NEW HORIZON
COLLEGE OF ENGINEERING

Department of Mechanical Engineering

Academic Year 2024-25

3rd and 4th Semester

Scheme & Syllabus

BATCH: 2023-27

CREDITS: 160

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NEW HORIZON COLLEGE OF ENGINEERING

VISION

To emerge as an institute of eminence in the fields of engineering, technology and management in serving the industry and the nation by empowering students with a high degree of technical, managerial and practical competence.

MISSION

- To strengthen the theoretical, practical and ethical dimensions of the learning process by fostering a culture of research and innovation among faculty members and students.

- To encourage long-term interaction between the academia and industry through their involvement in the design of curriculum and its hands-on implementation.

- To strengthen and mould students in professional, ethical, social and environmental dimensions by encouraging participation in co-curricular and extracurricular activities.

QUALITY POLICY

To provide educational services of the highest quality both curricular and co-curricular to enable students integrate skills and serve the industry and society equally well at global level

VALUES

- Academic Freedom
- Integrity
- Inclusiveness
- Innovation
- Professionalism
- Social Responsibility

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To create competent mechanical engineers capable of working in diversified disciplines for transformative impact on societal progressive development in the field of mechanical engineering through creative research and lifelong learning

MISSION

- To impart excellent education by providing the state of art research facilities in the field of mechanical engineering.
- To develop alliances with industries and other organizations for excellence in teaching learning process, research and consultancy projects.
- To enhance the knowledge of students in intellectual, entrepreneurial and ethical   challenges through active participation by critical thinking.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

➢ **PEO 1**: The graduates will be able to apply the overall knowledge of Mechanical Engineering along with concepts of Mathematics, Science, Communication and Computing skills to understand specific problem areas and finding the optimal solutions for the same.

➢ **PEO 2**: The graduates will be able to implement ideas of Mechanical Engineering for the challenging tasks in the interdisciplinary areas like Electrical, Electronics, Computer Science, Civil, Bio-Technology and allied branches.

➢ **PEO 3**: The graduates will be widely talented in the fields of manufacturing, service and design industries, which will not only improve their employability but also aid in establishing the above said industries.

➢ **PEO 4**: The graduates will develop lifelong learning attitudes, ethics and values that will help their career employability and growth in engineering, academia, defence, state and central government sectors.

PEO TO MISSION STATEMENT MAPPING

Program Educational Objectives	M1	M2	M3
PEO 1	3	2	3
PEO 2	2	3	2
PEO 3	2	3	2
PEO 4	1	2	3

PROGRAM OUTCOMES (POs)

Graduate Attributes	PO #	Program Outcomes
Engineering knowledge	1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex mechanical engineering problems
Problem Analysis	2	Identify, formulate, review research literature, and analyze complex engineering problems in Mechanical Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
Design Development of Solutions	3	Design solutions for complex engineering problems and design system components or processes of Mechanical Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Conduct Investigations of Complex Problems	4	Use research-based knowledge and research methods including design of experiments in Mechanical Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
Modern tool usage	5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities in Mechanical Engineering with an understanding of the limitations.
The Engineer and society	6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Mechanical Engineering.
Environment and Sustainability	7	Understand the impact of the professional engineering solutions of mechanical Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
Ethics	8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual & team work	9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
Communication	10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project management and finance	11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, manage projects and in multidisciplinary environments.
Lifelong learning	12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of mechanical Engineering Program, the graduates will be able to:

PSO1	Specify, fabricate, test and operate various machines along with essential documentations.
PSO2	Analyze, design, develop and implement the concepts of mechanical systems and processes towards product development

S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
					III Semester								
1	BSC	22MAE31	Numerical Methods and Transforms	BS	2	1	0	0	3	4	50	50	100
2	PCC	22MEE32	Mechanics of Materials	ME	3	0	0	0	3	3	50	50	100
3	PCCL	22MEL32	Mechanics of Materials Lab	ME	0	0	1	0	1	2	50	50	100
4	PCC	22MEE33	Fluid Mechanics and Machinery	ME	3	0	0	0	3	3	50	50	100
5	PCCL	22MEL33	Fluid Mechanics and Machinery Lab	ME	0	0	1	0	1	2	50	50	100
6	ESC	22MEE34X	ESC/ ETC/ PLC (2:0:1:0)	ME	3	0	0	0	3	3	50	50	100
7	AEC	22MEE35X	Ability Enhancement Course – III	ME	If the course is a Theory						50	50	100
					1	0	0	0	1	1			
					If the course is a Laboratory								
					0	0	1	0	1	2			
8	BSC	22BIK36	Bio Inspired Design and Innovation	Any Dept	3	0	0	0	3	3	50	50	100
9	UHV	22SCK37	Social Connect and Responsibility	Any Dept	0	0	1	0	1	2	50	--	50
		OR											
		22UHK37	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	100
10	NCMC	22NSS30	National Service Scheme	NSS coordinator	0	0	0	0	0	2	50	--	50
		22PED30	Physical Education and Sports	Physical Education Director									
		22YOG30	Yoga	Yoga Teacher									
			Total						**19**	**25/26**	**450**	**400 / 450**	**900 / 950**
11	NCMC	22DMAT31*	Basic Applied Mathematics -I	BS	0	0	0	0	0	2	50	--	**50**

BSC: Basic Science Course, **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **NCMC:** Non-Credit Mandatory Course, **AEC**: Ability Enhancement Course, **L:** Lecture, **T**: Tutorial, **P:** Practical **S: SDA**: Self Study for Skill Development, **K:** This letter in the course code indicates common to all the stream of engineering. **ESC:** Engineering Science Course, **ETC**: Emerging Technology Course, **PLC**: Programming Language Course, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation

22DMAT311*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Emerging Technology Course (ETC)			
22MEE341	Sustainable Manufacturing and Green Technologies	22MEE344	Instrumentation in Thermal Engineering
22MEE342	Material science and metallurgy	22MEE345	Tool Engineering
22MEE343	Bioenergy and Biofuels		

Ability Enhancement Course – III (For IT allied Branches, all are Laboratory Courses 0-0-1-0) (Other branches can have 1-0-0-0 or 0-0-1-0)			
22MEE351	Computer Aided Machine Drawing(0-0-1-0)	22MEE354	Industrial Waste Management(1-0-0-0)
22MEE352	Excel in MS Excel[0-0-1-0)	22MEE355	Introduction to virtual reality(0-0-1-0)
22MEE353	Workshop Technology(0-0-1-0)		

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Credit Definition: 1-hour Lecture (L) per week=1Credit 2-hoursTutorial(T) per week=1Credit 2-hours Practical / Drawing (P) per week=1Credit 2-hous Self Study for Skill Development (SDA) per week = 1 Credit	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions

S. No.	Course and Course Code		Course Title	BoS	Credit Distribution				Overall Credits	Contact Hours	Marks		
					L	T	P	S			CIE	SEE	Total
1	BSC	22MAE41	Numerical, Complex Analysis and Probability Theory	BS	2	1	0	0	3	4	50	50	**100**
2	PCC	22MEE42	Engineering Thermodynamics	ME	3	0	0	0	3	3	50	50	**100**
3	PCCL	22MEL42	Engineering Thermodynamics Lab	ME	0	0	1	0	1	2	50	50	**100**
4	PCC	22MEE43	Manufacturing Technology	ME	3	0	0	0	3	3	50	50	**100**
5	PCCL	22MEL43	Manufacturing Technology Lab	ME	0	0	1	0	1	2	50	50	**100**
6	PCC	22MEE44	Mechanical Measurements and Metrology	ME	3	0	0	0	3	3	50	50	**100**
7	PCCL	22MEL44	Mechanical Measurements and Metrology Lab	ME	0	0	1	0	1	2	50	50	**100**
8	ESC	22MEE45X	ESC/ETC/PLC (2:0:1:0)	ME	3	0	0	0	3	3	50	50	**100**
9	AEC	22MEE46X	Ability Enhancement Course – IV	ME	If the course is a Theory						50	50	**100**
					1	0	0	0	1	1			
					If the course is a Laboratory								
					0	0	1	0	1	2			
10	UHV	22UHK47	Universal Human Values and Life Skills	Any Dept	1	0	0	0	1	2	50	50	**100**
		OR											
		22SCK47	Social Connect and Responsibility	Any Dept	0	0	1	0	1	2	50	--	**50**
11	PROJ	22MEE48	Mini Project-I	ME	0	0	1	0	1	0	50	50	**100**
12	NCMC	22NSS40	National Service Scheme	NSS coordinator	0	0	0	0	0	2	50	--	**50**
		22PED40	Physical Education and Sports	Physical Education Director									
		22YOG40	Yoga	Yoga Teacher									
Total									21	27/28	600	500/450	**1100/1050**

| 13 | NCMC | 22DMAT41* | Basic Applied Mathematics-II | BS | 0 | 0 | 0 | 0 | 0 | 2 | 50 | -- | **50** |

BSC: Basic Science Course, PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non-Credit Mandatory Course, AEC: Ability Enhancement Course, PROJ: Mini Project work, L: Lecture, T: Tutorial, P: Practical S: SDA: Self Study for Skill Development, K: This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

22DMAT41*: This non-credit mandatory course to be offered with only CIE and no SEE to Lateral entry students.

Engineering Science Course / Emerging Technology Course / Programming Language Course (ESC/ETC/PLC)			
22MEE451	Programming for IoT(3-0-0-0)	22MEE454	Robotic Programming(3-0-0-0)
22MEE452	Essential of cyber security(3-0-0-0)	22MEE455	Object Oriented Programming Using JAVA(2-0-1-0)
22MEE453	Introduction to Machine learning(3-0-0-0)		

Ability Enhancement Course – IV (For IT allied Branches, all are Laboratory Courses 0-0-1-0) (Other branches can have 1-0-0-0 or 0-0-1-0)			
22MEE461	Mat Lab for Mechanical Engineers	22MEE464	Air Pollution Control
22MEE462	Energy management and auditing	22MEE465	Introduction to Embedded system
22MEE463	Disaster Management		

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor. A student can do mini project as
   (i)   A group of 2 if mini project work is single discipline (applicable to all IT allied branches)
   (ii)   A group of 2- 4 if mini project work is single discipline (applicable to all Core Branches)
  (iii) A group of 2 - 4 students if the Mini Project work is a multidisciplinary (Applicable to all Branches)

CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the percentage ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE) (Sports and Athletics), and Yoga (YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Credit Definition:	03-Credits courses are to be designed for 40 hours in Teaching-Learning Session
1-hour Lecture (L) per week=1Credit	02- Credits courses are to be designed for 25 hours of Teaching-Learning Session
2-hoursTutorial(T) per week=1Credit	
2-hours Practical / Drawing (P) per week=1Credit	01-Credit courses are to be designed for 15 hours of Teaching-Learning Sessions
2-hous Self Study for Skill Development (SDA) per week = 1 Credit	

III Semester Syllabus

NUMERICAL METHODS AND TRANSFORMS

Course Code	22MAE31	CIE Marks	50
L:T:P:S	2:1:0:0	SEE Marks	50
Hrs. / Week	4	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MAE31.1	Use appropriate numerical methods to solve algebraic equations and transcendental equations.
22MAE31.2	Differentiate the physical problems numerically, evaluate a definite integral numerically and use appropriate numerical methods to solve boundary value problems in partial differential equations.
22MAE31.3	Justify Z-transforms method to solve continuous/discrete model problems.
22MAE31.4	Express the periodic functions as Fourier series expansion analytically and numerically.
22MAE31.5	Solve the continuous model problems using Fourier transform.
22MAE31.6	Analyze the Fast Fourier transforms method to solve the discrete model problems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22MAE31.1	3	3	-	-	-	-	-	-	-	-	-	-
22MAE31.2	3	3	-	-	-	-	-	-	-	-	-	-
22MAE31.3	3	3	-	-	-	-	-	-	-	-	-	-
22MAE31.4	3	3	-	-	-	-	-	-	-	-	-	-
22MAE31.5	3	3	-	-	-	-	-	-	-	-	-	-
22MAE31.6	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	NUMERICAL METHODS-1	22MAE31.1	8 Hours

Numerical solution of algebraic and transcendental equations: Newton-Raphson Method-Problems. Interpolation: Newton's forward and backward formulae for equal intervals, Newton divided difference, Lagrange's formula and Lagrange's inverse interpolation formula for unequal intervals (without proofs)-Problems.

Case Study	Case studies on Numerical Analysis.
Text Book	Text Book 1: 28.2, 28.3, 29.6, 29.10, 29.12, 29.13. Text Book 3: 19.2, 19.3.

MODULE-2	NUMERICAL METHODS-2	22MAE31.2	8 Hours

Numerical Differentiation: Derivatives of first order and second order using Newton's forward differences and Newton's backward differences.
Numerical integration: Trapezoidal rule and Simpson's 1/3rd rule (without proofs)-Problems.

Applications	Application of numerical integration to velocity of a particle and volume of solids. Numerical solution of one-dimensional wave equation, heat equation and two-dimensional Laplace's equation.
Text Book	Text Book 1: 30.2, 30.6, 30.7, 29.6, 29.10, 29.12, 29.13, Text Book 3: 19.5.

MODULE-3	Z-TRANSFORM	22MAE31.3	8 Hours

Definition, Z-transforms of some standard functions, properties, damping rule, shifting rule (without proof), initial and final value theorems, inverse Z- transforms by partial fractions method.

Applications	Applications: Solving difference equations using Z-transform.
Text Book	Text Book 1: 23.3, 23.4, 23.5, 23.6, 23.9, 23.15, 23.16. Text Book 2: 6.14.11, 6.14.12

MODULE-4	FOURIER SERIES	22MAE31.4	8 Hours

Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period 2l, half range series-Problems.

Applications	Applications: Practical harmonic analysis-Problems.
Text Book	Text Book 1: 10.2, 10.4, 10.5, 10.6, 10.7, 10.11, Text Book 3: 11.1

MODULE-5	**FOURIER TRANSFORMS, DISCRETE AND FAST FOURIER TRANSFORMS**	22MAE31.5 22MAE31.6	8 Hours

Fourier Transforms: Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier sine and cosine transforms.

Discrete Fourier Transform and Fast Fourier Transform: Definition of N-Point DFT, problems for 4-points and inverse DFT for four points only. FFT algorithm to compute the Fourier transforms 4-point only.

Text Book	Text Book 1: 22.4, 22.5, Text Book 2:8.3, 8.4, 9.2, 9.3, Text Book 3: 11.9

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	5
L5	Evaluate	5
L6	Create	-

Suggested Learning Resources:
Text Books:
1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Tarun Kumar Rawat, Digital Signal Processing, Oxford University Press, Wiley-India Publishers, Second impression, 2015, ISBN: 9780198081937.
3) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:
1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):
1) https://youtu.be/IgoJV4g_0LM?si=JO1_bkIvMR8xlC0V
2) https://youtu.be/mIFwzg11uO4?si=Xd13dh0eNlmIswPS
3) https://youtu.be/74g5_3TC-tQ?si=yB2PHVGr4hxIlqPo
4) https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
5) https://youtu.be/5817fLmsTGE?si=Y7ORyV2ETSCxZRAZ

6)https://youtu.be/XJRW6jamUHk?si=G_UTgCM622bz9yh4
7)https://youtu.be/QHH50jy8s_A?si=eNUoUXYLEvEZj3KM
8)https://youtu.be/m3mMeXLt2OQ?si=r9QXzwCRo0PC0ewz
9)https://youtu.be/aSu5Yde9Sfk?si=6kZbU3QRXEfEn2ua
10)https://www.youtube.com/live/tjBxcBLBe6I?si=v4RH4oqyttKhfaPd
11)https://youtu.be/-Y_0FY-IDrI?si=-ERIHGln3U2dr54J
12)https://youtu.be/zWRVxWdwXaw?si=Y78g7TogvDZIKhvs
13)https://youtu.be/nl9TZanwbBk?si=LdywSeCJ0EIt5zCx
14)https://youtu.be/E8HeD-MUrjY?si=JWwQzkQWfaTIqVhG

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

Contents related activities (Activity-based discussions)
- ➢ For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
- ➢ Organizing Group wise discussions on related topics
- ➢ Seminars

MECHANICS OF MATERIALS

Course Code	22MEE32	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE32.1	Understand and calculate the simple stresses and strains induced in various bars of different cross sections, and the mechanical properties of materials in the design of structural members.
22MEE32.2	Identify the behavior of beams under various lateral loads, by determining the shear force and bending moments, and the shear force diagrams and bending moment diagrams and to evaluate the deflection of beams.
22MEE32.3	Analyze the effects of bending and shear loads on structural members.
22MEE32.4	Develop a working knowledge of the analytical methodologies used in column structural design.
22MEE32.5	Design circular shafts subjected to torsional loads and, compute the stresses and strains in thick and thin cylindrical pressure vessels.
22MEE32.6	Apply structural mechanics of deformable bodies to solve engineering problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE32.1	3	2	2	-	-	-	-	-	-	-	-	-	-	2
22MEE32.2	3	2	2	-	-	-	-	-	-	-	-	-	-	2
22MEE32.3	3	3	2	-	-	-	-	-	-	-	-	-	-	2
22MEE32.4	3	3	2	-	-	-	-	-	-	-	-	-	-	2
22MEE32.5	3	3	2	-	-	-	-	-	-	-	-	-	-	2
22MEE32.6	3	2	2	-	-	-	-	-	-	-	-	-	-	2

MODULE-1	SIMPLE STRESS AND STRAIN	22MEE32.1, 22MEE32.6	8 Hours

Assumptions in MOM, stress, strain, mechanical properties of materials, Hooke's Law and Poisson's ratio, Stress-Strain curve for Mild steel, cast iron and Aluminum. Extension /Shortening of a bar, bars with cross section varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self-weight, Principle of super position and numericals, Thermal Stresses (Non numericals), elastic constants (only definitions). Definition of Indeterminate structures (No Numerical's).

Self-study / Case Study	Study the mechanical properties of various materials and their applications
Text Book	Text Book 1: 2.1,2.2,2.4,2.5,2.6,2.7 Text Book 2: Page No. 1-90

MODULE-2	BENDING MOMENT AND SHEAR FORCE DIAGRAMS	22MEE32.2, 22MEE32.6	8 Hours

Introduction, Types of beams, loads and reactions, shear forces and bending moments, Rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams, numericals.

Self-study / Case Study	Study the various types of load acting on various structural members.
Text Book/Reference Book	Text Book 1:5.1,5.2,5.3 Text Book 2: Page No.160-282

MODULE-3	BENDING AND SHEAR STRESSES IN BEAMS	22MEE32.3, 22MEE32.6	8 Hours

Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress and radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections.

Self-study / Case Study	Study the importance of moment of inertia and kinds of cross sections for beams.
Text Book	Text Book 1:4.1,4.2,4.6,4.8,6.1,6.2,6.3 Text Book 2: Page No.283-333

MODULE-4	DEFLECTION OF BEAMS AND ELASTIC STABILITY OF COLUMNS	22MEE32.2 22MEE32.4 22MEE32.6	8 Hours

Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple, Macaulay's method.
Elastic Stability of Columns: Introduction, Columns and struts, slenderness ratio, Classification of columns, buckling load or critical load, Sign conventions, Euler's theory of buckling, Effective length for various boundary conditions, Limitations of Euler's theory, Rankine formula, numericals.

Self-study / Case Study	Study the importance of deflection of beams and slenderness ratio and applications of Euler's critical load in the design of long columns.
Text Book	Text Book 1: 9.1,9.2,9.3,10.1,10.2,10.3,10.4 Text Book 2:Page No.441-575 and 982-1010

MODULE-5	TORSION OF CIRCULAR SHAFTS, THICK AND THIN CYLINDERS	22MEE32.5 22MEE32.6	8 Hours

Introduction, Pure torsion, assumptions, derivation of torsional equations, polar modulus, Torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts, numericals.
Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders - Lame's equation, Problems on Lame's equation.

Self-study / Case Study	Study the importance of design parameters in the design of Boilers, Tanks and Gun Barrels etc. Also study the importance of design of shafts.
Text Book/Reference Book	Text Book 1:3.1,3.2 Text Book 2: Page No.759-798 and 945-981

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Ferdinand Beer & Russell Johston., 'Mechanics of Materials', McGraw Hill India, 7th Edition, 2016, ISBN- (13 digits): 9789339217624.
2) Ramamrutham S., 'Strength of Materials', Dhanpat Rai Publishing Co Pvt Ltd, 16th Edition, 2008, ISBN-81-27-433-54-X.

