filamentary Superconducting Composites: The Problem of Flux Pinning, Types of Super Conductor, Processing & structure of Multi filamentary superconducting composites. Applications of multi-filamentary superconducting composites.

Module-4	RBT Levels L1, L2	08 Hours
Nonconventional Composites: Introduction, Nanocomposites; Polymer clay nanocomposites, self-healing composites, self-reinforced composites. Biocomposites, Laminates; Ceramic Laminates, Hybrid Composites. Performance/Characterization of Composites: Static Mechanical Properties; Tensile Properties, Compressive Properties, Flexural Properties, In-Plane Shear Properties, Interlaminar Shear Strength. Fatigue Properties; Tension–Tension Fatigue, Flexural Fatigue. Impact Properties; Charpy, Izod, and Drop Weight Impact Test.		
Module-5	**RBT Levels L1, L2**	**08 Hours**
Micromechanics of Composites: Density, Mechanical Properties; Prediction of Elastic Constants, Micromechanical Approaches, Halpin-Tsai Equations, Transverse Stresses, Thermal properties. Numerical Problems**.** **Macromechanics of Composites:** Introduction, Elastic constants of an isotropic material, elastic constants of a lamina, relationship between engineering constants and reduced stiffnesses and compliances.		

Suggested Learning Resources:

Textbooks:

1.	Composite Material Science and Engineering Krishan K. Chawla Springer Third Edition First Indian Reprint 2015
2.	G Fibre-Reinforced Composites, Materials, Manufacturing, and Design P.K. Mallick CRC Press, Taylor & Francis Group Third Edition
3.	Mechanics of Composite Materials & Structures MadhijitMukhopadhay Universities Press 2004

Reference Books:

1.	G Mechanics of Composite materials Autar K. Kaw CRC Taylor & Francis 2nd Ed, 2005
2.	Stress analysis of fiber Reinforced Composites Materials Michael W, Hyer Mc-Graw Hill International 2009
3.	Mechanics of Composite Materials .Robert M. Jones Taylor & Francis 1999

Web links and Video Lectures (e-Resources):

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Course outcomes:

CO1	Describe the fundamental concepts of composite materials, including their definition, classification, and historical development. Explain the roles of reinforcements, matrix materials, coupling agents, coatings, and fillers in composite materials.
CO2	Explain the processing techniques for polymer matrix composites (PMC) and metal matrix composites, including thermoset and thermoplastic matrix processing, and evaluate the properties and applications of these composites.
CO3	Determine the various processing methods for ceramic matrix composites (CMC) and carbon fiber/carbon matrix composites, and assess their properties, interfaces, and applications.
CO4	Describe nonconventional composites such as nanocomposites, self-healing composites, and biocomposites, and evaluate their performance using static, fatigue, and impact property tests.
CO5	Apply micromechanical and macromechanical approaches to predict the mechanical and thermal properties of composites, including the use of Halpin-Tsai equations and the relationships between engineering constants and reduced stiffness.

CO-PO Mapping															
CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3		
CO2	3	2											3		
CO3	3	2											3		
CO4	3	2											3		
CO5	3	2											3		

High-3, Medium-2, Low-1

Course Title	Introduction to Artificial Intelligence and Machine Learning	**Semester**	IV
Course Code	ME271	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	2:0:0	**Total**	100
Credits	2	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- familiarize basic principles, and applications of AI
- guide the students on generalization as a means to capturing patterns in the data.
- demonstrate the reasoning to internal representations of knowledge.
- make to understand the of challenges in Artificial Intelligence domain.
- acquaint with the future trends of Artificial Intelligence.

Module-1	**RBT Level/s 1, 2**	**06 Hours**

Introduction to AI: Introduction, The Turing Test Approach, Cognitive Modeling Approach, Laws of thought Approach, Rational agent Approach, AI Methods and tools, Foundations of Artificial Intelligence, Goals of AI, Performing Natural Language Processing using Email Filters in Gmail, Performing Natural Language Generation using Smart replies in Gmail.