Reference Books:

1) R C Hibbeler., 'Mechanics of Materials', Pearson Education, 9th Edition, 2018, ISBN-(13 digits): 978- 9332584037; ISBN-(10 digits): 9332584036.
2) James M. Gere, Barry J. Goodno., 'Mechanics of Materials', Cengage Learning, 8th Edition, 2014, ISBN-(13 digits): 9788131524749.
3) S S Rattan., 'Strength of Materials', McGraw Hill India, 2nd Edition, 2011, ISBN-(13 digits): 978-0071072564; ISBN-(10 digits): 007107256X.
4) Dr.R K Bansal 'Strength of Materials'6th Edition,Laxmi Publications India,ISBN-978-81-318-0814-6

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=La4UEa7hA7Q&list=PLJoALJA_KMOARYNi50T6b488kPUBbOIsX
- https://www.youtube.com/watch?v=GkFgysZC4Vc
- https://www.youtube.com/watch?v=aQf6Q8t1FQE&list=PLEYqyyrm-hQ3wtF34smyJSAOqUJqnf1ch
- https://www.youtube.com/watch?v=B9lyGZzb_6M&list=PLIhUrsYr8yHzft7ygw5THZo4aDcsxEadP
- https://www.youtube.com/watch?v=MFsirsHnQi4
- https://www.youtube.com/watch?v=ihsnQWp09zg&list=PLDN15nk5uLiCAnu7Rjta7vvNhoJZv_gAt

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

- Visit to any design department of manufacturing/aero/auto industry
- Demonstration of short, medium and long columns
- Video demonstration of finding the mechanical properties of materials.
- Contents related activities (Activity-based discussions)
  - ➤ Organizing Group wise discussions on issues
  - ➤ Seminars

MECHANICS OF MATERIALS LAB

Course Code	22MEL32	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	2	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEL32.1	Examine the microstructure details of Ferrous and nonferrous materials.
22MEL32.2	Understand the function on multi-disciplinary teams in the area of materials testing stresses and strains in the members subjected to axial, bending and torsional loads.
22MEL32.3	Determine the impact strength, hardness and wear rate of various materials.
22MEL32.4	Identify the surface defects through NDT techniques for ferrous and nonferrous materials.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEL32.1	3	3	3	3	-	-	-	-	-	-	-	-	3	-
22MEL32.2	3	3	3	3	-	-	-	-	-	-	-	-	3	-
22MEL32.3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
22MEL32.4	3	3	3	3	-	-	-	-	-	-	-	-	3	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo		
	Demo: To determine the wear rate of the given specimen using Pin on Disc apparatus.	1	22MEL32.3
PART-A		
1	To determine the hardness number of aluminum specimen using Brinell hardness test.	2	22MEL32.3
2	Evaluating the hardness number of hardened steel specimen using Vickers'shardness test.	2	22MEL32.3
3	To determine the hardness number of mild steel/cast iron specimen usingRockwell hardness test.	2	22MEL32.3
4	To determine the impact energy and strength of notched specimen using Izod test.	2	22MEL32.3
5	To determine the impact energy and strength of notched specimen using Charpy test.	2	22MEL32.3
6	Metallographic examination and identification of microstructures of ferrous and non-ferrous materials materials.	2	22MEL32.1
PART-B		
7	Determination of cracks in given material using dye penetrant test.	2	22MEL32.2
8	To determine the ultimate shear strength of the given specimen in single and double shear using UTM.	2	22MEL32.2
9	To determine the moment of inertia, modulus of elasticity and maximum bending stress of wood specimen by conducting bending test.	2	22MEL32.2
10	To determine the compressive strength, modulus of elasticity, %	2	22MEL32.2

	reduction in length and % increase in area of cast iron specimen by conducting compression test on universal testing machine.			
11	To determine the modulus of rigidity, Torsional strength and modulus of toughness of mild steel specimen using torsion test.	2	22MEL32.2	
12	To determine the elastic strength, ultimate tensile strength, modulus of toughness and young's modulus of mild steel specimen by conducting tensile test on universal testing machine.	2	22MEL32.2	

<div style="text-align:center; color:red; font-weight:bold">

PART-C

Beyond Syllabus Virtual Lab Content (To be done during Lab but not to be included for CIE or SEE)

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1.Izod Impact Test
https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/

2. Charpy Impact Test
https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/

3. Brinell Hardness Test
https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/

4. Rockwell Hardness Test
https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/

5. Vickers Hardness Test

https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test/

6. Tensile Test on Mild Steel

https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/

7. Compression Test

https://sm-nitk.vlabs.ac.in/exp/compression-test-cast-iron/
https://sm-nitk.vlabs.ac.in/exp/compression-test-mild-steel/

8. Torsion Test on Mild Steel

https://sm-nitk.vlabs.ac.in/exp/torsion-test-mild-steel/

9.Shear Test
https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-timber/
https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-steel-plate/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	Remember	-	5
L2	Understand	5	10
L3	Apply	5	5
L4	Analyze	5	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	05
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	05
L6	Create	-

Suggested Learning Resources:
Reference Books:

1) R C Hibbeler., 'Mechanics of Materials', Pearson Education, 9th Edition, 2018, ISBN-(13 digits): 978- 9332584037; ISBN-(10 digits): 9332584036.
2) James M. Gere, Barry J. Goodno., 'Mechanics of Materials', Cengage Learning, 8th Edition, 2014, ISBN-(13 digits): 9788131524749.
3) S S Rattan., 'Strength of Materials', McGraw Hill India, 2nd Edition, 2011, ISBN-(13 digits): 978-0071072564; ISBN-(10 digits): 007107256X.
4) Dr.R K Bansal 'Strength of Materials'6th Edition,Laxmi Publications India,ISBN-978-81-318-0814-6

<div align="center">**FLUID MECHANICS AND MACHINERY**</div>

Course Code	22MEE33		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	03		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE33.1	Understand the properties of fluids and compute the parametric behaviour when acting on simple aerodynamic profiles and shapes in steady fluid flows.
22MEE33.2	Identify the various losses for fluids flowing through a pipe and implement the concepts of fluid statics, fluid kinematics and fluid dynamics in the applications of Hydraulics machinery
22MEE33.3	Analyze the types of fluid flow, different flow description and design a flow measuring device to analyze the discharge of fluid
22MEE33.4	Determine various equipment sizing / design aspects of turbo machines based on engineering requirement with the application of Continuity and Bernoulli's equations in order to develop solution for fluid flow process
22MEE33.5	Investigate the concepts and make an effective presentation on the application of suitable turbo machines under / within the specified conditions
22MEE33.6	Design and analysis of turbo machines by applying the knowledge to practical engineering problems for better sustainable solutions.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE33.1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE33.2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE33.3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
22MEE33.4	3	-	-	-	-	-	-	-	-	-	-	-	3	-
22MEE33.5	3	3	3	-	-	-	-	-	-	-	-	-	-	-
22MEE33.6	3	3	3	-	-	-	-	-	-	-	-	1	3	-

MODULE-1	**FLUID PROPERTIES AND BUOYANCY**	**22MEE33.1 22MEE33.2**	**8 Hours**

Fluid Properties and Fluid Statics: Fluid properties, Numerical on Fluid properties, Types of fluids, Pascal's law, Hydrostatic law (No numerical).
Buoyancy: Buoyancy, centre of buoyancy, Archimedes' principle, metacentre and metacentric height, stability of floating and submerged bodies, determination of Metacentric height by experimental method. (Numerical on Meta centre and centre of Buoyancy)

Case study	Case Study on determination of Metacentric height
Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.6, 2.1, 2.2, 2.3, 4.1, 4.2, 4.3, 4.4, 4.5 Text Book 2: 1.1, 1.2,1.3, 1.4, 1.5, 1.6, 2.3, 4.1, 4.2, 4.3, 4.4

MODULE-2	**FLUID KINEMATICS AND FLUID DYNAMICS**	**22MEE33.2 22MEE33.3 22MEE33.4**	**8 Hours**

Fluid Kinematics: Types of Flow, Continuity equation in 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function (Numerical).
Fluid Dynamics: Euler equation of motion and Bernoulli's equation from Euler's equation (Numerical). Application of Bernoulli's equation to Pitot tube, venturimeter, orifice meter (No Derivation and No Numerical).

Case Study	Case Study on Design & Fabrication of stepped notch/trapezoidal notch
Text Book	Text Book 1: 5.1, 5.2, 5.3,5.4,5.5, 5.7,5.8, 6.1,6.2,6.3,6.4, 7.1, 7.3 Text Book 2: 5.1, 5.3, 5.6, 6.1,

MODULE-3	FLOW THROUGH PIPES, LAMINAR AND TURBULENT FLOW	22MEE33.2 22MEE33.3 22MEE33.4	8 Hours

Flow Through Pipes: Energy losses through pipe, Major losses, Darcy- Weisbach equation, Chezy's Equation, Minor losses in pipes-sudden enlargement, sudden contraction (Numerical).
Laminar And Turbulent Flow: Definition, Relation between pressure and shear stresses, Laminar flow through circular pipe, Fixed parallel plates, Turbulent flow and velocity distribution. (Numerical)

Case Study	Case study on Major and Minor losses in flow through pipes
Text Book	Text Book 1: 9.1, 9.2, 9.310.1, 10.2, 10.3 Text Book 2: 11.2, 11.2, 10.4, 10.5

MODULE-4	Hydraulic Pumps	22MEE33.4 22MEE33.5 22MEE33.6	8 Hours

Hydraulic pumps: Concept and classification of pumps, Detailed study (construction, working and applications) of Centrifugal pump & Reciprocating pump. Performance (efficiency, discharge, head, specific speed and power consumption) of centrifugal pump and reciprocating pump with simple numerical example. Characteristic curves of centrifugal pump and reciprocating pump, Need for priming of centrifugal pump & Selection of pumps.

Case Study	Case study and practical applications of Hydraulic pumps
Text Book	Text Book 1: 19.1, 19.2, 19.3, 19.7, 19.9 Text Book 2: 3.1, 3.2, 3.3, 3.4, 3.5

MODULE-5	HYDRAULIC TURBINES	22MEE33.4 22MEE33.5 22MEE33.6	8 Hours

Hydraulic Turbines: Classification, construction, Design, working principle and applications of: Pelton wheel turbine, Francis's turbine, Kaplan turbine.
Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation.

Applications	Investigate the practical applications of hydraulic turbines.
Text Book	Text Book : 18.1, 18.2, 18.5, 18.6 18.8, 18.10 Text Book 2: 2.1, 2.2, 2.3, 2.4

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:
 Text Books:
1) Bansal R.K., "Fluid Mechanics and Hydraulic Machines", 9th edition, Laxmi Publications (P)Ltd., New Delhi, 2018. ISBN 9788131808153
2) R.K.Rajput, "A Text Book of Fluid Mechanics and Hydraulic Machines", 6th edition, S. Chand, 2015. ISBN 9789385401374

Reference Books:
1) Yunus A. Cengel and John M. Cimbala., 'Fluid Mechanics', McGraw Hill, 4th Edition, 2017, ISBN-(13 digits): 978-9385401374
2) P.N.Modi and Seth, "Fluid Mechanics and Hydraulic Machines",22nd edition, Standard Book House, 2018.

Web links and Video Lectures (e-Resources)
- **https://archive.nptel.ac.in/courses/112/105/112105171/**
- **https://unacademy.com/content/gate/videos/mechanical-engineering/fluid-mechanics/#**
- **https://www.youtube.com/watch?v=clVwKynHpB0**
- **https://nptel.ac.in/courses/103102211**
- **https://nitsri.ac.in/Department/DisplayDeptPage.aspx?page=magee&ItemID=ocgkk&nDeptID=e**

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

- Visit to any Hydraulic power plant
- Demonstration on working of Pumps /Turbines
- Demonstration on Flow measuring Devices
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Fluid Mechanics and Machinery related Flowcharts.
  - Organizing Group wise discussions on issues
  - Seminars

FLUID MECHANICS AND MACHINERY LAB

Course Code	22MEL33		CIE Marks	50
L:T:P:S	0:0:1:0		SEE Marks	50
Hrs / Week	02		Total Marks	100
Credits	01		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEL33.1	Apply the flow measuring devices such as Venturi meter, orifice meter and Notches to predict the coefficient of discharge for flow through pipes
22MEL33.2	Investigate the friction and measure the frictional losses in fluid flow
22MEL33.3	Understand the working of impact of jet on various types of vanes
22MEL33.4	Analyze the performance of hydraulic turbine, pumps, Air blower under different working conditions

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEL33.1	3	3	3	2	-	-	-	-	-	-	-	-	3	-
22MEL33.2	3	3	3	2	-	-	-	-	-	-	-	-	3	-
22MEL33.3	3	3	3	2	-	-	-	-	-	-	-	-	3	-
22MEL33.4	3	3	3	2	-	-	-	-	-	-	-	-	3	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Understand the properties of fluids • Demonstration on pascal's law, hydrostatic law • Demonstration on Buoyancy, determination of metacentric height.	2	NA
	PART-A		
1	Calibration of given Venturi meter and plotting the suitable calibration curve	2	22MEL33.1
2	Calibration of given Orifice meter and plotting the suitable calibration curve	2	22MEL33.1
3	Calibration of given V-notch, rectangular notch and plotting the suitable calibration curve	2	22MEL33.1
4	Determination of coefficient of friction and Chezy's constant for turbulent flow in pipes.	2	22MEL33.2
5	Determination of minor losses coefficient in flow through pipes due to sudden contraction and sudden expansion	2	22MEL33.2
6	Verification of Bernoulli's equation	2	22MEL33.1
	PART-B		
7	Determination of the impact of jet on Flat Vanes	2	22MEL33.3
8	Determination of the impact of jet on hemispherical vanes	2	22MEL33.4
9	Determination of the impact of jet on Inclined Vanes	2	22MEL33.4
10	Investigate the Performance test on Pelton Wheel Turbine	2	22MEL33.4
11	Determination of performance characteristics of centrifugal pump	2	22MEL33.4
12	Determine the efficiency of air blower	2	22MEL33.4

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PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)

</div>

Reciprocating-pump
- https://fmc-nitk.vlabs.ac.in/exp/reciprocating-pump/
  Francis-turbine
- https://fmc-nitk.vlabs.ac.in/exp/francis-turbine/
  Reynolds Experiment
- https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/introduction.html
  Pitot Tube
- https://me.iitp.ac.in/Virtual-Fluid-Laboratory/pitot/introduction.html
  Metacenter
- https://me.iitp.ac.in/Virtual-FluidLaboratory/metacenter/introduction.html

CIE Assessment Pattern (50 Marks – Lab)

	RBT Levels	Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	05
L2	Understand	05
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:
1)) Bansal R.K., "Fluid Mechanics and Hydraulic Machines", 9th edition, Laxmi Publications (P)Ltd., New Delhi, 2018 ISBN 9788131808153
2) R.K. Rajput, "A Text Book of Fluid Mechanics and Hydraulic Machines", 6th edition, S. Chand, 2015, ISBN 9789385401374

BIO INSPIRED DESIGN AND INNOVATION

Course Code	22BIK36	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	3	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22BIK36.1	Understand the biomimetics principles in relation to the needs at that moment.
22BIK36.2	Evaluate the Bio-material properties for health care applications.
22BIK36.3	Investigate novel bioengineering initiatives by evaluating design and development principles.
22BIK36.4	Investigate creative biobased solutions for socially vital issues with critical thought.
22BIK36.5	Analyze the bio computing optimization through research and experiential learning.
22BIK36.6	Explain the fundamental biological ideas through pertinent industrial applications and case studies.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22BIK36.1	3	3	3	3	2	-	-	-	1	1	-	2	3	-
22BIK36.2	3	3	3	3	2	-	-	-	1	1	-	2	3	-
22BIK36.3	3	3	3	3	2	-	-	-	1	1	-	2	3	-
22BIK36.4	3	3	3	3	2	-	-	-	1	1	-	2	3	-
22BIK36.5	3	3	3	3	2	-	-	-	1	1	-	2	3	-
22BIK36.6	3	3	3	3	2	-	-	-	1	1	-	2	3	-

MODULE-1	BIO-INSPIRED DESIGN AND ENGINEERING	22BIK36.1	8 Hours

Bio-Inspired Engineering and design, History, Evolution, Basics of Biomimetics and other Disciplines, Rawling's Classifications, Need for Bio-Inspired Designs. Bio inspired Additive manufacturing techniques, (self-healing, self-assembly).

Self-study	Investigate the Challenges of Bio inspired design, Compare with traditional areas of science and engineering.
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	BIO MATERIALS AND BIO HEALTHCARE DESIGN	22BIK36.2	8 Hours

Biomaterials, Design of Forms- (Hexagonal unit cells, anisotropy), Design of materials- (Hierarchy, fracture tough materials, structural colours, Actuating Materials, Bio-Compatible Materials). Bio-Mechanics, Applications of Biomaterials and Bio systems in Health care design.

Self-study	Investigate Bio-Compatible alloys and polymers for human implants and health care applications.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	BIO SUSTAINABLE DEVELOPMENT	22BIK36.3, 22BIK36.4	8 Hours

Innovations in Energy (Termite mound inspired shopping malls), Innovations in Resource-Air (purification, filtration), Dew water collection systems, water purification, desalination, Management of spaces, designs for megastructures.

Case Study	Explore the Bio inspired environmental constructions and development.
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	BIO COMPUTING AND OPTIMISATION	22BIK36.5	8 Hours

No Free Lunch Theorem, Bat Algorithm, Flower Pollination Algorithm, Genetic Algorithm- Crossover and Mutation Operations. Bio-Inspired Optimisation, Ant Colony Optimisation (ACO), Swam Intelligence- Particle Swam Optimisation (PSO).			
Self-study	Scrutinize the Different types of Optimization techniques, genetic research.		
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**APPLICATIONS OF BIO-INSPIRED INNOVATIONS**	**22BIK36.6**	**8 Hours**
Bioinspired innovations in– Automotive, Automation, Materials and Manufacturing, Sensors, Controllers, Communications, Healthcare, Agriculture, food production, and Sports, Environment infrastructure. Carbon Neutral Solutions (Coral Reefs, Eco-cements), Carbon Free Solutions (Lotus leaf inspired paints), eco-restorations (Eco-friendly pesticide).			
Applications	Survey on Bio inspired Innovations, design, applications and case studies of the same.		
Text Book	Text Book 2: 12.1 to 12.10		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:
 Text Books:
1) Helena Hashemi Farzaneh, Udo Lindemann, "A Practical Guide to Bio-inspired Design", Springer Vieweg, 1st edition 2019, ISBN-10 : 366257683X, ISBN-13 : 978-3662576830
2) Torben A. Lenau, Akhlesh Lakhtakia," Biologically Inspired Design: A Primer (Synthesis Lectures on Engineering, Science, and Technology)", Publisher: Morgan & Claypool Publishers, 2021, ISBN-10: 1636390471, ISBN-13: 978-1636390475
 Reference Books:
1) French M, "Invention and evolution: Design in nature and engineering", Publisher: Cambridge University Press, 2020
2) Pan L., Pang S., Song T. and Gong F. eds, "Bio-Inspired Computing: Theories and Applications", 15th International Conference, BIC-TA 2020, Qingdao, China, October 23-25, 2020, Revised Selected Papers (Vol. 1363). Springer Nature, 2021
3) Wann D, "Bio Logic: Designing with nature to protect the environment", Wiley Publisher, 1994

Web links and Video Lectures (e-Resources):
- **https://onlinecourses.nptel.ac.in/noc22_ge24/preview**
- **https://biodesign.berkeley.edu/bioinspired-design-course/**
- **https://nsf-gov-resources.nsf.gov/2023-03/Bio-inspired%20Design %20Workshop%20Report_2232327_October%202022_Final.508.pdf**

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

- ➢ Bio Materials printing using 3D Printing
- ➢ Flipped class room
- ➢ Organizing Group wise discussions on sub topics
- ➢ Student presentations

SOCIAL CONNECT AND RESPONSIBILITY

Course Code	22SCK37		CIE Marks	50
L:T:P:S	0:0:1:0		SEE Marks	--
Hrs / Week	02		Total Marks	50
Credits	01		Exam Hours	02

Course outcomes:

At the end of the course, the student will be able to:

22SCK37.1	Communicate and connect to the surrounding
22SCK37.2	Understand the needs and problems of the community and involve them in problem –solving
22SCK37.3	Develop among themselves a sense of social & civic responsibility and utilize their knowledge in finding practical solutions to individual and community problems
22SCK37.4	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22SCK37.1	-	-	-	-	-	3	2	-	2	3	-	1
22SCK37.2	-	-	-	-	-	3	2	-	2	3	-	1
22SCK37.3	-	-	-	-	-	3	2	-	2	3	-	1
22SCK37.4	-	-	-	-	-	3	2	-	2	3	-	1

MODULE-1	PLANTATION AND ADOPTION OF A TREE	22SCK37.1, 22SCK37.2	3 Hours

Plantation of a tree that will be adopted for three years by a group of 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.