Module-2	**RBT Level/s 1, 2**	**06 Hours**

Fundamentals of Machine Learning: Describing structural patterns, Machine Learning, Data Mining, Simple Examples, Fielded Examples, Machine Learning and statistics, Generalization as a search, Data mining and ethics. Data pre-processing using Weka, Handling high dimensional data through feature reduction in Weka.

Module-3	**RBT Level/s 1, 2**	**06 Hours**

Machine Learning Tasks: Decision Tables, Decision Trees, Classification rules, Association rules, Rules with exceptions, Rules involving relations, Trees for numeric prediction, Instance based representation, Clusters. Building soybean classification model using decision trees, generating association rules on weather data using Weka, Exploring Classification and Clustering techniques using scikit-learn or Weka.

Module-4	**RBT Level/s 1, 2**	**06 Hours**

Nature-inspired techniques in AI: Inspiration from brain, Perceptron, Artificial Neural Net, Unsupervised Learning, Genetic Algorithms. Weather Prediction through Neural Networks using Weka, Perform data labelling for various images using Supervisely.

Module-5	**RBT Level/s 1, 2**	**06 Hours**

Deep Learning: Basics of Deep Learning, Medical Image Analysis using Tensor Flow or Supervisely. Present and Future trends: The social effects of AI, A World with Robots, AI and Art, The Future, Integration, Artificial agents.

Suggested Learning Resources: **Textbooks:**	
1.	BlayWhitby, Artificial Intelligence: A Beginners Guide, Second Edition, One World Publisher, 2008
2.	Ian H. Witten, Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufman Publishers, 3rd Edition, 2011.
Reference Books:	
1.	AurélienGéron,Hands on Machine Learning with Scikit-Learn and TensorFlow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media,2017
2.	Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence,TMH Education Pvt. Ltd., 2008.
3.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/111101003/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/112/103/112103280/
4. https://www.analyticsvidhya.com/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

- Case Studies with Chatbot Design Challenges: Present real-world scenarios (e.g., customer service chatbots, educational chatbots)
- Algorithmic Debugging Race: Divide the class into teams and have them identify and fix bugs in intentionally buggy code snippets for common machine learning algorithms.
- Interactive Data Visualization Challenge: Introduce students to real-world datasets related to AI applications (e.g., image recognition, natural language processing).

Course outcomes:	
CO1	Understand the basic principles and goals of AI tasks
CO2	Outline the role of AI in different real-time applications
CO3	Construct a problem with the suitable AI task
CO4	Understanding of Deep Learning techniques and their application in medical image analysis with tools like Tensor Flow or Supervisely.

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1		2	2									2	
CO2		1		2	2									2	
CO3		1		2	2									2	
CO4		1		2	2									2	

High-3, Medium-2, Low-1

Course Title	Digital Marketing	**Semester**	IV
Course Code	ME272	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	2:0:0	**Total**	100
Credits	2	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- focus on the importance of digital marketing and its applications
- introduce current and core practices of Digital and Social Media Marketing that will allow learners
- analyze, plan, execute and evaluate a digital marketing strategy.

Module-1	**RBT Levels L1, L2**	**06 Hours**
Introduction to Digital Marketing (DM)-Meaning, Definition, Need of DM, Scope of DM, History of DM, Concept and approaches to DM, Examples of good practices in DM. Email Marketing-Need for Emails, Types of Emails, options in Email advertising, Mobile Marketing.		
Module-2	**RBT Levels L1, L2**	**06 Hours**
Social Media Marketing -Introduction to Blogging. Introduction to Face book, Twitter, Google +, LinkedIn, YouTube, Instagram and Pinterest; their channel advertising and campaigns.		
Module-3	**RBT Levels L1, L2**	**06 Hours**
Acquiring & Engaging Users through Digital Channels: Understanding the relationship between content and branding and its impact on sales, search engine marketing, mobile marketing, video marketing, and social-media marketing.		
Module-4	**RBT Levels L1, L2, L3**	**06 Hours**
Designing Organization for Digital Success: Digital transformation, digital leadership principles, online P.R. and reputation management. ROI of digital strategies, how digital marketing is adding value to business, and evaluating cost effectiveness of digital strategies		
Module-5	**RBT Levels L1, L2**	**06 Hours**
Digital Innovation and Trends: The contemporary digital revolution, digital transformation framework; security and privatization issues with digital marketing, Understanding trends in digital marketing – Indian and global context, online communities and co-creation.		