MODULE-2	HERITAGE WALK AND CRAFTS CORNER	22SCK37.2, 22SCK37.3	3 Hours

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.

MODULE-3	ORGANIC FARMING AND WASTE MANAGEMENT	22SCK37.3, 22SCK37.4	3 Hours

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

MODULE-4	WATER CONSERVATION	22SCK37.3, 22SCK37.4	3 Hours

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

MODULE-5	FOOD WALK	22SCK37.1, 22SCK37.4	3 Hours

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

CIE Assessment Pattern (50 Marks – Activity based) –
- **Each module is evaluated as given below and 100 marks in scaled down to 50 as final marks.**

CIE component for each module	Marks
Field Visit, Plan, Discussion	10
Commencement of activities and its progress	20
Case study-based Assessment Individual performance with report	20
Module wise study & its consolidation 5*5 = 25	25
Video based seminar for 10 minutes by each student at the end of semester with Report. Activities 1 to 5, 5*5 = 25	25
Total	**100**

- Implementation strategies of the project (NSS work).
- Individual student has to submit a final report which should be signed by NSS Officer, the HOD and Principal.
- Finally, the consolidated marks sheet and the reports should be available in the department. .

Activity-Based Learning / Practical Based learning
- Platform to connect to others and share the stories with others:
  - Jamming session
  - Open mic
  - Poetry
- Share the experience of Social Connect.
- Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

Pedagogy:

- The students will be divided into groups. Each group will be handled by faculty mentor.
- A total of 40 - 50 hrs engagement in the semester
- Faculty mentor will design the activities (particularly Jamming sessions, open mic and poetry)
- The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.
- The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-longactivities conducted by faculty mentors.
- 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.

Plan of Action:

- 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 mentor 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.
- Practice Session Description:
  - Lecture session in field to start activities
  - Students Presentation on Ideas
  - Commencement of activity and its progress
  - Execution of Activity
  - Case study-based Assessment, Individual performance
  - Sector/ Team wise study and its consolidation
  - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	**Plantation and adoption of a tree**	May be individual or team (3-5)	Farmers land/ parks / Villages / roadside/ community area / College campus	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
2.	**Heritage walk and crafts corner**	May be individual or team (3-5)	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations	Site selection /Proper consultation/ Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation	Evaluation as per the rubrics of scheme and syllabus

			/Government Schemes officers/ campus		authority	
3.	**Organic farming and waste management**	May be individual or team (3-5)	Farmers land / parks /Villages visits / roadside/ communityarea / College campus	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
4.	**Water conservation:** Conservation techniques	May be individual or team (3-5)	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers / campus	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
5.	**Food walk:** Practices in society	May be individual or team (3-5)	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	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

SUSTAINABLE MANUFACTURING AND GREEN TECHNOLOGIES

Course Code	22MEE341	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	3	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE341.1	Understand the basic design concepts, methods, tools, the key technologies and the operation of sustainable green manufacturing.
22MEE341.2	Apply the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise.
22MEE341.3	Identify the strategies for the purpose of satisfying a set of given sustainable green manufacturing requirements.
22MEE341.4	Design the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management scheme.
22MEE341.5	Understand concept of green technology
22MEE341.6	Understand the knowledge of carbon emission.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE341.1	2	3	-	-	2	-	3	-	-	-	-	2	3	-
22MEE341.2	2	2	-	-	3	-	3	-	-	-	-	2	3	-
22MEE341.3	3	3	-	-	3	-	3	-	-	-	-	2	3	-
22MEE341.4	3	2	-	-	3	-	3	-	-	-	-	2	3	-
22MEE341.5	3	3	-	-	3	-	3	-	-	-	-	2	3	-
22MEE341.6	2	3	-	-	3	-	3	-	-	-	-	2	3	-

MODULE-1	INTRODUCTION TO GREEN MANUFACTURING	22MEE341.1	8 Hours

Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing.
The Social, Business, and Policy Environment for Green Manufacturing: Introduction, The Social Environment—Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment—Present Atmosphere and Challenges for Green Manufacturing.

Self-study	Study on Green manufacturing challenges, strategies and its Applications.
Text Book	Text Book 1: 1.2, 1.31, 1.41, 1.13, 1.15, 1.17

MODULE-2	CLOSED LOOP PRODUCTION SYSTEM AND GREEN FUELS	22MEE341.2	8 Hours

Life Cycle of Production Systems, Economic and Ecological Benefits of ClosedLoop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Remanufacturing, Reuse, Approaches for Sustainable Factory Design.
Green Fuels: Definition of Green fuel their benefits and challenges, comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts, public policies and market driven initiatives
Biomass energy: Concept of biomass energy utilization, types of biomass.

Case Study	Study on Green fuels, benefits and Challenges.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	INTRODUCTION TO GREEN TECHNOLOGY	22MEE341.3, 22MEE341.4	8 Hours

	Definition of Green Technology and its Importance, History and evolution of green technology, advantages and disadvantages of green technologies, factors affecting green technologies, Role of Industry, Government and Institutions, introduction to industrial Ecology and role of industrial ecology in green technology.
Case Study	Study on Applications of Green Technology and its importance.
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10

MODULE-4	CLEANER PRODUCTION (CP)	22MEE341.5	8 Hours

Definition, Importance, Principles of Cleaner Production and its Benefits, Role of Industry, Government and Institutions in cleaner production, clean development mechanism, reuse, recovery, recycle, raw material substitution- Wealth from waste.

Self-study	Survey on recovery, reuse, recycle of waste.
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	CP AWARENESS AND LIFE CYCLE ASSESSMENT	22MEE341.6	8 Hours

Pollution Prevention and Cleaner Production Awareness Plan, Waste audit, Environmental Statement, carbon credit, carbon trading. Introduction to Life Cycle Assessment (LCA) and Elements of LCA.

Applications	Survey on Ceramics and Powder Metallurgy applications and case studies of the same.
Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Stark, John. Product Lifecycle Management: Paradigm for 21st Century ProductRealisation, Springer-Verlag, 2004. ISBN 1852338105

2) Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle

approach, Taylor & Francis 2006

Reference Books:

1) Saaksvuori Antti / ImmonenAnselmie, product Life Cycle Management Springer,Dreamtech,3-540-25731-4

2) Product Lifecycle Management, Michael Grieves, Tata McGraw Hill

3) Pollution Prevention: Fundamentals and Practice by Paul L. Bishop ,McGraw Hill International ISBN:2-540-25731-1

Web links and Video Lectures (e-Resources):
- https://youtu.be/EhodfnsyOWs
- **https://youtu.be/CsqEClHQBCI**
- **https://youtu.be/C_Zn9g3uELI**
- https://youtu.be/2iUL5ZBIZ1A
- https://youtu.be/ey6V_wDxDKE
- https://youtu.be/ZC5EWP0ZhvI

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts
- ➢ Organizing Group wise discussions on issues
- ➢ Seminars

MATERIAL SCIENCE AND METALLURGY

Course Code	22MEE342		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	3		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE342.1	Identify the properties of metals with respect to crystal structure and grain size.
22MEE342.2	Explain the concept of Phase diagram & understand the Construction and identification of phase diagrams and reactions
22MEE342.3	Analyze invariant reactions and various Equilibrium diagrams, hardenability of steels
22MEE342.4	Identify suitable type of Heat treatment process and various applications and Significance of properties vs microstructure.
22MEE342.5	Distinguish different types of cast irons, steels and nonferrous alloy for specific applications
22MEE342.6	Apply the concept of powder metallurgy in manufacturing process; understand the manufacturing processes of different types of Ceramics.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE342.1	3	3	3	-	-	-	3	-	-	-	-	3	3	
22MEE342.2	3	3	3	-	-	-	3	-	-	-	-	3	3	
22MEE342.3	3	3	3	-	-	-	3	-	-	-	-	3	3	
22MEE342.4	3	3	3	-	-	-	3	-	-	-	-	3	3	
22MEE342.5	3	3	3	-	-	-	3	-	-	-	-	3	3	
22MEE342.6	3	3	3	-	-	-	3	-	-	-	-	3	3	

MODULE-1	CRYSTAL STRUCTURE		22MEE342.1	8 Hours

BCC, FCC and HCP Structures, coordination number and atomic packing factors, Derivation of APF for BCC, FCC & HCP structures, crystal imperfections - point line and surface imperfections. Simple problems. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion. Simple problems.

Self-study	Study crystal structure and Diffusion.
Text Book	Text Book 1: 1.2, 1.3, 1.4, 1.13, 1.15, 1.16

MODULE-2	PHASE DIAGRAM		22MEE342.2	8 Hours

Phase Diagram I: Solid solutions, Hume Rothary rule, substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.
Phase Diagram II: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Different types invariant reactions – Eutectic, Eutectoid, Peritectic, Peritectectoid reactions

Case Study	Transformations in the solid state, allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys.
Text Book	Text Book 1: 2.2, 2.3, 2.4 to 2.15

MODULE-3	IRON CARBON EQUILIBRIUM DIAGRAM	22MEE342.3, 22MEE342.4	8 Hours

Description of phases, solidification of steels and cast irons, invariant reactions. Heat treating of metals TTT curves, continuous cooling curves, description of the following heat treatment processes with industrial applications: annealing and its types. Normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, Flame hardening, induction

	hardening.		
Case Study	Understand the different phases of steel and cast iron its Properties in Iron Carbon Diagram and its Applications.		
Text Book	Text Book 2: 3.1, 3.3, 3.5, 3.7, 3.10		
MODULE-4	**ENGINEERING MATERIALS AND NANO MATERIALS**	**22MEE342.5**	**8 Hours**

Engineering materials: Properties, Composition and Applications of Grey cast iron, White cast Iron, malleable iron, SG iron and steels, Copper & Aluminium alloys. Titanium and Magnesium alloys. Nanomaterials: History of nanomaterials; Synthesis of nanomaterials-physical nanofabrication techniques (PVD, MBE, CVD, self-assembly, lithographic techniques) Applications of nanomaterials- Application of nanomaterials in healthcare, biosenors, coatings environment, catalysis, agriculture, automotives, sensors, electronics, photonics, information technology, quantum computing, energy and aerospace sector

Self-study	Survey Applications, Properties of Engineering Materials and Nano Materials.		
Text Book	Text Book 1: 6.1, 6.3, 6.5, 6.7, Text Book 2: 10.1, 10.3, 10.5, 10.7		
MODULE-5	**CERAMICS AND POWDER METALLURGY**	**22MEE342.6**	**8 Hours**

Ceramics: Introduction to ceramics, nature of ceramics, types of ceramics, properties of ceramics materials, ceramic forming techniques, applications of ceramics. Powder Metallurgy: Definition and concept, applications, powder metallurgy process, Production of metal powders, characteristics of metal powders, compacting, pre sintering and sintering

Applications	Survey on Ceramics and Powder Metallurgy applications and case studies of the same.
Text Book	Text Book 2: 12.1 to 12.10

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Introduction to Physical Metallurgy Sidney H Avner, Mcgraw Hill Education, 1997,ISBN 13: 978007463
2) Fundamentals of Material Science and Engineering David G Rethwisch William D Callister Jr. Rethwisch Callister , John Wiley & Sons Publishers, 4th Edition, 2012, ISNB13: 978111806160

Reference Books:
1) Materials Science and Engineering, V.RAGHAVAN, PHI Learning, 2004, ISBN: 9788120324558
2) Engineering Materials, Kenneth G. Budinski, Michael K. Budinski, Prentice Hall, 9 edition, 2010, ISBN: 978013712842

Web links and Video Lectures (e-Resources):
- https://youtu.be/JCdNauLeDjs?si=BmDne36eFAqFB3w
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://youtu.be/I3ZVonq66LQ?si=YKw5ORJzrtVOty3j
- https://youtu.be/jqjVC9R4FFk?si=3BJcio4pqkzgJH0
- https://youtu.be/BJrTZ07bHm4?si=kVcD9UnRRXmZDITn
- https://youtu.be/As0cVG_lwyA?si=hTJYOFSRHzsrnwCHhttps://youtu.be/jVC9R4FFk

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Video demonstration of latest trends in bio inspired design
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

BIOENERGY AND BIOFUELS

Course Code	22MEE343		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	3		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE343.1	Understand the importance of energy from biomass and biofuels.
22MEE343.2	Explain the various energy conversion technologies on biomass and biogas.
22MEE343.3	Analyze the alternative energy requirement for meeting the current Scenario.
22MEE343.4	Analyze the fuel preparation and storage systems.
22MEE343.5	Apply the testing on the fuel with required engine modification.
22MEE343.6	Implement modified fuels on transport systems for sustainable development.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE343.1	3	-	-	-	-	-	-	-	-	3	2	2	-	3
22MEE343.2	3	-	-	-	-	-	-	-	-	3	-	3	-	3
22MEE343.3	3	2	2	-	-	-	-	-	-	3	2	2	-	3
22MEE343.4	3	3	2	3	2	2	-	-	-	3	-	3	-	3
22MEE343.5	3	3	3	3	2	2	-	-	3	3	3	3	-	3
22MEE343.6	3	3	3	-	3	3	3	-	3	3	3	3	-	3

MODULE-1	BIOMASS AND CONVERSION TECHNOLOGIES	22MEE343.1 22MEE343.2	9 Hours

Biomass and Conversion Technologies - Introduction, Biomass as a sources of energy, Biomass conversion Technologies - Wet Processes, Dry Processes, Photosynthesis, Biogas Generation, Energy Plantation, advantages of Energy Plantation, Plants proposed for energy plantation, methods for energy from biomass, Thermal gasification process, classification, chemistry and applications of gasifier and Pyrolysis.

Self-study / Case Study	Study the Problems in Development of gasifiers.
Text Book	Text Book 1: 7.313, 7.385, 7.414

MODULE-2	BIOGAS AND PRODUCTION TECHNOLOGIES	22MEE343.1 22MEE343.2	8 Hours

Biogas and Production Technologies **-** Biogas Generation, Factors affecting Biodigestion or Generation of gas, Classification of biogas plants, advantages and disadvantages of Floating Drum Plant and Fixed dome type Plant. Types of biogas plants, Constructional Details of the plants, biogas from plant waste, Community biogas plants, material used for biogas generation, site selection, digester design consideration, methods for maintaining biogas production and utilization of biogas.

Case Study	Case study on fuel properties of biogas.
Text Book	Text Book 1: 7.327, 7.381

MODULE-3	ALTERNATIVE FUELS AND BIOFUEL	22MEE343.3 22MEE343.4 22MEE343.5 22MEE343.6	9 Hours

Alternative Fuels **-** Introduction, Classification, Scenario of conventional auto fuels, oils reserves of the world, Fuel quality aspects related to emissions, technological upgradations required, need for alternative fuels.

Biofuel - Methanol – Introduction, history of methanol, Methanol properties. Production, applications, advantages and disadvantages, health hazards and economics of Methanol. Methanol storage and

dispensing system, Methanol vehicles worldwide, Methanol combustions and emissions.			
Applications	Application of Methanol for fuel cells.		
Text Book	Text Book 2: 1.9, 10.176		
MODULE-4	**ETHANOL AND BUTANOL FUEL**	**22MEE343.4** **22MEE343.5** **22MEE343.6**	**9 Hours**
Ethanol – Introduction, history, Properties and Production of ethanol, dry milling process, second generation bio-ethanol, Material compatibility of ethanol, storage, Transportation and Dispensing of ethanol, Piping for ethanol, advantages and disadvantages, health and environmental effects of Ethanol. Ethanol diesel blends (E-diesel), Ethanol gasoline blends (gasohol), Engine modifications for ethanol Combustions of ethanol, Emissions from ethanol, Flex fuel vehicles with ethanol, Standards for ethanol. Butanol - Introduction, history, Production and of Butanol, Butanol as an automotive fuel, Advantages and disadvantages of butanol, Storage and material compatibility and Health hazards of butanol.			
Self-study / Case Study	Study on Ethanol vehicles worldwide, Ethanol worldwide Scenario, Ethanol Scenario in India.		
Text Book	Text Book 2: 11.185, 12.204		
MODULE-5	**STRAIGHT VEGETABLE OIL (SVO) AND BIODIESEL**	**22MEE343.4** **22MEE343.5** **22MEE343.6**	**9 Hours**
Straight Vegetable Oil (SVO) - Introduction, Feedstock selection and iodine value for SVO, history of SVO, SVO as diesel engine fuel, Properties and production of SVO, SVO from algae, Degumming, Storage, Dispensing, Material compatibility, advantages and disadvantages of SVO, SVO engine modifications, SVO fuel kits, SVO twin tank or dual fuel system, SVO fuel treatment and combustion. Emissions from SVO vehicles, SVO standards. Biodiesel - Introduction, history and biodiesel feedstock selection, raw materials for biodiesel production, Biodiesel production. Properties, storage, dispensing, material compatibility, standards, transportation, advantages and disadvantages and hazards of biodiesel. Second generation biodiesel, Engine modifications for biodiesel, Biodiesel combustion and emissions and Biodiesel vehicles.			
Self-study / Case Study	Study on SVO vehicles worldwide and SVO Scenario in India. Case study on Ethanol Scenario in India.		
Text Book	Text Book 2: 13.209, 14.229		

CIE Assessment Pattern (50 Marks – Theory) –

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	-	-
L2	**Understand**	5	-	-
L3	**Apply**	5	5	5
L4	**Analyze**	5	5	5
L5	**Evaluate**	5	5	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

 Text Books:
1) Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, ISBN.: 81.7409-073-8.
2) Alternative Fuels – Concepts, Technologies and Developments, S.S.Thipse, JAICO Publishing house, ISBN 978-81-8495-078-6

 Reference Books:
1) Fuels and Combustion, Samir Sarkar, Universities Press,Third Edition 2009, Reprinted 2010
2) Biodiesel – A Realistic Fuel Alternative for Diesel Engines, Ayhan Demirbas, Springer International Edition, Reprint 2012.
3) Alternative Fuels Guidebook – Properties, Storage, Dispensing and Vehicle Facility Modifications, Richard L. Bechtold, P.E., SAE International, 1997.

Web links and Video Lectures (e-Resources):
- **https://www.youtube.com/watch?v=H1hrkC--dto**
- **https://www.youtube.com/watch?v=ymCQWxwatuk**
- **https://www.youtube.com/watch?v=rjbq_Q0yEbo**
- **https://www.youtube.com/watch?v=xnr70DQVHr8**
- **https://www.youtube.com/watch?v=HCBa7te1thk**

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

- Visit to fuel preparation and testing industry

- Video demonstration of latest trends in fuel preparation and testing technologies

- Contents related activities (Activity-based discussions)

    ➢ For active participation of students, instruct the students to collect fuel preparation and testing technologies.

    ➢ Organizing Group wise discussions on issues in fuel preparation and testing technologies.

    ➢ Seminars

INSTRUMENTATION IN THERMAL ENGINEERING

Course Code	22MEE344	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE344.1	Understand the thermal engineering measuring devices, utilization of computers in measurement applications and advanced measuring systems.
22MEE344.2	Analyze Instrumentation related to thermal system
22MEE344.3	Apply general concept of measurement, statistical analysis of experimental data and performance analysis of a measuring system
22MEE344.4	Evaluate given experimental requirement and recommend a correct measurement procedure and device pertaining to kinetic and thermo-physical measurement4.Understand the integration of digital to analog way of measurement
22MEE344.5	Develop skills to analyze and interpret measurement data, understanding its significance in the context of thermal engineering applications.
22MEE344.6	Design and implement instrumentation systems for monitoring and controlling thermal processes, ensuring efficient and reliable operation.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE344.1	3	1	1	-	-	-	-	-	-	-	-	-	-	2
22MEE344.2	3	2	2	-	-	-	-	-	-	-	-	-	-	2
22MEE344.3	3	2	2	-	-	-	-	-	-	-	-	-	-	2
22MEE344.4	3	3	2	-	-	-	-	-	-	-	-	-	-	2
22MEE344.5	3	3	2	-	-	-	-	-	-	-	-	-	-	2
22MEE344.6	3	3	2	-	-	-	-	-	-	-	-	-	-	2

MODULE-1	MEASUREMENT CHARACTERISTICS	22MEE52.1 22MEE52.4 22MEE52.6	8 Hours

Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

Case Study/Applications	Case Studies on Performance and emission characteristics of IC engine
Text Book	Text Book 1: 1.1,1.2,1.3

MODULE-2	MEASUREMENT OF PHYSICAL QUANTITIES	22MEE52.2	8 Hours

Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables.