Suggested Learning Resources: **Textbooks:**	
1.	Fundamentals of Digital Marketing by Puneet Singh Bhatia, Pearson
2.	Moutsy Maiti: Internet Marketing, Oxford University Press India
3.	Vandana, Ahuja; Digital Marketing, Oxford University Press India (November, 2015).
4.	Eric Greenberg, and Kates, Alexander; Strategic Digital Marketing: Top Digital Experts
Reference Books:	
1.	Ryan, Damian; Understanding Digital Marketing: marketing strategies for engaging the digital generation; Kogan Page (3rd Edition, 2014).
2.	Tracy L. Tuten & Michael R. Solomon: Social Media Marketing (Sage Publication)
Web links and Video Lectures (e-Resources): 1. https://archive.nptel.ac.in/courses/110/106/110106072/ 2. https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg24/	
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning	

Course outcomes:	
CO1	understand its scope and need, and be aware of its historical evolution. They will also be able to identify and apply effective digital marketing strategies and tactics
CO2	utilize various social media platforms for marketing purposes. They will understand the concept of channel advertising and campaigns on these platforms.
CO3	explain the relationship between content and branding and its impact on sales. And effectively implement search engine marketing, mobile marketing, video marketing, and social media marketing strategies to acquire and engage users.
CO4	impliment the concept of digital transformation and its implications for organizations and to develop digital leadership principles, manage online public relations and reputation, and evaluate the ROI of digital strategies.
CO5	idenify the digital revolution, its impact on businesses, security and privacy concerns, global and Indian digital marketing trends, and the role of online communities and co-creation.

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				2	2					2	1			2	
CO2				2	2					2	2	1		2	
CO3				2	2					2	1	1		2	
CO4			2	2	2					1	1			2	
CO5				2	2					2	2			2	

High-3, Medium-2, Low-1

Course Title	Probability and Statistics for Engineers	**Semester**	IV
Course Code	ME273	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/week	2:0:0	**Total**	100
Credits	2	**Exam. Duration**	3 Hours
Teaching Dept	Mechanical Engineering		

Course objective is to:

- study the basics of statistics, measure central tendency and dispersion.
- develop statistical methods for correlation, regression analysis and curve fitting.
- explore the principles of probability.
- understand the principles of probability distribution
- explain the sampling theory, errors and chi distribution.

Module-1	**RBT Levels L1, L2**	**06 Hours**
Basic Statistics: Measures of central tendency, measures of dispersion, range quartile deviation, mean deviation, standard deviation, coefficient of variation, Skewness and Kurtosis, problems.		
Module-2	**RBT Levels L1, L2**	**06 Hours**
Statistical Methods: correlation and regression – Karl Pearson's coefficient of correlation and rank correlation problems, regression analysis-lines of regression, problems. Curve fitting: curve fitting by the method of least square-fitting the curves of the form $Y=ax+b$, $y=ab^x$, $y=ax^2+bx+c$		
Module-3	**RBT Levels L1, L2, L3**	**06 Hours**
Probability: Introduction, sample space and events, Axioms of probability, Addition and multiplication theorems, conditional probability, Bayes' Theorem, problems.		
Module-4	**RBT Levels L1, L2, L3**	**06 Hours**
Probability Distributions: Random variables (discrete and continuous), probability mass/density function, Binomial, Poisson, Exponential and normal distributions- problems (no derivations for mean and standard deviation)		
Module-5	**RBT Levels L1, L2**	**06 Hours**
Sampling theory: Introduction to sampling distributions, standard error, type-I and type-II errors. Test of hypothesis of means, students' distribution, Chi-square distribution as a test of goodness of fit problems.		