Applications	Investigate the applications of air standard cycles and Rankine cycle
Text Book	Text Book 1: 2.1,2.2,2.3

MODULE-3	MICROPROCESSORS AND COMPUTERS IN MEASUREMENT	22MEE52.3 22MEE52.4 22MEE52.6	8 Hours

Data logging and acquisition – use of sensors for error reduction, elements of microcomputer interfacing, intelligent instruments in use.

Applications	Analyze the Applications of gas turbine cycles
Text Book	Text Book 1: 3.1,3.2,3.3

MODULE-4	MEASURING DEVICES AND INSTRUMENDATION	22MEE52.5 22MEE52.6	8 Hours

Thermal expansion method: Liquid-in-glass thermometer, pressure thermometer, bimetal type thermometer. Resistance Thermometer: RTD, Thermistor. Thermocouple, quartz thermometer, radiation thermometer. Boiler power plant instrumentation, air conditioning plant control, industrial robotics system

Case Study/Applic ations	Case study and practical applications of reversed Carnot cycle, vapor absorption cycles
Text Book	Text Book 2: 5.1,5.2,5.3,5.4

MODULE-5	ADVANCE MEASUREMENT TECHNIQUES	22MEE52.5 22MEE52.6	8 Hours

Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement

Applications	Investigate the applications of Psychometric Chart
Text Book	Text Book 1: 8.1,8.2,8.3

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:
1. Holman J.P., Experimental methods for engineers, 7 edition (1 July 2017)   McGraw-Hill, ISBN-13: 978-0070647763
2. Bolton.W, Industrial Control & Instrumentation, Universities Press, Second Edition, 2001, ISBN-13: 978-0582068025

Reference Books:
1. Intelligent Instrumentation, Prentice Hall of India, 1988, ISBN-13: 978-0134682167
2. Nakra, B.C., Choudhry K.K., Instrumentation, Measurements and Analysis Tata McGraw Hill, New Delhi, Fourth edition (1 August 2016), ISBN-13: 978-9385880629
3. John G Webster, The measurement, Instrumentation and sensors Handbook, CRC and IEE Press, 2008. ISBN-13: 978-0849383472

Web links and Video Lectures (e-Resources)
- **https://www.learnthermo.com/T1-tutorial/ch01/lesson-A/pg01.php**
- **http://www.freeonlinecoursesforall.com/2017/01/01/10-free-online-courses-on-thermodynamics/**
- **https://archive.nptel.ac.in/courses/112/105/112105123/**
- **http://www.digimat.in/nptel/courses/video/112105123/L13.html**

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

- Visit to any Thermal power plant
- Demonstration of working of IC engine/refrigerator
- Video demonstration on Laws of thermodynamics
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare thermodynamics related Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

Course Code	22MEE345	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	3	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE345.1	Understand the basics concepts of Injection mould design.
22MEE345.2	Apply knowledge in Compression mold design.
22MEE345.3	Understand the casting techniques and the essential parts for the design of molds.
22MEE345.4	Remember the fundamentals of press tool design.
22MEE345.5	Analyze the basics of jigs and fixtures.
22MEE345.6	Apply the gained knowledge to practical applications.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE345.1	3	-	-	-	-	-	-	-	-	-	-	-	2	-
22MEE345.2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
22MEE345.3	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22MEE345.4	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22MEE345.5	3	-	2	-	-	-	-	-	-	-	-	-	2	-
22MEE345.6	3	-	3	-	-	-	-	-	-	-	-	-	3	-

MODULE-1	INJECTION MOULDING	22MEE345.1 22MEE345.3 22MEE345.6	8 Hours

Plastics product design Concepts, factors, process variables, product design. Uniform and symmetrical wall thickness, Draft angle Rib & Radius Bosses Holes, metal inserts parting line Tolerances.

Self-study / Case Study / Applications	Injection Moulding areas of industrial applications.
Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5

MODULE-2	GENERAL MOLUDING CONSTRUCTION	22MEE345.1 22MEE345.3 22MEE345.6	8 Hours

Introduction , Mold design concepts, mold elements parting line and parting surface construction of core and cavities Bolsters mold alignment, Feed system, Sprue, runner, gate & position of gate runner & gate balancing.

Case Study	Moulding construction case study.
Text Book	Text Book 1: 2.1, 2.2, 2.3, 2.4, 2.5

MODULE-3	COMPRESSION MOULDING	22MEE345.2 22MEE345.3 22MEE345.4	8 Hours

Types of compression mold, open flash, semi-positive type, positive, displacement molds, types of loading chambers, flash thickness, pot design, projected area, compression pressure, clamping force.

Applications	Compression Moulding areas of industrial applications.
Text Book	Text Book 1: 4.1, 4.2, 4.3, 4.4, 4.5

MODULE-4	PRESS TOOLS	22MEE345.5	8 Hours

Types of presses, types of dies, Clearance, die sets, materials of die sets, cutting force, punch design, punch holder and die support, stripper plate, die springs, die wear.

Applications	Press tools areas of industrial applications.		
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.4, 5.5		
MODULE-5	**JIGS AND FIXTURES**	**22MEE345.5** **22MEE345.6**	**8 Hours**

Production devices, Elements of jigs and fixtures, Advantages of jigs and fixtures, Inspection devices, Materials used presentation of work piece.

Case Study	Jigs and fixtures industrial applications and case studies of the same.
Text Book	Text Book 2: 1.1, 1.2, 1.3, 1.4,1.5, 1.6

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Injection Mould Design An Introduction And Design For The Thermoplastics Industry by Pye R G W. Publisher: Affiliated East-West Press Pvt. Ltd.2019, ISBN 9788185336682

2) Jigs and fixtures design manual by P.H.Joshi Publication Tata McGraw Hill Education Private Limited. 2015, ISBN 9780071334524

Reference Books:

1) Press Tools Design and Construction, 2012, by Joshi P.H. (Author), S.Chand and publications.2018
2)Injection mold design engineering, David O Kazmer, 2nd edition Hanser publications.2017

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=I71YrXafg0o
- https://www.youtube.com/watch?v=l-7ivFEAzw8
- https://www.youtube.com/watch?v=0t_kie_sBLw
- https://www.youtube.com/watch?v=uOYIoX3srbw

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

- Video demonstration of latest trends in   Tool Engineering
- Contents related activities (Activity-based discussions)
  - ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - ➢ Organizing Group wise discussions on issues
  - ➢ Seminars

COMPUTER AIDED MACHINE DRAWING

Course Code	22MEE351	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	2	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE351.1	Understand the orientation and sections of solids in different views.
22MEE351.2	Explain the students with Indian Standards on drawing practices, production of 2 D drawings.
22MEE351.3	Investigate the limits, fits and tolerance on component dimensions along with GD&T.
22MEE351.4	Apply the knowledge on 3D surface models using CAD software.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE351.1	3	2	-	-	2	-	-	-	-	2	-	-	1	3
22MEE351.2	3	2	-	-	2	-	-	-	-	2	-	-	1	3
22MEE351.3	3		-	-		-	-	-	-	2	-	-	1	3
22MEE351.4	3	2	2	-	2	-	-	-	-	2	-	2	1	3

MODULE-1	SECTIONS OF SOLIDS	22MEE351.1	6 Hours

Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids), True shape of sections

Self-study / Case Study / Applications	Investigate the truncation, frustum of solids.
Text Book	Text Book: 1; 1.1-1.13,

MODULE-2	RIVETED JOINTS	22MEE351.2	4 Hours

Forms and proportions of rivet heads, Single and double riveted lap joints, butt joints with single/double cover straps

Applications	Application of riveted joints in the structural members.
Text Book	Text Book: 1; 2.1-2.13,

MODULE-3	GEOMETRIC DIMENSIONING AND TOLERANCE	22MEE351.2	2 Hours

Introduction to limits, fits and tolerances, dimensional and geometric tolerances, surface finish symbols. Practical examples using industrial drawings

Applications	Application of Geometric dimensioning and tolerance for commercial applications.
Text Book	Text Book: 1;10.1-10.8

MODULE-4	SURFACE MODELLING	22MEE351.3	6 Hours

Generation of 3D sheet metal components Tray, Brackets, Funnel, Belt Guards, Air filters, Housings, Transition Pieces etc.

Applications	Explore the different applications of Surface modeling.
Text Book	Text Book: 3

MODULE-5	3D GEOMETRIC MODELING AND ASSEMBLY	22MEE351.4	12 Hours

Machine components – Screw jack (Bottle type), Plummer block (Pedestal Bearing), Machine vice, I.C. Engine connecting rod, Rams Bottom Safety Valve, Tailstock of lathe, Tool Head of a shaper.

Self-study	Scrutinize the Different types of modelling techniques.

Text Book	Text Book : 1; 9.1-9.5,

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	Self-study
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:
TEXTBOOKS
1. 'Machine Drawing', K.R. Gopala Krishna, Subhash Publication, 2017, ISBN-139789383214235
2. 'Machine Drawing' N. D. Bhat, V M Panchal, Charotar Publication House, 2014, ISBN: 9789385039232, 9385039237.
1. 3. Advanced Surface Modeling in Matrixgold, Mohsen Mohammadvali, ISBN**:** 9780074603376

Reference Books:
2. 'Machine Drawing with Auto CAD', Goutam Pohit & Goutham Ghosh, 1st Indian print Pearson Education, 2005, ISBN: 13-978-8131706770
3 'Machine Drawing', N. Siddeshwar, P. Kanniah, V.V.S. Sastri, published by Tata McGraw Hill,2014, ISBN**:** 007460337X /
4 'Machine Drawing' Junnarkar N. D., Pearson Education, 2007, ISBN: 8131706788

Web links and Video Lectures (e-Resources):
- Bureau of Indian Standards (BIS): SP-46, 2003
- NPTEL Web Course: https://nptel.ac.in/courses/112103019/
- NPTEL Video Course: https://nptel.ac.in/syllabus/112106075/

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Visit to any manufacturing/aero/auto industry/process industry/any power plant.
- Demonstration of design stages in the manufacturing or process industry.
- Video demonstration of latest modelling techniques.

EXCEL IN MS EXCEL

Course Code	22MEE352		CIE Marks	50
L:T:P:S	1:0:0:0		SEE Marks	50
Hrs / Week	01		Total Marks	100
Credits	01		Exam Hours	02

Course outcomes:

At the end of the course, the student will be able to:

22MEE352.1	Understand the basic skill relevant to various industries and techniques that are applicable across the industry sector.
22MEE352.2	Acquire the data analysis skill techniques through real life case study.
22MEE352.3	Explore the work data sheet for multi-source located in VLOOKUP, XLOOKUP and HLOOKUP development.
22MEE352.4	Study on the different types of charts and graphics techniques, to format tables and dynamics pivot charts.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE352.1	3	3	3	3	2	-	-	-	-	-	-	-	3	3
22MEE352.2	3	3	3	3	2	-	-	-	-	-	-	-	3	3
22MEE352.3	3	3	3	3	2	-	-	-	-	-	-	-	3	3
22MEE352.4	3	3	3	3	2	-	-	-	-	-	-	-	3	3

MODULE-1	Create Worksheets and Workbooks	22MEE352.1	3 Hours

Create workbooks, Modify workbooks. Modify worksheets, Merge and unmerge cells. Customize the Excel app window, Manage the ribbon, and Manage the Quick Access Toolbar, Customize the status bar. Change the magnification level of a worksheet, Arrange multiple workbook windows, Skills review, Practice tasks. Work with data and Excel tables Enter and revise data, Manage data by using Flash Fill, Move data within a workbook, Sidebar: Quickly access data-formatting commands, Find and replace data, Correct and fine-tune data, Define Excel tables, Skills review, Practice tasks

Self-study / Case Study / Applications	To study the Worksheets and Workbooks, and data formatting, Practice tasks which is used in various fields
Text Book	Text Book 1 :3 to 39 and 41 to 68

MODULE-2	Perform calculations on data	22MEE352.2	3 Hours

Name data ranges. Create formulas to calculate values. Summarize data that meets specific conditions. Copy and move formulas. Create array formulas. Find and correct errors in calculations. Configure automatic and iterative calculation options. Change workbook appearance Format cells, Define and manage cell styles , Apply and modify workbook themes , Apply and modify table styles , Make numbers easier to read , Change the appearance of data based on its value ,Add images to worksheets .

Applications	To Find and correct errors in calculations and Configure automatic and iterative calculation options
Text Book	Text Book 1 : 71 to 133

MODULE-3	Analyze and present data	22MEE352.3	3 Hours

Manage worksheet data, Filter data ranges and tables, Summarize filtered data, Sidebar: Randomly select list rows, Enforce data entry criteria. Reorder and summarize data, Sort worksheet data, Sort data by using custom, lists Outline and subtotal data. Combine data from multiple sources, Look up data from other locations , Locate information in the same row (VLOOKUP) , Locate information in the same column (HLOOKUP) , Locate information anywhere (XLOOKUP) , Link to data in other locations , Consolidate multiple sets of data .

Applications	To Investigate the various Multi-source located in VLOOKUP, XLOOKUP and HLOOKUP development.		
Text Book	Text Book 1: 137 to 191		
MODULE-4	**Analyze alternative data sets**	**22MEE352.4,**	**3 Hours**

Analyze alternative data sets, Define and display alternative data sets, Forecast data by using data tables, Identify the input necessary to achieve a specific result. Create charts and graphics , Create standard charts , Create combo charts , Create specialized charts , Hierarchy charts , Statistic charts , Scatter charts , Stock charts , Map charts, Customize chart appearance , Identify data trends , Summarize data by using spark lines , Illustrate processes and relationships, ix Insert and manage shapes , Sidebar: Insert mathematical equations. Create PivotTables and Pivot Charts, Analyze data dynamically in PivotTables, Filter, show, and hide PivotTable data, Edit Pivot Tables, Format PivotTables and Create dynamic Pivot Charts.

Applications	To get knowledge of practicing the charts, tables and graphs which is used in various fields.
Text Book	Text Book 1: 194 to 277

MODULE-5	**Collaborate and share in Excel**	**22MEE352.5,** **22MEE352.6**	**3 Hours**

Print worksheets and charts ,Add headers and footers to printed pages ,Prepare worksheets for printing , Fit your worksheet contents to the printed page , Change page breaks in a worksheet , Change the page printing order for worksheets , Print worksheets , Print parts of worksheets ,Print charts. Automate tasks and input , Enable and examine macros, Set macro security levels in Excel , Examine macros , Create and modify macros, Run macros , Assign a macro to a Quick Access Toolbar button , Assign a macro to a shape , Run a macro when a workbook opens , Present information and options as form controls Work with other Microsoft 365 apps , Combine Excel, Word, and PowerPoint content , Link from Excel to a document or presentation , Embed file content , Create hyperlinks from worksheets.

Applications	To Create hyperlinks from worksheets.
Text Book	Text Book 1: 285 to 346

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		Test (s)	Qualitative Assessment (s)	MCQ's
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create		-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		**Exam Marks Distribution (50)**
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:

1) Microsoft Excel Step by Step (Office 2021 and Microsoft 365) 'Joan Lambert Curtis Frye' ISBN-13: 978-0-13-756427-9 Pearson Education, Inc.
2) Advanced Excel Formulas 'Alan Murray' 978-1-4842-7125-4 Published: 28 August 2022

3) Microsoft Excel 2019: Data Analysis And Business Modelling 'Wayne L. Winston'

Reference Books:

1)Excel Formulas and Functions: Cool Tips and Tricks with Formulas in Excel

Web links and Video Lectures (e-Resources):
- **https://www.youtube.com/watch?v=RkQl2wVpQAo**
- https://www.youtube.com/watch?v=8Ob8Hre_SnI
- **https://learn.microsoft.com/en-us/power-pages/getting-started/tutorial-add-custom-page-layout**

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

- Demonstration of excel operations
- Demonstration of Create charts and graphics
- Demonstration of Change workbook appearance
- Video demonstration of latest trends in mobility
- Contents related activities (Activity-based discussions)
    - For active participation of students, instruct the students to prepare Flowcharts and Handouts
    - Organizing Group wise discussions on issues
    - Seminars

WORKSHOP TECHNOLOGY

Course Code	22MEE353	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	02	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE353.1	Analyze the basic need for the fitting and make various models of fitting
22MEE353.2	Apply the concept of developments of lateral surfaces to develop the sheet metal models
22MEE353.3	Analyze the various welding techniques to make the welding models
22MEE353.4	Apply the various Brazing & Soldering techniques to make the respective models

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE353.1	3	3	2	2	-	-	-	-	-	-	-	-	3	-
22MEE353.2	3	3	2	2	-	-	-	-	-	-	-	-	3	-
22MEE353.3	3	3	2	2	-	-	-	-	-	-	-	-	3	-
22MEE353.4	3	3	2	2	-	-	-	-	-	-	-	-	3	-

Exp. No.	List of Experiments	Hours	COs
	PART-A		
1	Study of fitting tools, fitting operations & joints	2	22MEE353.1
2	Fitting Model1: Rectangular Joint , Semicircular Joint	2	22MEE353.1
3	Fitting Model2: Triangular Joint, Dovetail Joint	2	22MEE353.1
4	Introduction to development of lateral surfaces, types, section plane concepts	2	22MEE353.2
5	Development of regular pentagonal, square & hexagonal prism models	2	22MEE353.2
6	Development of truncated right circular cone model & frustum of cone model	2	22MEE353.2
	PART-B		
7	Development of pyramid & frustum of pyramid models	2	22MEE353.2
8	Development of cylinder and truncated cylinder models	2	22MEE353.2
9	Welding: Introduction, types of welding, Model 1, 2 (Lap, Butt joints)	2	22MEE353.3
10	Welding Models 3, 4 (T, L joints)	2	22MEE353.3
11	Brazing: Introduction and Model	2	22MEE353.4
12	Soldering: Introduction and Model	2	22MEE353.4

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	Remember		5
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	5
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Text Books:
1) Elements of workshop Technology- Vol1 & 2, S.K.H Choudhury, A.K.H Choudhury, Nirjhar Roy, Media promotors and publishers, 2018,ISBN 9789381075037
2) Manufacturing Technology by P.N. Rao, ISBN 9781259861077

INDUSTRIAL WASTE MANAGEMENT

Course Code	**22MEE354**	**CIE Marks**	**50**
L:T:P:S	**1:0:0:0**	**SEE Marks**	**50**
Hrs / Week	**2**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

22MEE354.1	Understand the types and characteristics of waste produced.
22MEE354.2	Evaluate the waste for Recycle, reuse and byproduct recovery.
22MEE354.3	Investigate the waste with respect to quality and quantity.
22MEE354.4	Investigate treatment methods for socially vital issues with critical thought.
22MEE354.5	Analyze the hazardous waste management through research and experiential learning.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE354.1	3	3	3	3	2	-	-	-	1	1	-	2	1	3
22MEE354.2	3	3	3	3	2	-	-	-	1	1	-	2	1	3
22MEE354.3	3	3	3	3	2	-	-	-	1	1	-	2	1	3
22MEE354.4	3	3	3	3	2	-	-	-	1	1	-	2	1	3
22MEE354.5	3	3	3	3	2	-	-	-	1	1	-	2	1	3

MODULE-1	**INTRODUCTION**	**22MEE354.1**	**6 Hours**

Types of industries and industrial pollution – Characteristics of industrial wastes – Population equivalent – Bioassay studies – effects of industrial effluents on streams, sewer, land, sewage treatment plants and human health – Environmental legislations related to prevention and control of industrial effluents and hazardous wastes.

Self-study / Case Study / Applications	Investigate the Challenges of Industrial waste on the environment.
Text Book	Text Book1: 1.2, 1.4, 1.6

MODULE-2	**CLEANER PRODUCTION**	**22MEE354.2**	**6 Hours**

Waste management Approach – Waste Audit – Volume and strength reduction – Material and process modifications – Recycle, reuse and byproduct recovery – Applications.