Suggested Learning Resources:

Textbooks:

1.	**Statistical Methods for Engineers and Scientists** by Douglas C. Montgomery, Rebecca A. Peck, and Geoffrey G. Vining Publisher: Wiley, Edition: 9th Edition (2021)
2.	**Introduction to Probability and Statistics for Engineers and Scientists** by Sheldon Ross, Academic Press, 10th Edition (2021)

3.	**Engineering Statistics: A Primer** by William W. Hines and Douglas C. Montgomery, Wiley, 6th Edition (2017)
Reference Books:	
1.	**Statistics for Engineers and Scientists** by George E. P. Box, William G. Hunter, and Jerry S. Hunter, Wiley, 5th Edition (2018).
2.	**Statistical Modeling and Analysis for Engineers and Scientists** by Michael L. Klein and Michael R. Schucany, Springer, 3rd Edition (2017)
3.	**Probability and Statistics with R** by Michael J. Crawley, Wiley, 3rd Edition (2019)

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/110/106/110106072/
2. https://archive.nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg24/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning

Course outcomes:	
CO1	Elucidate the basic principles of statistics
CO2	Apply the correlation and regression analysis to engineering problem
CO3	Apply the principles of probability to engineering problems
CO4	Explain probability distribution and solve problems
CO5	Explain the sampling, error and its applications

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1									2	
CO2	2	3	3	2	2									2	
CO3	2	3	3	3	1									1	
CO4	3	2	2	3	1									1	
CO5	3	2	2	3	2									1	

High-3, Medium-2, Low-1

Course Title	Biology for Engineers	**Semester**	IV
Course Code	BG257	**CIE**	50
Total No. of Contact Hours	30	**SEE**	50
No. of Contact Hours/Week	2:0:0	**Total**	100
Credits	2	**Exam. Duration**	3 Hours
Teaching Dept.	Basic Sciences		

Course objective is to enable students:

- Acquire an understanding on basic modern biological concepts with an emphasis on how bioprocesses are analogous to engineering field, as a multidisciplinary field.
- Understand basic engineering principles imminently run physiological processes particularly about engineering designs and solutions that are arrived citing body functional examples.
- Explain aspects that many bio-solutions could be foundational to design, develop better processes, products and useful to achieve quality of life.

Module-1	**RBT Level L1, L2**	**6 Hours**

Biomimetics:
Biology for Engineers, Body Fluid: Blood – Mechanics of heart, Blood pressure, Life molecules: Water, Carbohydrates, Proteins, Lipids and Nucleic acids, Biomimetics: Bio-processes- engineering analogies.

Module-2	**RBT Level L1, L2**	**6 Hours**

Bioenergy:
Unit of life: Human and Plant cell, Metabolism: Enzymes as Bio-catalysts and physiological entities, Anabolism – Bioenergy from Sun-Photosynthesis, catabolism.

Module-3	**RBT Level L1, L2**	**6 Hours**

Biomechanics (Human body Movement Mechanics)
Normal Human Movement: Force-vector of body; Movement Angles; Muscle contraction-relaxation; Posture – Static & Dynamic; Ideal and abnormal posture, Practical: Stepping- Lifting- Sit-Stand.

Module-4	**RBT Level L1, L2**	**6 Hours**

Bioelectronics
Brain & Computer: Senso-neural networks, Biosensors and IoT as applied to biology, Bionic Eye: Mechanism of Vision, Electronic Nose: Bio-olfactory mechanisms (Science of smell), Impulses: Cardiac and Nerve, Biological Clock and Circadian rhythm.

Module-5	**RBT Level L1, L2,L3**	**6 Hours**

Biopharma:
Metabolic syndromes, Cancer and its diagnostics, Lab on a chip, Drug Discovery.

Suggested Learning Resources: **Textbooks:**	
1	Campbell, N.A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S.A.; Minorsky, P.V.; Jackson, R. B. Pearson. "Biology: A global approach", , Global Edition, 10/E, 2014
2	David Nelson, Michael Cox. "Lehniger Principles of Biochemistry". W H Freeman & Company, Seventh Edition, 2017.
Reference Books:	
1	Janine M Benvus. "Biomimicry: Innovation inspired by Nature". William Morrow Paperbacks, 2002.
Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning Real world problem solving and puzzles using group discussion. Demonstration of solution to a problem though experiential learning. Demonstration using real objects taking students on educational tour.	

Course outcomes: **At the completion of the course. The student shall be able to**	
CO1	Apply and utilize essential knowledge of the biological mechanisms of living organisms from the perspective of engineers and find solutions to solve bio-engineering problems with appropriate tools.
CO2	Distinguish and make use of optimal designs in engineering that are bio-mechanical in nature and build and use by observing and understanding bio-physiological processes involved in sensing, locomotion, and knowledge application of range of bio-chemicals.
CO3	Demonstrate that bio-chemical, bio-sensory, bioprocesses could be path-finders to optimise similarities for functional aspects of electronic, computer, mechanical, electrical machines.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1				1					1
CO2	3	1	1				1					1
CO3	3	1	1				1					1

High-3, Medium-2, Low-1

Course Title	NSS - Phase 2	**Semester**	IV
Course Code	NS258	**CIE**	50
Total No. of Contact Hours	25 Hours	**SEE**	0
No. of Contact Hours/week	0:2:0	**Total**	50
Credits	-----	**Exam. Duration**	-----
Teaching Dept.	Any Department		

Course objective is to: National Service Scheme (NSS) will enable the students to:

1.Understand the community in which they work

2.Identify the needs and problems of the community and involve them in problem-solving

3.Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems

4.Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes

5.Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony

Module:1	**RBT Level L1, L2**	**4 Hours**

Organic farming

Indian Agriculture (Past, Present and Future) Connectivity for marketing. Waste management– Public, Private and Govt organization, 5 R's.Plantation and adoption of plants. Know your plants. Awareness on Organic farming.

Module:2	**RBT Level L1, L2**	**3 Hours**

Developing Water conservation techniques
To develop sustainable water management system, – Role of different stakeholders– Implementation Developing Sustainable Water management system for rural areas and implementation approaches.

Module: 3	**RBT Level L1, L2**	**8 Hours**

Activity Based Programmes:

A. Campus Activities: Celebration of national importance days

Awareness Programmes – Preparing an actionable business proposal for enhancing the village income and approach for implementation. Importance of health, hygiene, and sanitation Healthy life style, HIV /AIDS, drugs and substance

Module: 4	RBT Level L1, L2	10 Hours
Off Campus Activities: Govt. school Rejuvenation and helping them to achieve good infrastructure and results, Women Empowerment Programme, Health Camps, Blood grouping awareness and Blood donation, Legal awareness Programme, Literacy Programme, Water Conservation Programme, One Day Special Camp in a village (preferably in adopted village.		