Self-study / Case Study / Applications	Investigate the quantity and quality of the industrial waste produced.
Text Book	Text Book 2: 2.2, 2.6, 2.8, 2.9

MODULE-3	**POLLUTION FROM MAJOR INDUSTRIES**	**22MEE354.3**	**6 Hours**

Sources, Characteristics, waste treatment flow sheets for selected industries such as Textiles, Tanneries, Pharmaceuticals, Electroplating industries, Dairy, Sugar, Paper, distilleries, Steel plants, Refineries, fertilizer, thermal power plants – Wastewater reclamation concepts

Self-study	Explore the characteristics of the industrial waste.
Text Book	Text Book1: 4.2, 4.6, 4.8, 4.10

MODULE-4	**TREATMENT TECHNOLOGIES**		**22MEE354.4**	**6 Hours**

Equalisation – Neutralisation – Removal of suspended and dissolved organic solids - Chemical oxidation – Adsorption - Removal of dissolved inorganics – Combined treatment of industrial and municipal wastes – Residue management – Dewatering - Disposal

Self-study	Scrutinize the Different types of Optimization techniques.
Text Book	Text Book 2: 5.1, 5.2, 5.3, 5.5

MODULE-5	**HAZARDOUS WASTE MANAGEMENT**		**22MEE354.5**	**6 Hours**

Hazardous wastes - Physico chemical treatment – solidification – incineration – Secured land fills

Self-study	Survey on Industrial waste, treatment and case studies of the same.
Text Book	Text Book 1: 8.1, 8.2, 8.3 , 8.4

CIE Assessment Pattern (50 Marks – Theory) –

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	4	-	-
L2	Understand	4	-	-
L3	Apply	6	3	5
L4	Analyze	8	7	5
L5	Evaluate	3	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

TEXTBOOKS

1. M.N.Rao & A.K.Dutta, "Waste water Treatment", Oxford - IBH Publication, 1995. ISBN 9788120417190
2. W .W. Eckenfelder Jr., "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi, 2000.ISBN 9780071815583.

Reference Books:

1. T.T.Shen, "Industrial Pollution Prevention", Springer, 1999.
2. R.L.Stephenson and J.B.Blackburn, Jr., "Industrial Waste water Systems Hand book", Lewis Publisher, New Yark, 1998
3. H.M.Freeman, "Industrial Pollution Prevention Hand Book", McGraw-Hill Inc., New Delhi, 1995.
4. Bishop, P.L., "Pollution Prevention: Fundamental & Practice", McGraw-Hill, 2000.

Web links and Video Lectures (e-Resources):

- https://shorturl.at/tLST3
- https://www.youtube.com/watch?v=aS-U8xsvZ
- https://www.youtube.com/watch?v=HBkwTyBI75M
- https://archive.nptel.ac.in/courses/105/105/105105160/
- https://nsf-gov-resources.nsf.gov/2023 03/Bioinspired%20Design%20Workshop%20Report_2232327_October%202022_Final.508.pdf

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

- Visit to any manufacturing/aero/auto industry/process industry/any power plant
- Demonstration of waste produce though in the manufacturing or process industry.
- Video demonstration of latest waste treatment methods
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

INTRODUCTION TO VIRTUAL REALITY

Course Code	22MEE355		CIE Marks	50
L:T:P:S	0:0:1:0		SEE Marks	50
Hrs / Week	2		Total Marks	100
Credits	01		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE355.1	Investigate digital product creation technology and Set up platform technology for VR and AR experiences.
22MEE355.2	Implement controls for virtual object interactions also apply instantiation and related features for gaming objects.
22MEE355.3	Design an interactive UI with control tools.
22MEE355.4	Develop an interactive gaming app using available assets.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE355.1	3	-	-	-	3	-	-	-	-	-	-	2	3	-
22MEE355.2	3	3	-	-	3	-	-	-	-	-	-	2	3	-
22MEE355.3	3	3	3	-	3	-	-	-	3	-	-	-	3	-
22MEE355.4	3	3	3	-	3	-	-	-	3	-	-	-	3	-

Exp. No. / Pgm. No.	List of Experiments / Programs	Hours	COs
Prerequisite Experiments / Programs / Demo			
	Proficiency in programming languages like C# or C++, Knowledge of 3D graphics and game development	2	NA
PART-A			
1.	Build a Metaverse Avatar: Create your own Metaverse avatars using Metaverse platforms like Roblox or VR Chat. Also customize their avatars' appearance and experiment with different virtual identities.	2	22MEE355.1
2.	Virtual World Exploration: Explore a Metaverse platform of your choice. Document the experiences, noting features, interactions, and any challenges which are encountered.	2	22MEE355.1
3.	Get started with Unity: Install and configure your development environment. Craft and customize sprites for your game's visual elements.	2	22MEE355.1
4.	Manage and optimize internal game assets efficiently. Control the game flow by saving and loading scenes seamlessly	2	22MEE355.2
5.	Generate a character featuring Rigid Body and Collider components. Develop a script for nuanced control over acceleration, deceleration, and character movement.	2	22MEE355.2
6.	Utilize ray casting to establish grounded status, permitting jumps exclusively when the character is on solid ground. Incorporate customizable parameters for jump height, movement speed, and more	2	22MEE355.2
PART-B			
7	Craft a game object, tailor its attributes, and enhance it with various components. Craft a script that spawns a game object precisely at the mouse click location.	2	22MEE355.3

8	Develop a coroutine for a gradual, time-based transformation of a game object's color.	2	22MEE355.3
9	Construct a script deliberately containing errors (e.g., attempting to access a non-existent component) to explore error message outputs in the console	2	22MEE355.3
10	Create a Canvas object by right-clicking in the Hierarchy and selecting "UI" > "Canvas," then configure its Render Mode to "Screen Space - Overlay.	2	22MEE355.4
11	Craft a straightforward material for an object within the scene, such as a sphere, and experiment with various shader options, including properties like color, emission, and transparency.	2	22MEE355.4
12	Access the Unity Asset Store through Unity's Window menu, and explore available free or trial assets that can enhance your scene, such as UI elements, shaders, particle effects, or 3D models.	2	22MEE355.4

PART-C
Beyond Syllabus Virtual Lab Content

- https://learn.unity.com/course/create-with-vr
- https://www.lncc.br/~jauvane/papers/RelatorioTecnicoLNCC-0603
- https://mv-iitkgp.vlabs.ac.in/List%20of%20experiments.html
- https://mv-iitkgp.vlabs.ac.in/exp/pitot-tube/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Weekly Evaluation	Project Evaluation	Lab CIE Test
		10	20	20
L1	Remember	2	-	-
L2	Understand	2	-	-
L3	Apply	2	5	5
L4	Analyze	2	5	5
L5	Evaluate	2	5	5
L6	Create		5	5

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	10
L4	Analyze	30
L5	Evaluate	10
L6	Create	

Suggested Learning Resources:
Text Books:
 1) Unity in Action: Multiplatform Game Development in C#, By Joe Hocking, Manning Publications, 2015, ISBN: 978-1617292323.
 2) Unity Animation Essentials by Alan Thorn, Packt Publishers, 2015, ISBN: 978-1782174813.
Reference Books:
1) Unity Artificial Intelligence Programming" by Dr. Davide Aversa, Packt, 2022, ISBN: 9781803238531.

Web links and Video Lectures (e-Resources):
- https://onlinecourses.nptel.ac.in/noc22_ge24/preview
- https://biodesign.berkeley.edu/bioinspired-design-course/
- https://www.youtube.com/watch?v=cwxXY9Qe8ss
- https://www.youtube.com/watch?v=V2GvQXvjhLA

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- **VR Game Jam:** Practice a VR game jam where students have a limited time (e.g., 48 hours) to design and develop a complete VR game. They provide a theme or specific constraints to make it more challenging.
- **Cross-Platform Compatibility:** Challenges to develop a VR app that works seamlessly across multiple VR platforms (e.g., Oculus Rift, HTC Vive, and mobile VR).
- **Immersive Storytelling:** Create an immersive VR storytelling experience with interactive elements and branching narratives.

IV Semester Syllabus

NUMERICAL, COMPLEX ANALYSIS AND PROBABILITY THEORY

Course Code	22MAE41	CIE Marks	50
L:T:P:S	2:1:0:0	SEE Marks	50
Hrs. / Week	4	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MAE41.1	Solve initial value problems using appropriate numerical methods
22MAE41.2	Apply the concepts of Complex variables to solve Engineering Problems
22MAE41.3	Apply the concepts of Transformations, Complex integration, Poles and Residuals in the stability analysis of engineering problems
22MAE41.4	Gain ability to use probability distributions to analyze and solve real time problems
22MAE41.5	Apply the concept of sampling distribution to solve engineering problems
22MAE41.6	Use the concepts to analyze the data to make decision about the hypothesis

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22MAE41.1	3	3	-	-	-	-	-	-	-	-	-	-
22MAE41.2	3	3	-	-	-	-	-	-	-	-	-	-
22MAE41.3	3	3	-	-	-	-	-	-	-	-	-	-
22MAE41.4	3	3	-	-	-	-	-	-	-	-	-	-
22MAE41.5	3	3	-	-	-	-	-	-	-	-	-	-
22MAE41.6	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	NUMERICAL METHODS	22MAE41.1	8 Hours

Numerical solution of ordinary differential equations of first order and of first degree: Taylor's series method, Modified Euler's method and Runge-Kutta method of fourth-order-Problems. Milne's predictor and corrector methods-Problems. Numerical Solution of second order ordinary differential equations by Runge-Kutta method of fourth-order-Problems.

Case Study	Case studies on Numerical Analysis.
Text Book	Text Book 1: 32.3, 32.5, 32.7, 32.9, 32.12, Text Book 2: 21.1.

MODULE-2	COMPLEX VARIABLES	22MAE41.2	8 Hours

Functions of complex variables, Analytical functions, Cauchy-Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic functions-Problems using Milne-Thompson's method.

Application	Applications of Flow Problems-Velocity potential, Stream functions and complex potential functions.
Text Book	Text Book 1: 20.2, 20.4, 20.5, 20.6, Text Book 2: 13.1, 13.2, 13.3, 13.4.

MODULE-3	CONFORMAL TRANSFORMATIONS AND COMPLEX INTEGRATIONS	22MAE41.3	8 Hours

$W = z^2$ and $W = e^z$. Cauchy's Theorem (with proof), Generalized Cauchy's integral formula, Singularities, Poles and Residues, Residue theorem (without proof)-Problems.

Text Book	Text Book 1: 20.10, 20.13, 20.14, 20.18. Text Book 2: 14.1, 14.2, 14.3, 14.4, 16.1, 16.2, 16.3, 16.4, 17.1.

MODULE-4	PROBABILITY DISTRIBUTIONS	22MAE41.4	8 Hours

Random variables (discrete and continuous), probability density functions, Discrete Probability distributions: Binomial and Poisson Distributions-Problems. Continuous Probability distributions: Exponential and Normal Distributions-Problems. Joint Probability Distribution-Problems.

Case Study	Case studies of Probability Theory in signal &image processing and in Optical communication

	system.
Text Book	Text Book 1: 26.8, 26.9, 26.12, 26.14, 26.15, 26.16.

MODULE-5	**SAMPLING THEORY**	**22MAE41.5** **22MAE41.6**	**8 Hours**

Sampling, Sampling distributions, test of hypothesis of large samples for means and proportions, Inferences for variance and proportion. Central limit theorem (without proof), Confidence limits for means, Student's t-distribution, Chi-Square test of goodness of fit and F-distribution for test of goodness of fit for small samples.

Case Study	Case Studies of Sampling Theory in multi band signal Analysis and Extension of Sampling Theorem in speech Compression.
Text Book	Text Book 1: 27.2, 27.3, 27.4, 27.5, 27.6, 27.7, 27.8, 27.9, 27.10, 27.11, 27.12, 27.14, 27.15, 27.16, 27.17, 27.19.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	5
L5	Evaluate	5
L6	Create	-

Suggested Learning Resources:
Text Books:
1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022,
   ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint
   2016, ISBN: 9788126554232.
Reference Books:
1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition,
   2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited,
   Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018,
   ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth
   Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):
1)https://youtu.be/4lCiEnuhbA4?si=My95pvqwAMRDfjid
2)https://youtu.be/QQFIWwDA9NM?si=3wJrtlm1NdPSbXmB
3)https://youtu.be/bI46OqXUtd8?si=_Po-jfjq_94X4p_O
4)https://youtu.be/NqZUHJgitHk?si=Y6viSg1DFA4hgM9u

5)https://youtu.be/oPPJNoKYCro?si=A5zWC_vQQaHY7HlQ
6)https://youtu.be/hll0DAilhoA?si=2dN3KfJMBy9ZGxjD
7)https://youtu.be/x6X1P8rGXXs?si=YcmH8nxx1iQwq8mA
8)https://youtu.be/dOr0NKyD31Q?si=dMBU-BXGdGL6jIZy
9)https://youtu.be/BR1nN8DW2Vg?si=melzz97SqhK3wr--
10)https://youtu.be/ugd4k3dC_8Y?si=xF5U2gjIgP0woDQt
11)https://youtu.be/z0Ry_3_qhDw?si=6IG2a65BZgdbaKsn
12)https://youtu.be/36cAE1Ovpq4?si=jfR8gkFmMOCkWNZ_
13)https://youtu.be/vFz2FG65HBc?si=SCHi3Y1XuHWg-pPT
14)https://youtu.be/2Dsz1lZBJ3Y?si=8ATLUE-mkJSMewO3

Activity-Based Learning (Suggested Activities in Class)/Practical Based Learning:
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

ENGINEERING THERMODYNAMICS

Course Code	22MEE42		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	03		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE42.1	Understand basic concepts of thermodynamics like systems, equilibrium, process etc. and its applications
22MEE42.2	Apply the laws of thermodynamics to solve engineering, problems
22MEE42.3	Identify the different types of work and heat transfer mechanisms
22MEE42.4	Analyze reversible and irreversible process using second law and entropy concepts
22MEE42.5	Apply the quantities used to describe the composition of a gas mixture, such as mass fraction, mole fraction, and volume fraction
22MEE42.6	Understand the behavior of real gases at various conditions

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE42.1	3	3	3	-	-	-	-	-	-	-	-	-	-	3
22MEE42.2	3	3	2	-	-	-	-	-	-	-	-	-	-	3
22MEE42.3	3	3	3	-	-	-	-	-	-	-	-	-	-	3
22MEE42.4	3	3	3		-	-		-	-	-	-	-	-	3
22MEE42.5	3	3	3	-	-	-	-	-	-	-	-	-	-	3
22MEE42.6	3	3	3	-	-	-	-	-	-	-	-	-	-	3

MODULE-1	FUNDAMENTAL CONCEPTS & DEFINITIONS	22MEE42.1 22MEE42.2	8 Hours

Fundamental Concepts & Definitions: Microscopic and Macroscopic approaches. System and its types, Surroundings, boundary, Thermodynamic properties: definition and units, Intensive and extensive properties, quasi-static process. Thermodynamic equilibrium: definition and conditions, Zeroth law of thermodynamics.
Temperature: concept, two-point scales and one-point scale, International fixed points. Temperature measurements, Numerical on temperature scales

Applications	Analyze the Practical Applications of zeroth law of thermodynamics and temperature concepts.
Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4,1.5, 2.1,2.2, 2.3 Text Book 2: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.9, 1.11

MODULE-2	WORK AND HEAT AND FIRST LAW OF THERMODYNAMICS:	22MEE42.1 22MEE42.2 22MEE42.3	8 Hours

Work and Heat: Mechanics definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work explanation, expressions for displacement work in various processes through p-V diagrams, Problems on work transfer and heat transfer.
First Law of Thermodynamics: Joules experiment, equivalence of heat and work. Statement of the First law of thermodynamics, Internal energy, prove energy is a property of the system, steady state-steady flow

energy equation, Assumptions for SFEE and some important applications. Numerical on open and closed systems	
Case Study/Applications	Investigate the applications of steady flow energy equation
Text Book	Text Book 1: 3.1, 3.2, 3.5, 3.6 , 4.1, 4.2, 4.3 , 5.1, 5.2 Text Book 2: 2.1, 2.2, 2.3, 3.1, 3.2, 3.3

MODULE-3	SECOND LAW OF THERMODYNAMICS:	22MEE42.2 22MEE42.4	8 Hours

Second Law of Thermodynamics: Thermal reservoirs. Direct heat engine; schematic representation and efficiency. Reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck and Clausius statement; PMM I and PMM II, Equivalence of the two statements; Reversible and irreversible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Numerical

Applications	Analyze the Application of second law of thermodynamics
Text Book	Text Book 1: 6.3, 6.4, 6.5, 6.6, 6.7, 6.8 Text Book 2: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6

MODULE-4	ENTROPY AND PURE SUBSTANCES	22MEE42.4	8 Hours

Entropy: Clausius theorem, Clausius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy for irreversible process, principle of increase in entropy of the universe, entropy as a quantitative test for irreversibility, Numerical

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, Numerical.

Case Study/Applications	Case study and practical applications of Entropy and pure substance concepts
Text Book	Text Book 1: 7.4, 7.6, 7.7, 7.8, 9.1, 9.2, 9.7 Text Book 2: 5.1, 5.6, 5.7, 5.8, 7.1, 7.2, 7.3

MODULE-5	IDEAL GAS MIXTURES AND REAL GASES	22MEE42.5 22MEE42.6	8 Hours

Ideal gas mixtures: Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of mass fractions, mole fractions, Expressions for C_P,C_V and Gas constant of the mixture. Numerical on mixtures.

Real Gases: Introduction. Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart. Numerical on real gases.

Applications	Investigate the applications of Ideal and Real gas mixtures
Text Book	Text Book 1: 10.1,10.2,10.3, 10.4, 10.5 Text Book 2: 8.1, 8.2, 8.3, 8.5.

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:

Text Books:
1) Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill Publication, 2nd edition, 2017, ISBN: 9780070151314.
2) Basic Thermodynamics, B.K Venkanna, Swati B. Wadavadagi, PHI Learning Private Limited, 2020, ISBN 13 – 9788120341128.

Reference Books:
1) Fundamentals of Engineering Thermodynamics, Moran J Shapiro., John wiley Pub.2015, ISBN – 9780470032091.
2)Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2016, ISBN – 9780073305370
3) Fundamentals of Thermodynamics, Claus Borgnakke, Richard Edwin Sonntag, 8th Edition,WILEY, ISBN – 9781306947732, 2012

Web links and Video Lectures (e-Resources)
- **https://www.learnthermo.com/T1-tutorial/ch01/lesson-A/pg01.php**
- **http://www.freeonlinecoursesforall.com/2017/01/01/10-free-online-courses-on-thermodynamics/**
- **https://archive.nptel.ac.in/courses/112/105/112105123/**
- **http://www.digimat.in/nptel/courses/video/112105123/L13.html**

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

- Visit to any Thermal power plant

- Demonstration of working of IC engine/refrigerator

- Video demonstration on Laws of thermodynamics

- Contents related activities (Activity-based discussions)

  ➢ For active participation of students, instruct the students to prepare thermodynamics related Flowcharts and Handouts

  ➢ Organizing Group wise discussions on issues

  ➢ Seminars

ENGINEERING THERMODYNAMICS LAB

Course Code	22MEL42		CIE Marks	50
L:T:P:S	0:0:1:0		SEE Marks	50
Hrs / Week	02		Total Marks	100
Credits	01		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEL42.1	Conduct tests to determine the properties of fuels and oils
22MEL42.2	Analyze the area of irregular and regular surfaces using planimeter
22MEL42.3	Investigate the viscosity of given liquid using different viscometers.
22MEL42.4	Determine the Calorific value of solid, liquid and gaseous fuels and cloud point, pour point of the given sample

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEL42.1	3	3		-	-	-	-	-	-	-	-	-	3	2
22MEL42.2	3	3	3	3	-	-	-	-	-	-	-	-	3	2
22MEL42.3	3	3			-	-	-	-	-	-	-	-	3	2
22MEL42.4	3	3	3	3	-	-	-	-	-	-	-	-	3	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	• Understand the properties of fluids • Demonstration on working of 2-stroke engine and 4-stroke engine.	2	NA
	PART-A		
1	Determination flash point and fire point using Abel's Apparatus	2	22MEL42.1
2	Determination flash point and fire point using Pensky Marten's Apparatus	2	22MEL42.1
3	Determination flash point and fire point using Cleveland's Apparatus	2	22MEL42.1
4	Determination of area of irregular surface using Planimeter	2	22MEL42.2
5	Determination of Calorific value of solid and liquid fuels	2	22MEL42.4
6	Determination of Calorific value of gaseous fuels	2	22MEL42.4
	PART-B		
7	Determination of viscosity of given lubricating oil using Saybolt Viscometer.	2	22MEL42.1, 22MEL42.3
8	Determination of viscosity of given lubricating oil using Redwood Viscometer.	2	22MEL42.1, 22MEL42.3
9	Determination of viscosity of given lubricating oil using Torsion Viscometer.	2	22MEL42.1, 22MEL42.3
10	Determination of cloud point of the given sample	2	22MEL42.4
11	Determination of Pour point of the given sample	2	22MEL42.4
12	Determination of property values for common refrigerants using tables	2	22MEL42.4
	PART-C **Beyond Syllabus Virtual Lab Content** **(To be done during Lab but not to be included for CIE or SEE)**		

- http://htv-au.vlabs.ac.in/heat-thermodynamics/Thermo_Couple_Seebeck_Effect/
- http://htv-au.vlabs.ac.in/heat-thermodynamics/Characteristics_of_Thermistor/
- http://vlabs.iitkgp.ernet.in/rtvlas/#
- https://mv-iitkgp.vlabs.ac.in/exp/assmann-psychrometer/

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:
1) Engineering Thermodynamics, P.K.Nag, Tata McGraw Hill Publication, 6th edition, 2017, ISBN: 9789352606429
2) Engineering Thermodynamics, R.K Rajput, Lakshmi Publications , 2019, ISBN 9788131800584.2016.