Course outcomes: **At the completion of the course. The student shall be able to**	
CO1	Describe the concept of Youth and compare the international definitions of the term Youth.
CO2	Students will be able to appreciate our demographic advantage and its role in nation building.
CO3	Know the growth and evolution of NSS and its role in Nation building through community service
CO4	Visualize the signs, symbols, logo of NSS and understand their broader meaning.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	1					1
CO2						1	1					1
CO3						1	1					1
CO4						1	1					1

High-3, Medium-2, Low-1

Course Title	Physical Education (PE) (Sports and Athletics) – Phase 2	**Semester**	IV
Course Code	PE258	**CIE**	50
Total No. of Contact Hours	25 Hours	**SEE**	0
No. of Contact Hours/Week	0:2:0	**Total**	50
Credits	--	**Exam. Duration**	------
Teaching Dept	Sports		

Course objective:

Physical education aims to develop all aspects of the human personality through physical and sports activities. Being a subject of science, it has its own value in society and human life. Physical Education is a form of one of the most effective means of education imparted through exercises, fun activities and sports. It is an integral part of the education system. It caters to the need for development of the students on physical, mental and social aspects.

Module – 1	**RBT Level L1, L2**	**5 Hours**

Ethics and Moral Values:

A. Ethics in Sports.
B. Moral Values in Sports and Games

Module – 2	**RBT Level L1, L2**	**15 Hours**

Specific Games (Any one to be selected by the student)

A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower Hand Pass.
B. Throw ball – Service, Receive, Spin attack, Net Drop & Jump throw.
C. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
D. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 up.
E. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & BackHand), Smash.
F. Athletics (Track / Field Events) – Any event as per availability of Ground.

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Module - 3	**RBT Level L1, L2**	**5 Hours**

Role of Organization and administration

Course outcomes: At the end of the course, the student will be able to	
CO1	Understand the ethics and moral values in sports and athletics.
CO2	Perform in the selected sports or athletics of student's choice
CO3	Understand the roles and responsibilities of organization and administrationof sports and games

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1

High-3, Medium-2, Low-1

Course Title	Yoga for a Better Life - Phase 2	**Semester**	IV
Course Code	YG258	**CIE**	50
Total No. of Contact Hours	25	**SEE**	0
No. of Contact Hours/week	0:2:0	**Total**	50
Credits	0	**Exam. Duration**	-----
Teaching Dept	**Any Department**		

Course objectives:

1) To enable the student to have good health.
2) To practice mental hygiene.
3) To possess emotional stability.
4) To integrate moral values.
5) To attain higher level of consciousness.

SEMESTER IV	**RBT Levels L1, L2**	**25 Hours**

Patanjali's Ashtanga Yoga, its need and importance. Yama :Ahimsa, satya, asteya, brahmacarya, aparigraha Niyama :shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan.
Suryanamaskar12 count- 4 rounds of practice
Asana, Need, importance of Asana. Different types of asana. Asana its meaning by name, technique, precautionary measures and benefits of each asana Different types of Asanas

a. Sitting
1. Sukhasana
2. Paschimottanasana

b. Standing
1. Ardhakati Chakrasana
2. Parshva Chakrasana

c. Prone line
1. Dhanurasana

d. Supine line
1. Halasana
2. Karna Peedasana

Meaning, importance and benefits of Kapalabhati. 40 strokes/min 3 rounds Meaning, Need, importance of Pranayama.
Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama Pranayama –
1. Suryanuloma –Viloma 2. Chandranuloma-Viloma 3. Suryabhedana 4. Chandra Bhedana 5. Nadishodhana

Suggested Learning Resources:

Textbooks:

1. Yogapravesha in Kannada by Ajitkumar
2. Light on Yoga by BKS Iyengar
3. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4. Yoga Instructor Course hand book published by SVYASA University, Bengaluru
5. Yoga for Children –step by step – by Yamini Muthanna

Web links and Video Lectures (e-Resources):

Refer links

- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as;

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioural therapy for smoking cessation and substance abuse (including alcohol abuse). If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- **Physical**
  1. Improved body flexibility and balance
  2. Improved cardiovascular endurance (stronger heart)
  3. Improved digestion
  4. Improved abdominal strength
  5. Enhanced overall muscular strength
  6. Relaxation of muscular strains
  7. Weight control
  8. Increased energy levels
  9. Enhanced immune system