MANUFACTURING TECHNOLOGY

Course Code	22MEE43		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	03		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE43.1	Understand the selection of suitable moulding and casting processes
22MEE43.2	Apply various concepts of forging and joining techniques for required materials.
22MEE43.3	Analyze the tool life and tool failure during machining process
22MEE43.4	Select the appropriate machine tools and machining operations to manufacture the components
22MEE43.5	Apply Indexing the number of divisions on the work using various indexing techniques during gear cutting operations
22MEE43.6	Investigate on special Moulding processes & Machines

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
22MEE43.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
22MEE43.2	3	2	-	-	-	-	-	-	-	-	-	-	2	2
22MEE43.3	3	2	-	-	-	-	-	-	-	-	-	-	2	2
22MEE43.4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
22MEE43.5	3	2	-	-	-	-	-	-	-	-	-	-	2	2
22MEE43.6	3	2	-	-	-	-	-	-	-	-	-	-	2	-

MODULE-1	CASTING & MOULDING TECHNOLOGY	22MEE43.1	8 Hours

Casting by Moulding sand: Introduction to Casting process & steps involved. Mixture ingredients for different sand mixtures. Method used for sand moulding, such as Greensand, dry sand and skin dried moulds.
Patterns & Cores: Definition, Need, Types, Material. Method of making patterns, cores, Binders & additives used in sand moulding. Concept of Gating &Risers: Principle and types.
Casting defects: Types & methods to avoid

Self-study / Case Study	Make a typical pattern by suitable software supported tool.
Text Book	Text Book 1: chapter1.1,1.2,2.1,2.2,2.3,2.4,2.5,2.6

MODULE-2	SPECIAL MOULDING PROCESSES	22MEE43.2	8 Hours

Special moulding Process: Study of important moulding processes, No bake moulds, Flask less moulds, Sweep mould, CO_2 mould, Shell mould, Investment mould. Metal moulds: Gravity die-casting, Pressure die casting, Centrifugal casting, Squeeze Casting, Slush casting, Thixo-casting and Continuous Casting Processes. Moulding Machines: Jolt type, Squeeze type, Jolt & Squeeze type and Sand slinger, classifications of Melting Furnaces.

Self-study / Case Study	Make a typical Sand/Metal mould by suitable moulding machine.
Text Book	Text Book 1: chapter3.11, 3.13, 5.2

MODULE-3	MACHINES FOR MANUFACTURING	22MEE43.3, 22MEE43.4	8 Hours

Theory of metal cutting: Single point cutting tool nomenclature ,types of metal cutting, Mechanism of chip formation, types of chips. Tool wear and tool failure, tool life. Effects of cutting parameters on tool life. Tool failure criteria, Taylors tool life equations, numericals on tool life.

Turning (lathe): classifications, Work holding devices, constructional features of turret and capstan lathe, tool layout.

Milling machines: classification,, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concept. Various milling operations, Indexing: simple, compound, differential and angular indexing calculations

Drilling machine: classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials, reaming, boring, tapping

Self-study / Case Study	Make a typical work piece using all the Computer Numerical Controlled machining processes.
Text Book	Text Book 2: Chapters 2.12,2.19,4.5,4.8,4.11,4.12,4.13 Text Book 3: Chapters 12.1,12.2,12.6,12.12,12.39,16.2,16.3,16.4,16.15,16.17,16.27,18.4,18.7

MODULE-4	**WELDING & JOINING TECHNIQUES**	**22MEE43.5**	**8 Hours**

Welding process: Principle of welding, classification, application advantages and disadvantages, welding terminology, edge preparation.

Arc welding: Arc welding process, Metal arc welding(MAW) or Flux shielded metal arc welding(FSMAW), Tungsten inert gas welding(TIG), Metal inert gas welding(MIG), Submerged arc welding(SAW), Atomic hydrogen welding(AHW).

Soldering and Brazing: Surface cleaning and soldering flux, Types of soldering, advantages and disadvantages, types of brazing, advantages and disadvantages.

Self-study / Case Study	Make a typical special welded/brazed model by suitable welding/brazing process.
Text Book	Text Book 1: chapter 23.1, 23.2, 23.3, 23.4, 23.5, 23.6, 23.7

MODULE-5	**FORGING TECHNOLOGY**	22MEE43.6	**8 Hours**

Forging: Introduction, Classification of forging processes. Forging machines & equipment. Forging pressure and load in open die forging and closed die forging, concepts of friction hill and factors affecting it. Die- design parameters. Material flow lines in forging. Forging defects, Residual stresses in forging. Advantages and disadvantages of forging. Simple problems.

Self-study / Case Study	Make a typical die forged model by suitable die forging process.
Text Book	Text Book 4: Chapters 3.3,3.7,3.9,3.14,3.16,3.17

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Lab)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	

Suggested Learning Resources:
 Text Books:
 1) Manufacturing Process-I, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2017. ISBN:978-8128002076
 2) Hazara Choudhry, 'Work shop Technology', Vol – II, Media promoters and publishers Pvt. Ltd. 2018, ISBN:9788185099156
 3) R.K.Jain, 'Production Technology', Khanna Publishers-Delhi , 2017, ISBN:9788174090997
 4) Manufacturing Process-III, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2017. ISBN:978-8128010439
 Reference Books:
 1) Fundamentals of Metal machining and machine tools, G. Boothroyd , McGraw Hill, 2015, ISBN:978- 1574446593
 2) HMT, 'Production Technology', HMT, Tata McGraw Hill, 2017. ISBN:978-0070964433

Web links and Video Lectures (e-Resources):
- https://www.google.com/search?q=non+destructive+testing+videos&rlz=1C1CHBF_enIN959IN959&oq=non+destructive+testing+videos&aqs=chrome..69i57j0i22i30j0i390i650l3.17238j0j4&sourceid=chrome&ie=UTF-8
- https://www.youtube.com/watch?v=uTGXHxgcHCo
- https://www.youtube.com/watch?v=kZ7YfWW-rg0
- https://www.slideshare.net/anishadevarashetty/non-destructive-testing-ppt
- https://www.powershow.com/view2b/65bd0c-NTM1N/Non-destructive_testing_NDT_powerpoint_ppt_presentation
- Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.shobhituniversity.ac.in/pdf/econtent/Jitendra-J-NDET-Monograph.pdf

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

- Visit to any manufacturing/aero/auto industry or any power plant
- Demonstration of lathe/milling/drilling/CNC operations
- Demonstration of working of IC engine/refrigerator
- Demonstration of metal joining process
- Video demonstration of latest trends in mobility/robotics
- Contents related activities (Activity-based discussions)
  - ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - ➢ Organizing Group wise discussions on issues
  - ➢ Seminars

MANUFACTURING TECHNOLOGY LAB

Course Code	22MEL43	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	02	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEL43.1	Analyze the properties of sand by determining various values from the sand tests and develop the skill towards metal joining techniques
22MEL43.2	Apply Utilization of the patterns of different geometrical shapes for mold making and volumetric calculation in forging processes
22MEL43.3	Apply the various lathe operations to manufacture cylindrical components
22MEL43.4	Apply the various drilling & milling operations to machine components and make holes

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEL43.1	3	3	3	-	-	-	-	-	-	-	-	-	3	3
22MEL43.2	3	3	3	-	-	-	-	-	-	-	-	-	-	3
22MEL43.3	3	3	3	-	2	-	-	-	-	-	-	-	3	-
22MEL43.4	3	3	3	-	2	-	-	-	-	-	-	-	3	-

Exp. No.	List of Experiments	Hours	COs
	PART-A		
1	Foundry Models: Model 1- Preparation of moulds using two moulding boxes with pattern	2	22MEL43.2
2	Model 2- Preparation of moulds using two moulding boxes without pattern	2	22MEL43.2
3	Permeability test and Sieve analysis test	2	22MEL43.1
4	Clay content test and Moisture content test	2	22MEL43.1
5	Forging Models: Model 1- Converting round rod to square rod	2	22MEL43.2
6	Joining Models: Model 1- Soldering, Model 2- Brazing, Model 3- Electric Arc & gas welding	2	22MEL43.1
	PART-B		
7	Preparation of models on lathe involving facing, plain turning, step turning, taper turning, knurling and thread cutting.	2	22MEL43.3
8	Cutting of v groove/ dovetail/ rectangular groove/gear teeth using milling/Shaping	2	22MEL43.4
9	Preparation of models on drilling involving reaming, boring and internal thread cutting.	2	22MEL43.4
10	Grinding of a surface using a surface grinding machine	2	22MEL43.4
11	Milling of surfaces using both horizontal & vertical milling machines	2	22MEL43.4
12	Demonstration of melting, pouring for casting and CNC turning and milling centres	2	22MEL43.2, 22MEL43.3

<table>
<tr><td colspan="2" align="center">PART-C
Beyond Syllabus Virtual Lab Content
(To be done during Lab but not to be included for CIE or SEE)</td></tr>
</table>

- https://smfe-iiith.vlabs.ac.in/exp/permeability/simulation.html
- https://ms-nitk.vlabs.ac.in/exp/fineness-modulus-of-aggregates/simulation.html
- http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp1/Webpage/index.html
- http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/exp2/webpage/index.html
- http://msvsdei.vlabs.ac.in/mem103/Unit3Simulations.php?MEM103/Unit3/Simulations/Casting .m p4

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	**30**
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	10
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Text Books:
1.Manufacturing Process-I, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2017.ISBN:978-8128002076
2.Hazara Choudhry, 'Work shop Technology', Vol – II, Media promoters and publishers Pvt. Ltd. 2018, ISBN:9788185099156
3.R.K.Jain, 'Production Technology', Khanna Publishers-Delhi , 2017, ISBN:9788174090997
4.Manufacturing Process-III, Dr.K.Radhakrishna, Sapna Book House, 5th Revised Edition 2017.ISBN:978-8128010439

MECHANICAL MEASUREMENTS AND METROLOGY

Course Code	22MEE44	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE44.1	Apply the concepts of metrology to identify the suitable standards for calibrating the end bars.
22MEE44.2	Design the gauges for engineering components using the concepts of Limits, fits, geometric dimensioning and tolerances (GD&T)
22MEE44.3	Understand the working principle of various linear measuring instruments and principles of interference
22MEE44.4	Analyze the various types of screw threads and gear tooth used in various applications and its measuring instruments
22MEE44.5	Identify the surface finish on the components using various methods
22MEE44.6	Investigate appropriate measuring instruments for measurement of force, torque, pressure, temperature and nano impact on metrology.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE44.1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE44.2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE44.3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE44.4	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE44.5	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE44.6	3	3	-	-	-	-	-	-	-	-	-	-	-	3

MODULE-1	Standards of Measurement:	22MEE44.1	8 Hours

Definition and Objectives of metrology, Material standards-International Prototype meter, Imperial standard yard, Airy points, Wave length standard, subdivision of standards, line and end standard, calibration of end bars, Indian Standards (M-87, M- 112) of Slip gauges, Wringing phenomena, Numerical problems on building of slip gauges. Measurements and measurement systems: Generalized measurement system, basic definitions, Errors in measurement, classification of errors.

Text Book	Text Book 1: 1.1, 1.2, 1.4, 1.5, 1.6 ,1.7, 1.8, 1.10, 1.11, 1.12,5.5, 5.7, 5.8, 5.9
Case Study / Applications	Case Study: subdivision of standards Applications : slip gauges

MODULE-2	Limits, Fits, Tolerance and Gauge:	22MEE44.2	8 Hours

Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring gauge, and gauge materials.

Text Book	Text Book 1: 2.1 to 2.11, 2.14 to 2.29
Case Study / Applications	Case Study: Interchangeability and selective assembly Applications : Types of gauges

MODULE-3	Comparators:	22MEE44.3, 22MEE44.4	8 Hours

Introduction to comparators, characteristics, classification of comparators, Johnson's Mikrokator, Sigma comparator, Dial gauge, Ziess ultra-optimeter, Solex pneumatic gauge. Principles of interference, concept of flatness, flatness testing, optical flats, optical interferometer and laser interferometer. Principle of sine bar, sine center, angle gauges, numerical on building of angles.	

Text Book	Text Book 2: 3.1 to 3.8, 3.3, 3.5, 3.7, 3.10, 3.13 to 3.16		
Self-study / Applications	Self-study: Electrical and electronic comparators. Applications : Principle of sine bar, comparators		
MODULE-4	**Surface Metrology:**	**22MEE44.5**	**8 Hours**

Surface Texture Measurement - importance of surface conditions, roughness and waviness, surface roughness standards specifying surface roughness parameters- Ra, Ry, Rz, RMS value etc., surface roughness measuring instruments – Tomlinson and Taylor Hobson versions, surface roughness symbols. Form Measurement: 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. Tool maker's microscope, gear tooth terminology, gear tooth vernier caliper.

Text Book	Text Book 1: 4.7, to 4.20 Text Book 3: 11.1, 11.2, 11.3, 11.11, 11.12.		
Case Study / Applications	Case Study: roughness and waviness. Applications: screw threads, gear tooth vernier caliper.		
MODULE-5	**Measurement of Force, Torque, Pressure:**	**22MEE44.6**	**8 Hours**

Measurement of force, torque, pressure: Principle of analytical balance, platform balance, proving ring. Torque measurement-Prony brake, hydraulic dynamometer. Pressure measurements- McLeod gauge, Pirani gauge. Measurement of Temperature: Resistance thermometers, thermocouple, law of thermo couple. Nano Impact on Metrology: Introduction, Nanotechnology, Importance of Nanometrology, Introduction to Microscopy, Principles of XRD, Bragg Law, Two-dimensional XRD System, Applications of XRD System.

Text Book	Text Book 1: 7.1 to 7.6 ,7.14, 7.15 ,8.4 to 8.7, Reference text book 4: 17.1 to17.5.4
Case Study / Applications	Case Study: Prony brake, hydraulic dynamometer. Applications : Two-dimensional XRD System

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	5	-
L2	**Understand**	5	5	5
L3	**Apply**	5	5	5
L4	**Analyze**	5	-	-
L5	**Evaluate**	5	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

		Exam Marks Distribution (50)
RBT Levels		
L1	**Remember**	5
L2	**Understand**	5
L3	**Apply**	15
L4	**Analyze**	15
L5	**Evaluate**	10
L6	**Create**	--

Suggested Learning Resources:

Text Books:
1) Dr. T Chandrashekar, 'Metrology and Measurement', Subhas publication, 2017, ISBN: 9789383214198.
2) Beckwith Marangoni and Lienhard, 'Mechanical Measurements', Pearson Education, 7th Edition, 2015, ISBN 13: 978-8131717189.
3) R.K. Jain, 'Engineering Metrology', Khanna Publishers, 2017, ISBN-13: 978-8174091536.

Reference Books:

1) I.C. Gupta, 'Engineering Metrology', Dhanpat Rai Publications, Delhi, 8th Edition, 2018, ISBN 13: 9788189928452.
2) R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, 2008, ISBN: 9788174091918. 3) Anand K. Bewoor & Vinay A. Kulkarni, 'Metrology & Measurement', Tata McGraw Hill Pvt. Ltd., New Delhi, 2009, ISBN: 9781259081323.
3) N V Raghavendra and Krishnamurthy, 'Engineering Metrology and Measurement', Oxford University Press, 2013, ISBN: 9780198085492.

Web links and Video Lectures (e-Resources):
- https://archive.nptel.ac.in/courses/112/104/112104250/
- https://archive.nptel.ac.in/courses/112/106/112106138/
- https://www.youtube.com/watch?v=BqAmLOI8uzs
- **https://www.youtube.com/watch?v=X8KPNVZhvmo**

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

- Visit to any manufacturing/aero/auto industry.

- Demonstration of inspection tool used for machining operations

- Demonstration of sensors.

- Video demonstration of latest trends in Comparators

- Contents related activities (Activity-based discussions)

  ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

  ➢ Organizing Group wise discussions on issues

  ➢ Seminars

MECHANICAL MEASUREMENTS AND METROLOGY LAB

Course Code	22MEL44	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	2	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEL44.1	Investigate the measuring instruments such as micrometer, pressure gauge, LVDT, load cell, thermocouple, strain gauge etc ...
22 MEL44.2	Determine the taper angle, surface roughness and alignment of machined components
22 MEL44.3	Analyze the screw thread and gear tooth parameters of the specimens
22 MEL4.4	Compute the cutting forces and torque in drilling and turning using dynamometers

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEL44.1	3	-	-	-	-	-	-	-	2	-	-	-	1	-
22 MEL44.2	3	-	-	-	-	-	-	-	2	-	-	-	-	2
22 MEL44.3	3	2	-	-	-	-	-	-	2	-	-	-	-	2
22 MEL44.4	3	2	-	-	-	-	-	-	2	-	-	-	1	2

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Demo		
	• Demonstration on measuring devices	2	NA
	PART-A		
1	Calibration of load cell using standard weights	2	22MEL44.1
2	Calibration of micrometer using slip gauge	2	22MEL44.1
3	Calibration of LVDT using micrometer	2	22MEL44.1
4	Calibration of pressure gauge	2	22MEL44.1
5	Measurement of Taper angle using sine bar and slip gauge	2	22MEL44.2
6	Measurement of surface roughness of a component using mechanical comparator	2	22MEL44.2
	PART-B		
7	Measurement of a screw thread parameters using floating carriage micrometer by 2-wiremethod	2	22MEL44.3
8	Measurement of gear parameters using gear tooth vernier	2	22MEL44.3
9	Measurement of alignment of surface plate using roller set	2	22MEL44.2
10	Comparison and measurement of temperature using thermocouple and RTD	2	22MEL44.1
11	Measurement of cutting forces and torque using lathe/ drill tool Dynamometer	2	22MEL44.4
12	Determination of young s modulus using strain gauge.	2	22MEL44.1

CIE Assessment Pattern (50 Marks – Lab)

	RBT Levels	Test (s)	Weekly Assessment
		20	30
L1	Remember	-	5
L2	Understand	-	5
L3	Apply	10	10
L4	Analyze	10	10
L5	Evaluate	-	-
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:
Reference Books:
1) I.C. Gupta, 'Engineering Metrology', Dhanpat Rai Publications, Delhi, 8th Edition, 2018, ISBN 13: 9788189928452.
2) R.K. Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, 2008, ISBN: 9788174091918.
3) Anand K. Bewoor & Vinay A. Kulkarni, 'Metrology & Measurement', Tata McGraw Hill Pvt. Ltd., New Delhi, 2009, ISBN: 9781259081323.
4) N V Raghavendra and Krishnamurthy, 'Engineering Metrology and Measurement', Oxford University Press, 2013, ISBN: 9780198085492.

MINI PROJECT-I			
Course Code	**22MEE48**	**CIE Marks**	**50**
L: T:P:S	**0:0:1:0**	**SEE Marks**	**50**
Hrs / Week	**0**	**Total Marks**	**100**
Credits	**01**	**Exam Hours**	**03**

Course outcomes:

At the end of the course, the student will be able to:

22MEE48.1	Identify an open ended problem in area of mechanical engineering
22MEE48.2	Identify the methods and materials required for the project work
22MEE48.3	Apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach.
22MEE48.4	Formulate and implement innovative ideas for social and environmental benefit
22MEE48.5	Analyze the results to come out with concrete solutions
22MEE48.6	Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context

Mini Project Roadmap: Guiding Principles for Mini Project Success

Project Overview:

- Clearly define the project's scope, objectives, and expected outcomes.
- Provide a brief description of the problem the project aims to solve or the functionality it should implement.

Project Milestones:

- Set clear project milestones and deadlines for various phases, such as planning, design, implementation, testing, and presentation.

Project Requirements:

- List the specific features or functionality that students need to implement in their projects.
- Clearly state any constraints or limitations they should be aware of during development.

Testing and Quality Assurance:

- Incorporate testing practices into their development process.
- Specify the types of testing (e.g., unit testing, integration testing)

Collaboration and Communication:

- If the project involves teamwork, outline expectations for collaboration, including communication channels and responsibilities within the team.

Documentation:

- Emphasize the importance of thorough documentation throughout the project.
- Require students to maintain documentation for code, design, and usage instructions.

Presentation:

- Require students to present their projects to the class, explaining their design choices, challenges faced, and how they overcame them.

CIE Assessment Pattern (50 Marks – Reviews as per the rubric statements defined)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	-
L2	Understand	-
L3	Apply	20
L4	Analyze	10
L5	Evaluate	10
L6	Create	10

Suggested Learning Resources:
 Text Books:
1. Kothari, C.R., 2018. Research Methodology: Methods and Techniques. New Age International. ISBN-13: 978-8122436235
2) Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2015, An introduction to Research Methodology, RBSA Publishers. ISBN-13: 978-8176111652
3) Ranjithkumar, 2014, research methodology, saga publications,4th edition ISBN-13- 978- 9351501336
 Reference Books:
1.Anderson, T. W., 2011, An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi. ISBN-13: 978-8126524488
2) Montgomary, Douglas C. & Runger, George C. (2016) 6/e, Applied Statistics & probability for Engineers (Wiley India) ISBN-13: 978-1118539712

Web links and Video Lectures (e-Resources):

1.https://www.youtube.com/watch?v=YScxVF6ZcYI
2. https://www.youtube.com/watch?v=9WMgaulAJ-0

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

These challenging mini project activities can provide students with opportunities to think critically, apply their knowledge, and develop problem-solving skills in a practical context.
Interdisciplinary Projects:
- Encourage collaboration among students from different disciplines to work on projects that require diverse expertise.

Prototype Development:
- Challenge students to create a prototype of a product or device.

Simulation and Modelling:
- Task students with creating computer simulations or mathematical models to solve complex problems or simulate real-world scenarios.

1.Humanitarian and Social Impact Projects:

1.**Environmental Sustainability Projects:**
Challenge students to propose and implement sustainability initiatives or renewable energy projects.
2.Scientific Research Projects:
Assign students to conduct scientific research experiments, gather data, and present findings.

PROGRAMMING FOR IoT

Course Code	22MEE451	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs. / Week	03	Total Marks	100
Credits	03	Exam Hours	03

Course Outcomes:

At the end of the course, the student will be able to:

22MEE451.1	Understand the fundamentals of Embedded system and microcontrollers.
22MEE451.2	Apply the concept of Embedded System for its Software development.
22MEE451.3	Analyze the Linux operating system and Wi-Fi for raspberry pi.
22MEE451.4	Enable to configure various Sensors and Actuators, Memory, Communication Interface I2C
22MEE451.5	Evaluate the Architecture and features of Raspberry Pi and become familiar with the design aspects of I/O and Memory Interfacing circuits.
22MEE451.6	Apply modern tools to acquire competency in various storage devices and apply the knowledge gained in designing websites.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE451.1	3	-	-	-	-	-	-	-	-	-	-	2	3	-
22MEE451.2	-	3	-	-	3	-	-	-	-	-	-	2	3	2
22MEE451.3	-	-	3	-	-	-	-	-	-	-	-	2	3	3
22MEE451.4	-	-	-	3	3	-	-	-	-	-	-	2	3	3
22MEE451.5	-	-	-	-	3	-	-	-	-	-	-	2	3	3
22MEE451.6	-	-	-	-	3	-	-	-	-	-	-	2	3	3

MODULE-1	INTRODUCTION TO EMBEDDED SYSTEMS	22MEE451.1	8 Hours

Importance of Embedded Systems, Embedded Systems Vs. General Computing Systems, Classification of Embedded System, Major Application areas of Embedded System, Purpose of Embedded System, and The Innovative Bonding of lifestyle with Embedded Technology, CISC vs. RISC, fundamentals of Von-Neumann/Harvard architectures, Types and selection of Microcontrollers.

Case Study	Make a brief report on Introduction to IoT with the different selection of micro controllers.
Text Book	Text Book 1: 3.1, 3.2

MODULE-2	OS INSTALLATION & Wi-Fi SET UP FOR RASPBERRY Pi	22MEE451.2	8 Hours

Download of Linux OS Latest version, installation, and partitioning, Embedded development environment - GNU debugger - tracing & profiling tools - binary utilities - kernel debugging - debugging embedded Linux applications - porting Linux - Linux and real time - SDRAM interface, Wireless connection using Wi-Fi for raspberry pi.

Case Study	Hands-on with Raspberry Pi Tools
Text Book	Text Book 1: 14,15

MODULE-3	I/O & SERIAL PROTOCOL PROGRAMMING	22MEE451.3	8 Hours

I/O & Serial protocol programming for Embedded development
Core of the Embedded System, Sensors and Actuators, Memory, Communication Interface, Embedded Firmware, Other System Components Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, quality attributes of embedded system.
Understanding I2C and I2C Interface, programmingI2C Understanding of serial communication protocol I2C, Details of sensors and actuator using I2C protocol, APIs to configure the I2C module on raspberry-pi and communicate to other devices over I2C,Programming the GPIO and interfacing peripherals With Raspberry Pi, Boot Process of Raspberry-Pi.

Case Study	Programming for Embedded development
Text Book	Text Book 1:13.1-13.5

MODULE-4	INTRODUCTION TO SINGLE BOARD COMPUTER	22MEE451.4	8 Hours

Types of Processors, Advantages and Applications of Raspberry Pi.
Introduction to Embedded Software Development, Compiling the applications, software flow, input, output and peripheral accesses, Microcontroller interfaces.
Raspberry Pi board and its Data Sheet, , Client-Server programming

Case Study	Raspberry Pi board data sheet, Using libcurl (for JSON objects),Boot Process of Raspberry-Pi, Client-Server programming.
Text Book	Text Book 1: 5.1-5.5

MODULE-5	SINGLE BOARD COMPUTER AND PERIPHERALS INTERFACING	22MEE451.5. 22MEE451.6	8 Hours

Lego Train's IR protocol("LPF RC Protocol": LEGO Power Function RC Protocol), I2C GPIO expander board(using MCP23017), I2C GPIO Expander IC MCP23017/MCP23S17, Sample code to use I2C GPIO Expander, Understanding Stepper Motor, Using LDR Sensor Module with Raspberry Pi, BCM2835-ARM-Peripherals, BCM-2835 SOC details.

Case Study	Hands-on with IR/RC protocols, Generating PWM signals through the Pi.
Text Book	Text Book 1: 6.1, 6.2, 7.1, 7.2

CIE Assessment Pattern (50 Marks – Theory) –

		Marks Distribution		
	RBT Levels	**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	5	-	-
L2	Understand	5	-	-
L3	Apply	5	5	-
L4	Analyze	5	5	5
L5	Evaluate	5	5	5
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	**Exam Marks Distribution (50)**
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	-

Suggested Learning Resources:

Text Books:

1) Introduction to Embedded Systems, Shibu K V, 2009, TMH. ISBN-13. 978-9339219680
2) Embedded Systems – A contemporary Design Tool, James K Peckol, 2014, John Wiley. ISBN:978-1-119-45755-8.

Reference Books:
1) Microprocessors and Interfacing – Programming & Hardware Douglas Hall, 2nd edition, 1990, McGraw Hill. ISBN:10. 0070257426
2) Microprocessors and Microcontrollers: Architecture, Programming and System Design, Krishna Kant, 2007, PHI. ISBN: 8120331915
3) The Intel Microprocessors Architecture, Programming and Interfacing, Barry B. Brey, 2007, Pearson Education.

Web links and Video Lectures (e-Resources):
- **Hands-on with the Raspberry Pi 3 Model**
- https://devopedia.org/programming-for-iot
- https://www.raspberrypi.org/

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

- Visit to any Manufacturing Industry

- Video demonstration of latest trends in IoT Platforms.

- Contents related activities (Activity-based discussions)

  ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

  ➢ Organizing Group wise discussions on issues

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ESSENTIALS OF CYBER SECURITY

</div>

Course Code	22MEE452		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	3		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE452.1	Explain the concepts of confidentiality, availability and integrity in Information Assurance, including physical, software, devices, policies and people.
22MEE452.2	Applying knowledge in the field of cyber security to analyze real world problems.
22MEE452.3	Understand the tools and methods used in cyber crime
22MEE452.4	Describe the cybercrime vulnerabilities, exploitations of the Internet & appropriate responses to cybercriminal activity
22MEE452.5	Identify the legal perspectives in cyber security and challenges to Indian law.
22MEE452.6	Identify cyber security incidents to apply appropriate response and current structure of cyber security roles across the enterprise, including the roles and responsibilities of the relevant organizations.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE452.1	3	2	1	1	-	-	-	-	-	-	-	-	2	-
22MEE452.2	3	2	1	1	-	-	-	-	-	-	-	-	2	-
22MEE452.3	3	2	1	1	-	-	-	-	-	-	-	-	2	-
22MEE452.4	3	2	1	1	-	-	-	-	-	-	-	-	2	-
22MEE452.5	3	2	1	1	-	-	-	-	-	-	-	-	2	-
22MEE452.6	3	2	1	1	-	-	-	-	-	-	-	-	2	-

MODULE-1	**INTRODUCTION TO CYBER SECURITY**		**22MEE452.1**	**8 Hours**

Definition of Cyber Security and Cyber Security Policy, Domains of Cyber Security Policy, Laws and Regulations,
Technology Operations, Technology Configuration, Strategy versus Policy; Cyber Security Evolution: Productivity,
Internet, e-Commerce.

Text Book	Text Book 2: 1.1 to 1.4,2.1 to 2.3			
MODULE-2	**INTRODUCTION TO CYBER CRIME**		**22MEE452.2**	**8 Hours**

Definition and evolution of Cyber Crimes, Cybercrime and Information Security, Cybercriminals,
Classifications of
Cybercrimes.

Cyber offenses: Introduction, How criminal plan the attacks, Social engineering, Cyber stalking.			
Text Book	Text Book 1: 1.1 to 1.5,2.1 to 2.4		
MODULE-3	**TOOLS AND METHODS USED IN CYBERCRIME**	**22MEE452.3**	**8 Hours**
Introduction, Proxy servers and anonymizers, Password cracking, Key loggers and spywares, Virus and worms, Trojan horses and backdoors, Steganography, DoS and DDoS attacks, SQL injection, Buffer overflow..			
Self-study / Case Study	Security policy objectives, cyber security management		
Text Book	Text Book1: 4.1 ,4.2,4.4 to 4.11		
MODULE-4	**PHISHING AND IDENTITY THEFT**	**22MEE452.4**	**8 Hours**
Phishing: Introduction, Phishing: methods of phishing, phishing techniques, spear phishing, types of phishing scams, phishing countermeasures. Identity Theft (ID Theft): personally identifiable information, Types of identity theft, techniques of ID theft, Identity Theft Countermeasures.			
Self-study	Cyber Governance Issues,		
Text Book	Text Book 1: 5.1 to 5.3		
MODULE-5	**CYBERCRIMES AND CYBERSECURITY: LEGAL PERSPECTIVES**	**22MEE452.5, 22MEE452.6**	**8 Hours**
The legal perspectives: Introduction, Cybercrime and the legal landscape around the world, why do we need cyber laws: the Indian context, The Indian IT act, Challenges to Indian law and cybercrime scenario in India.			
Text Book	Text Book 1: 6.1 to 6.5		

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
	RBT Levels	**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	**Remember**	5	-	-
L2	**Understand**	10	**5**	-
L3	**Apply**	5	5	5
L4	**Analyze**	5	5	5
L5	**Evaluate**	-	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	**Exam Marks Distribution (50)**
L1	**Remember**	**10**
L2	**Understand**	**20**
L3	**Apply**	**10**
L4	**Analyze**	**10**
L5	**Evaluate**	--
L6	**Create**	--

Suggested Learning Resources:
Text Books:
1. Nina Godbole, Sunit Belapur, "Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Publications, copyright 2011, reprint 2015, ISBN 9788126541144
2. Jennifer L. Bayuk, Jason Healey, Paul Rohmeyer, "Cyber Security Policy Guidebook" Wiley Publications.

Reference book:

1. James Graham, Richard Howard, Ryan Olsan, "Cyber Security Essentials" CRC Press. ISBN 9780367330471.

Web links and Video Lectures (e-Resources):

1. https://www.mastersindatascience.org/resources/cybersecurity-resource-guide/

2. https://www.aicte-india.org/CyberSecurity

3. https://cybersecurityventures.com/industry-news/

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

• Demonstration of Phishing and Identity Theft

• Demonstration of Tools and Methods used in Cyber Crime

• Demonstration of Cyber Crimes

• Contents related activities (Activity-based discussions)

    ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

    ➢ Organizing Group wise discussions on issues

    ➢ Seminars

INTRODUCTION TO MACHINE LEARNING

Course Code	21MEE453	CIE Marks	50
L:T:P:S	3:0:0:0	SEE Marks	50
Hrs / Week	3	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

21MEE453.1	Determine the problems for machine learning and gather Knowledge based on machine learning
21MEE453.2	Apply Classification concepts for solving machine learning problems
21MEE453.3	Implementation of association rule mining in data mining
21MEE453.4	Illustrate Artificial Neural Networks (ANN's)
21MEE453.5	Evaluating Mathematical Models for Machine Learning algorithms
21MEE453.6	Illustrate Convolution Neural Networks and implementation for solving machine learning problems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21MEE453.1	3	3	3	3	2	-	-	-	-	-	-	2	2	-
21MEE453.2	3	3	3	3	2	-	-	-	-	-	-	2	2	-
21MEE453.3	3	3	3	3	2	-	-	-	-	-	-	2	2	-
21MEE453.4	3	3	3	3	2	-	-	-	-	-	-	2	2	-
21MEE453.5	3	3	3	3	2	-	-	-	-	-	-	2	2	-
21MEE453.6	3	3	3	3	2	-	-	-	-	-	-	2	2	-

MODULE-1	INTRODUCTION	21MEE453.1	8 Hours

Introduction: Introduction to Machine Learning, Supervised Learning, Unsupervised Learning and Reinforcement Learning, Goals and Challenges of machine learning, Gradient (Steepest) Descent (OR) Learning Rule , LASSO and Ridge Regression, Prescriptive Analytics : Linear Programming model building

Text Book	Text Book1 - Chapter 1, 4, 6 Text book3 - Chapter 11, Reference Book2 - Chapter 1

MODULE-2	DECISION TREES AND SVM	21MEE453.2	8 Hours

Chi-Square Automatic Interaction Detectors (CHAID), Classification and Regression Tree (CART), C4.5. Support Vector Machine: Kernel Function and Kernel SVM.

Text Book	Text Book1 - Chapter 3, 5

MODULE-3	ASSOCIATION RULE MINING AND CORRELATIONS	21MEE453.3	8 Hours

Association Rule Mining: Apriori, FP‑Growth, Correlations: Basic Concepts and Methods, Pattern Mining in Multilevel, Multidimensional Space, Sequential Pattern Mining

Case Study	A – priori algorithm with any sample data set.		
Text Book	Text Book1 - Chapter 9, Text book3 - Chapter 3,		

MODULE-4	**ARTIFICIAL NEURAL NETWORKS**	**21MEE453.4, 21MEE453.5**	**8 Hours**

Artificial Neural Networks: Introduction, Neural Network representation, Appropriate Problems, Perceptron, Back Propagation algorithm, Introduction to deep learning

Self-study / Case Study / Applications	Feed Forward Back Propagation and Cascade Forward Back Propagation Algorithms - using Data set(patient and healthy people – all gender with different age)		
Text Book	Reference Book2 - Chapter 1		
MODULE-5	**CONVOLUTIONAL NEURAL NETWORKS (CNN)**	**21MEE453.6**	**8 Hours**

Convolutional Neural Networks (CNN): Convolutional, Pooling and Soft-Max Layers, Training CNNs, activation functions, initialization, Batch Normalization.

Self-study/ Case Study / Applications	Aggregate mining for concrete production – using CNN or Convolutional Neural Networks for object recognition on mobile devices		
Text Book	Reference Book2 - Chapter 12		

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	-	-	-
L2	Understand	10	5	5
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	**Exam Marks Distribution (50)**
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:
Text Books
1. Manaranjan Pradhan, U Dinesh Kumar, "Machine Learning using Python", Wiley, First Edition, 2020, ISBN 978-81-265-7990-7.
2. Tom M. Mitchell, "Machine Learning", McGraw Hill Education, Indian Edition, 2017, ISBN 9780072299144.
3. EthemAlpaydin, "Introduction to Machine Learning", MIT press, Second Edition, 2010, ISBN 9780262043793.

Reference Books:
1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer Series in Statistics, Second Edition, 2017, ISBN 9781280187438.
2. Dipanjan Sarkar, Raghav Bali, Tushar Sharma, "Practical Machine Learning with Python-A Problem-Solver's Guide to Building Real-World Intelligent Systems", A Press, First Edition, 2018, ISBN 978-1-4842-3206-4.
3. Simon Haykin, "Neural Networks and Learning Machines", Pearson, Third Edition, 2016, ISBN 9780133002553
4. Kevin P. Murphy , Francis Bach , "Machine Learning: A Probabilistic Perspective", Massachusets Institute of Technology, First Edition, 2012, ISBN 9780262044660.

Web links and Video Lectures (e-Resources):
- https://www.youtube.com/watch?v=NWONeJKn6kc
- https://www.youtube.com/watch?v=i_LwzRVP7b
- https://www.youtube.com/watch?v=GwIo3gDZCVQ
- https://www.youtube.com/watch?v=ukzFI9rgwfU
- https://www.youtube.com/watch?v=f_uwKZIAeM0

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Case study
- Presentation on latest topics related to machine learning

ROBOTICS PROGRAMMING

Course Code	22MEE454		CIE Marks	50
L:T:P:S	3:0:0:0		SEE Marks	50
Hrs / Week	03		Total Marks	100
Credits	03		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE454.1	Understand the robotics design and implementation
22MEE454.2	Apply the knowledge on fundamentals of robotic programming
22MEE454.3	Analyze the behavior of different types of sensors and actuators
22MEE454.4	Understand the ROS fundamentals
22MEE454.5	Design robotic applications using ROS
22MEE454.6	Design products by suitable integration of Adriano and Raspberry Pi boards with ROS

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
22MEE454.1	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE454.2	3	-	-	-	-	-	-	-	-	-	-	-	-	3
22MEE454.3	3	3	-	-	-	-	-	-	-	-	-	-	-	3
22MEE454.4	3	3	-	-	-	-	-	-	-	-	-	-	2	-
22MEE454.5	3	3	-	-	-	-	-	-	-	-	-	-	2	3
22MEE454.6	3	3	-	-	-	-	-	-	-	-	-	-	2	

MODULE-1	INTRODUCTION TO ROBOTICS AND PROGRAMMING BASICS	22MEE454.1 22MEE454.2	8 Hours

Introduction to robotics and its applications. Understanding the components of a robot. Introduction to programming languages (Python, C++, etc.). Setting up the development environment.

Self-study / Case Study / Applications	Writing and executing simple programs
Text Book	Text Book 1: 1.1, 1.2, 1.3

MODULE-2	ROBOT KINEMATICS AND MOTION CONTROL	22MEE454.1 22MEE454.2	8 Hours

Basics of robot kinematics, Forward and inverse kinematics, End-effector control and tool frames, Trajectory planning and motion control

Self-study / Case Study / Applications	Programming robot movements
Text Book	Text Book 3: Chapter 1.1, 1.2, 1.5

MODULE-3	SENSORS AND PERCEPTION	22MEE454.1, 22MEE454.3	8 Hours

Types of sensors in robotics (IR, ultrasonic, camera, etc.). Sensor data processing and filtering. Introduction to computer vision for robots. Object detection and tracking.