- **Mental**
  1. Relief of stress resulting from the control of emotions

2. Prevention and relief from stress-related disorders
3. Intellectual enhancement, leading to improved decision-making skills

- **Spiritual**
  1. Life with meaning, purpose, and direction
  2. Inner peace and tranquillity
  3. Contentment

Course outcomes: **At the completion of the course. The student shall be able to**	
CO1	Understand the meaning, aim and objectives of Yoga.
CO2	Perform Suryanamaskar and able to Teach its benefits.
CO3	Understand and teach different types of Pranayama, Asanas by name, its importance, methods and benefits.
CO4	Instruct Kapalabhati and its need and importance.
CO5	Coach different types of Kriyas , method to follow and usefulness.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1
CO4			1			1	1					1
CO5			1			1	1					1

Course Title	Social Connect and Responsibilities	**Semester**	IV
Course Code	SC259	**CIE**	50
Total No. of Contact Hours	25	**SEE**	0
No. of Contact Hours/week	0:0:2	**Total**	50
Credits	0	**Exam. Duration**	-----
Teaching Dept	Any Department		

Course objectives:

- Provide a formal platform for students to communicate and connect to the surrounding.
- Create a responsible connection with the society.
- Understand the community in general in which they work.
- Identify the needs and problems of the community and involve them in problem –solving.
- Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
- Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

SEMESTER IV	**RBT Levels L1, L2,L3**	**25 Hours**

Part I:

Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

Part II :

Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.

Part III :

Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus – Objectives, Visit, case study, report, outcomes.

Part IV:

Water conservation:

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices – Objectives, Visit, case study, report, outcomes.

Part V :

Food walk:

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes

Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY:

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersion with NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

COURSE TOPICS:

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

Course outcomes: **At the completion of the course. The student shall be able to**	
CO1	Communicate and connect to the surrounding.
CO2	Create a responsible connection with the society.
CO3	Involve in the community in general in which they work.
CO4	Notice the needs and problems of the community and involve them in problem –solving.
CO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

Duration:

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. Program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic and poetry) Faculty mentors have to design the evaluation system as per VTU guidelines of scheme & syllabus.

Pedagogy – Guidelines :

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	**Plantation and adoption of a tree:**	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	**Heritage walk and crafts corner:**	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc…..	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	**Organic farming and waste management:**	May be individual or team	Farmers land / parks / Villages visits / Roadside/ community area / College campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	**Water conservation: & conservation techniques**	May be individual or team	Villages/ City Areas / Grama Panchayat/ public associations/Government Schemes officers / campus etc…..	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	**Food walk: Practices in society**	May be individual or team	Villages/ City Areas / Grama Panchayat/ public associations/Government Schemes officers/ campus etc…..	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty

Plan of Action (Execution of Activities)	
Sl.No	Practice Session Description
1	Lecture session in field to start activities
2	Students Presentation on Ideas
3	Commencement of activity and its progress
4	Execution of Activity
5	Execution of Activity
6	Execution of Activity
7	Execution of Activity
8	Case study based Assessment, Individual performance
9	Sector/ Team wise study and its consolidation
10	Video based seminar for 10 minutes by each student At the end of semester with Report.

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

Assessment Details for CIE (both CIE and SEE)		
Weightage	**CIE – 100%**	• Implementation strategies of the project (NSS work). • The last report should be signed by NSS Officer, the HOD and principal. • At last report should be evaluated by the NSS officer of the institute. • Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit.
Field Visit, Plan, Discussion	10 Marks	
Commencement of activities and its progress Case study based Assessment	20 Marks	
Individual performance with report	20 Marks	
Sector wise study & its consolidation 5*5 = 25	25 Marks	
Total marks for the course	100 Marks	

For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.

Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			1			1	1					1
CO2			1			1	1					1
CO3			1			1	1					1
CO4			1			1	1					1
CO5			1			1	1					1

High-3, Medium-2, Low-1