Self-study / Case Study / Applications	Integrating sensors for environment perception		
Text Book	Text Book 4: 4.1, 4.2, 4.3 ,4.6		
MODULE-4	**ROS FUNDAMENTALS**	**22MEE454.4** **22MEE454.5**	**8 Hours**

Ubuntu Linux for Robotics-Ubuntu Graphical User Interface, Shell Commands, C++ and Python for Robotic Programming- Basic Concepts with Examples

Self-study / Case Study / Applications	Simulating path planning and localization		
Text Book	Text Book 1: Chapter 4.5, 4.6, 4.7		
MODULE-5	**ROS PROGRAMMING**	**22MEE454.6**	**8 Hours**

  Creating ROS Workspace and Package, Using ROS Client Libraries, Programming Embedded Board using ROS-Interfacing Arduino with ROS, ROS on a Raspberry Pi

Self-study / Case Study / Applications	Design and program a robotic task		
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.4		

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	-	-	-
L2	Understand	10	**5**	**5**
L3	Apply	10	5	5
L4	Analyze	5	5	-
L5	Evaluate	-	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	5
L5	Evaluate	5
L6	Create	--

Suggested Learning Resources:
 Text Books:
  1. Jonathan Cacace; Lentin Joseph, Mastering ROS for Robotics Programming: Design, build, and simulate complex robots using the Robot Operating System, 2nd Edition, PacktPublishing, 2018. ISBN 9781788478950
  2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox for "Probabilistic Robotics", MIT Press 2015, ISBN 9780262201629
  3. Kevin M. Lynch, Frank C. Park for Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press, 2017
  4. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo for Robotics: Modelling, Planning and Control, Springer Science & Business Media, 2020

Reference Books:
  1. Hughes, C. and Hughes, T., Robot programming: a guide to controlling autonomous robots. Que Publishing, 2016
  2. Quigley, M., Gerkey, B. and Smart, W.D., Programming Robots with ROS: a practical introduction to the Robot Operating System. " O'Reilly Media, Inc.", 2015
  3. Anil Mahtani, Luis Sanchez, Enrique Fernandez, Aaron Martinez, Lentin Joseph. ROS Programming: Building Powerful Robots. Packt Publishing, 2018
  4. Lentin Joseph, Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, 1st Edition, APress, 2018.

Web links and Video Lectures (e-Resources):
   - **https://www.youtube.com/watch?v=pwwVOpXrazs&list=PL4g1oAdmuCfqmYvURLzVFkMMUI7839biN**
   - **https://www.youtube.com/watch?v=gizihSJ63o4&list=PL4g1oAdmuCfqmYvURLzVFkMMUI7839biN&index=2**
   - **https://www.youtube.com/watch?v=BnzUXag1qx8&list=PL4g1oAdmuCfqmYvURLzVFkMMUI7839biN&index=3**
   - **https://www.youtube.com/watch?v=7mm4ig8Lyc8&list=PL4g1oAdmuCfqmYvURLzVFkMMUI7839biN&index=5**
   - **https://www.youtube.com/watch?v=RBD9LfLfkxA&list=PLQ3sZ7NCnFlEej8AWH_BfO9W7xlirvK6l&index=43**
   - **https://www.youtube.com/watch?v=E2nnohpDw5k&list=PLQ3sZ7NCnFlEej8AWH_BfO9W7xlirvK6l&index=44**
   - **https://www.youtube.com/watch?v=LGmvg0m1mJk&list=PLQ3sZ7NCnFlEej8AWH_BfO9W7xlirvK6l&index=45**

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

- Visit to any Robot implemented manufacturing/assembly industry
- Demonstration of Robot operations
- Demonstration of working of Robot
- Demonstration of Robot programming applied to a typical robot task
- Video demonstration of latest trends in mobility/robotics
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Organizing Group wise discussions on issues
  - Seminars

OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code	22MEE455	CIE Marks	50
L:T:P:S	2:0:1:0	SEE Marks	50
Hrs / Week	2+2	Total Marks	100
Credits	03	Exam Hours	03

Course outcomes:
At the end of the course, the student will be able to:

22MEE455.1	Apply an object-oriented approach to programming and identify potential benefits of object-oriented programming over other approaches.
22MEE455.2	Execute the concepts of classes and objects and their significance in real world
22MEE455.3	Implement overloading concepts of function and operators
22MEE455.4	Handle the inheritance, polymorphism and object relationship
22MEE455.5	Reuse the code and design applications which are easier to debug, maintain and extend
22MEE455.6	Analyze the probable error and develop a mechanism to handle it Real-time

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE455.1	3	-	3	-	3	-	-	-	-	-	-	2	3	-
22MEE455.2	3	-	3	-	3	-	-	-	-	-	-	2	3	-
22MEE455.3	3	-	3	-	3	-	-	-	-	-	-	2	3	-
22MEE455.4	3	-	3	-	3	-	-	-	-	-	-	2	3	-
22MEE455.5	3	-	3	-	3	-	-	-	-	-	-	2	3	-
22MEE455.6	3	-	3	-	3	-	-	-	-	-	-	2	3	-

MODULE-1	OBJECT ORIENTED PROGRAMMING AND BASICS OF C++	22MEE455.1	6 Hours

Procedural Vs Object oriented programming, Principles of Object oriented programming, Tokens, Expressions, control structure, Functions in C++

Laboratory content:	**3 Hours**

1. Write a program to check prime number using C++
2. Write a program for Arithmetic calculator using switch case menu..

Self-study	Explore the Challenges of token creations, expressions
Text Book	Text Book 1: 1.1-1.8

MODULE-2	CLASSES AND OBJECTS	22MEE455.2	6 Hours

Class, Data members and Member functions, Creating Objects of Class, Access Specifiers, Friend Functions and Friend Classes, Static Members- Constructors and Destructors, Function overloading, Operator Overloading, Overloading unary operators, overloading binary operators, overloading special operators, type conversions

Laboratory content:	**3 Hours**

3. Write a program to check prime number using C++
4. Write a program for Arithmetic calculator using switch case menu.

Self-study / Applications	Desirable identification of systems with classes of inputs and functions.
Text Book	Text Book 1:5.1-5.19

MODULE-3	INHERITANCE, POLYMORPHISM, TEMPLATES AND EXCEPTION HANDLING	22MEE455.3, 22MEE455.4	6 Hours

Types of inheritance, virtual base class, virtual functions, class templates, function templates, exception handling, assertions

Laboratory Components:			3 Hours

5. Design a super class called Staff with details as StaffId, Name, Phone, Salary. Extend this class by writing three subclasses namely Teaching (domain, publications), Technical (skills), and Contract (period). Write a Java program to read and display at least 3 staff objects of all three categories.
6. Write a java program demonstrating Method overloading and Constructor overloading.

Self-study	Explore the problems with inheritance.

Text Book	Text Book 1:8.1-8.12

MODULE-4	INTRODUCTION TO JAVA	22MEE455.5	6 Hours

Constants, variables and data types, operators, expressions, classes, objects,
methods, arrays, strings and vectors, Interfaces, packages,

Laboratory Components:			3 Hours

7. Write a Java program to create n Student objects and print the USN, Name, Branch, and Phone of these objects with suitable headings Create a Java class called Student with the following details as variables within it. USN, Name, Branch, Phone
8. Write a program to perform string operations using Array List. Write functions for the following a. Append - add at end b. Insert – add at particular index c. Search d. List all string starts with given letter.

Self-study / Case Study	Explore the problems with arrays and strings.

Text Book	Text Book 1:17.1-17.5,

MODULE-5	JAVA PROGRAMMING	22MEE455.6	6 Hours

Multithread programming, managing errors and exceptions, Applet programming, Managing files

Laboratory Components:			3 Hours

9. Write a program to generate the resume. Create 2 Java classes Teacher (data: personal information, qualification, experience, achievements) and Student (data: personal information, result, discipline) which implements the java interface Resume with the method biodata().
10. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
11. Write a Java program that implements a multi-thread application that has three threads. First thread generates a random integer for every 1 second; second thread computes the square of the number and prints; third thread will print the value of cube of the number.

Self-study / Case Study /	Explore the problems with multithread programming

Text Book	Text Book 1: 12.1-12.7

	CIE Assessment Pattern (50 Marks – Theory)			
		Marks Distribution		
	RBT Levels	**Test (s)**	**Qualitative Assessment (s)**	**Lab CIE (Like SEE Lab)**
		25	**05**	**20**
L1	**Remember**	5	-	-
L2	**Understand**	5	-	-
L3	**Apply**	5	5	5
L4	**Analyze**	5	-	5
L5	**Evaluate**	5	-	-
L6	**Create**	-	-	-

SEE Assessment Pattern (50 Marks – Theory)		
	RBT Levels	**Exam Marks Distribution (50)**
L1	**Remember**	**10**
L2	**Understand**	**10**
L3	**Apply**	**10**
L4	**Analyze**	**10**
L5	**Evaluate**	**10**
L6	**Create**	**--**

Suggested Learning Resources:
 Text Books:

1) Object Oriented Programming Using C++ and Java, E Balagurusamy, 7th edition, 2017, TMH, ISBN 9789352608327

 Reference Books:

1. C++ Primer Plus, Stephen Prata, 6th Edition, 2015, Pearson Education Limited, ISBN 9780134498379.

2. C++ PROGRAMMING Today, Barbara Johnston, 2nd Edition, 2015, Pearson Education

3. Herbert schildt (2010), The complete reference, 7th edition, Tata Mc graw Hill, New Delhi

4. Kathy Sierra and Bert Bates, Head First Java (Second Edition), O'ReiIIy, 2005

Web links and Video Lectures (e-Resources):
- https://www.youtube.com/watch?v=MzPjHEq-MYg
- https://www.youtube.com/watch?v=bSrm9RXwBaI

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

- Demonstration of daily operated program failures.

- Contents related activities (Activity-based discussions)

  ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts

  ➢ Organizing Group wise discussions on issues

MATLAB FOR MECHANICAL ENGINEERS

Course Code	22MEE461	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	02	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE461.1	Analyze Matrices, Differential equations, Integration, System of Linear Equations using MATLAB.
22MEE461.2	Solve engineering problems using MATlab to develop the proficiency in variational calculus.
22MEE461.3	Solve Mechanical Engineering problems like Airfoil, Engineering mechanics, Truss, Vibration using MATLAB
22MEE461.4	Understand the Plots using MATLAB software.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE461.1	3	3	-	3	2	-	-	-	1	1	-	2	3	-
22MEE461.2	3	2	-	3	-	-	-	-	1	1	-	2	2	3
22MEE461.3	3	3	3	3	-	-	-	-	1	1	-	2	3	3
22MEE461.4	-	-	3	3	3	-	-	-	1	1	-	2	3	-

Exp. No.	List of Experiments	Hours	COs
	Prerequisite Experiments / Programs / Demo		
	• Engineering Mathematics		
	PART-A		
1	Introduction to Matlab codes	2	22MEE461.1
2	Solving Matrices Problems, System of Linear Equations using MATLAB Codes.	2	22MEE461.1
3	Solving Trigonometric problems using MATLAB Codes.	2	22MEE461.1
4	Solving Logorithemic Equations using MATLAB Codes.	2	22MEE461.2
5	Solving Differential Equations using MATLAB Codes.	2	22MEE461.2
6	Solving Differentiation and Integration Problems Using MATLAB Codes	2	22MEE461.2
	PART-B		
7	Solving Mechanical Engineering Problems - Engineering mechanics ,Truss problems	2	22MEE461.3
8	Solving Mechanical Engineering problems - Airfoil	2	22MEE461.3
9	Mechanical Vibration problems- Beats	2	22MEE461.3
10	Generating Overlay plots using plot command, Hold command, Line commands	2	22MEE461.4
11	Solving the Bode plots using Mat Lab codes	2	22MEE461.4
12	Solving the Heat Transfer Problems using Mat Lab codes-Heat conduction problem	2	22MEE461.4

PART-C
- https://www.mathworks.com/videos/virtual-labs-with-matlab-and-simulink-1605544954052.html
- https://www.mathworks.com/academia/educators/resources.html
- https://www.mathworks.com/academia/courseware/mass-spring-damper-systems.html
- https://www.mathworks.com/academia/courseware/heat-transfer.html

CIE Assessment Pattern (50 Marks – Lab)

RBT Levels		Test (s)	Weekly Assessment
		20	30
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	5	10
L4	Analyze	5	10
L5	Evaluate	5	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Lab)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	05
L2	Understand	05
L3	Apply	10
L4	Analyze	20
L5	Evaluate	10
L6	Create	-

Reference Books:
1) Rao V Dukkipatti : Matlab for Mechanical Engineers, New Age Science,2009, ISBN 9788170374886
2) Y kirani singh, B. B. chaudhuri : Matlab Programming, PHI Learning Edition June 2007, ISBN 9788120333084
3) David Houcque :Introduction to MATLAB for Engineering students, North western University,version 1.2,August 2005

ENERGY MANAGEMENT AND AUDITING

Course Code	22MEE462	CIE Marks	50
L:T:P:S	0:0:1:0	SEE Marks	50
Hrs / Week	2	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE462.1	Identify the demand supply gap of energy in specific applications at education buildings.
22MEE462.2	Carry out energy audit of applications in industry / Organization.
22MEE462.3	Draw the energy flow diagram of an application and identify the energy wasted
22MEE462.4	Perform energy audit in any type of application and suggest the conservation measures.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE462.1	2	3	-	-	-	-	-	-	2	3	-	-	3	
22MEE462.2	-	3	3	-	2	2	-	-			-	-	-	3
22MEE462.3	-	2		3	-	-	3	2		2	-	-	-	3
22MEE462.4	2	-	-	3	-	3	-	-	2		-	-	3	-

MODULE-1	Industrial Energy Conservation	22MEE462.1,3	5 Hours

Introduction , Initiatives in India, Potential energy Conservation, Barriers, Energy audit and types

Self-study / Case Study / Applications	Explore the energy Conservation and Energy audit
Text Book	Text Book 1: 1.1, 1.2, 1.3

MODULE-2	Diesel Generating sets	22MEE462.2,3,4	6 Hours

Introduction, System description, Fuel Conservation, waste heat recovery, fuel additives, Lubricating oil Conservation

Self-study / Applications	Explore the Diesel Generating sets and applications.
Text Book	Text Book 1: 3.1, 3.2, 3.3

MODULE-3	Cooling Towers	22MEE462.2,3,4	6 Hours

Introduction, Classification, Selection and usage, Factors affecting cooling tower performance and Energy saving opportunities

Self-study / Case Study	Energy saving types
Text Book	Text Book 1: 5.1, 5.2, 5.3, 5.5

MODULE-4	Solar energy options for Industries	22MEE462.2,3,4	6 Hours

Introduction , Solar Thermal Technologies, Solar Collector, Solar thermal systems and Industrial process heating

Self-study / Case Study / Applications	Performance test on Solar radiation on various systems.
Text Book	Text Book 1: 8.1, 8.2, 8.3

MODULE-5	Refrigeration and Air conditioning	22MEE462.2,3,4	6 Hours

Introduction, Types, Comparison between VCR and VAR systems, Measurements and field testing, Performance evaluation and Energy efficiency

Self-study / Case Study / Applications	Energy analysis of the refrigeration systems.
Text Book	Text Book 1:10.1, 10.2, 10.4

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	-
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	-	-
L6	Create		-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	5
L2	Understand	10
L3	Apply	15
L4	Analyze	15
L5	Evaluate	5
L6	Create	--

Suggested Learning Resources:
 Text Books:
1) Y P Abbi and Shashank Jain , Hand book on Energy Audit and Environment Management, TERI, New Delhi,2006, ISBN 9788179931013.

Reference Books:
1) Trivedi, PR, Jolka KR, Energy Management, Commonwealth Publication, New Delhi, 1997.
2) Ursala Eicker, "Solar Technologies for buildings", Wiley publications, 2003.

Web links and Video Lectures (e-Resources):
- https://www.youtube.com/watch?v=agSEQaVMkDE
- https://courses.ensaveindia.in/courses/general-aspects-of-energy-management-and-energy-audit
- https://www.youtube.com/watch?v=yyr2x3KbiKg

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

- Visit to any type of Energy Conservation systems
- Demonstration of Energy Conservation systems – Various renewable and non-renewable type
- Video demonstration of latest trends in Energy Conservation systems
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - Seminars

DISASTER MANAGEMENT

Course Code	22MEE463		CIE Marks	50
L:T:P:S	1:0:0:0		SEE Marks	50
Hrs / Week	01		Total Marks	100
Credits	01		Exam Hours	03

Course outcomes:

At the end of the course, the student will be able to:

22MEE463.1	Understands the basics and classifications of disasters and Hazards.
22MEE463.2	Describe various types of disasters, hazards and develop disaster response strategies.
22MEE463.3	Apply the techniques used to assess the damages by disaster.
22MEE463.4	Analyze the disaster response strategies

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE463.1	3	1	-	-	-	3	3	2	3	3	3	3	-	-
22MEE463.2	3	2	-	2	2	3	3	3	3	2	2	3	2	1
22MEE463.3	3	2	-	2	2	3	3	3	2	2	2	3	2	1
22MEE463.4	3	2	3	3	3	2	1	1	1	2	3	2	1	2

MODULE-1	FUNDAMENTAL CONCEPTS OF DISASTERS AND HAZARDS	22MEE463.1	3 Hours

Introduction - Disaster and types of disaster. Natural Disasters: Earthquakes, Volcanoes, Cyclones, Tsunamis, Floods and Landslides. Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Outbreaks Of Disease And Epidemics, War And Conflicts.

Self-study / Case Study	Endemic, Epidemics and Pandemics.
Text Book	Text Book 1: Chapter 3.1, 3.2, 3.5, 3.6

MODULE-2	DISASTER RESPONSE STRATEGIES.	22MEE463.2	3 Hours

Disaster Management Cycle, Phases of Disaster, Preparedness Plans, Action Plans and Procedures, Early warning Systems Models in disaster preparedness, Components of Disaster Relief- (Water, food, sanitation, shelter, Health and Waste Management), Community based DRR

Self-study / Case Study	Concept of life period based design- case study
Text Book	Text Book 1: Chapter 2.2, 2.5 , 2.6

MODULE-3	TECHNIQUES OF DAMAGE ASSESSMENT	22MEE463.4	3 Hours

New & emerging approaches in disaster management – Use of information technology (GIS, GPS etc) in disaster management – Community based disaster preparedness – Disaster risk reduction – Safety audits, onsite and offsite emergency plans -Management of transportation accidents.

Text Book	Text Book 2: Chapter 4.1, 4.3,4.4, 4.5

MODULE-4	RESTORATION, RECONSTRUCTION AND RECOVERY COMMUNITY STRUCTURES	22MEE463.5	3 Hours

Safety analysis and rating – reliability assessment repairs and retrofitting techniques of community structures – dams and bridges, Testing and evaluation - methods and materials for strengthening for different disaster qualification test, detailing aspects of structures subjected to probable disaster - analysis methodology – techniques for optimal performance, provision for artificial disaster – blast and impact, developing disaster resistant buildings.

Self-Learning Exercise	Construction techniques, Protection buildings.		
Text Book	Text Book 3 : Chapter 8.1,8.2, 8.3		
MODULE-5	**HAZARD AND VULNERABILITY PROFILE INDIA**	**22MEE463.6**	**3 Hours**

Disaster Management Indian scenario, Disaster Management Act 2005, Dam Safety Act and Policy guidelines, National Institute of Disaster Management, National Disaster Response Force (NDRF), National Disaster Management Authority, States Disaster Management Authority, District Disaster Management Authority.

Self-Learning Exercise	Disaster profile Case Studies of India
Text Book	Text Book 3: Chapter 10.11, 10.12, 10.13

CIE Assessment Pattern (50 Marks – Theory) –

	RBT Levels	Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	5	5	5
L4	Analyze	5	-	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	10
L3	Apply	10
L4	Analyze	10
L5	Evaluate	10
L6	Create	--

Suggested Learning Resources:
 Text Books:
 1. Dr. Mrinalini Pandey, "Disaster Management", Wiley India Pvt. Ltd. ISBN 9788126555868
 2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill Education (India) Pvt. Ltd. ISBN 9780070669655
 3. Jagbir Singh, "Disaster Management: Future Challenges and Opportunities", K W Publishers Pvt. Ltd.

 Reference Books:
 1. Raiker, R.N., "Learning from Failures, Deficiencies in Design, Construction and Service", R & D Centre, Raiker Bhavan, 1987.ISBN 9788185192573
 2. R.B. Singh., "Natural Hazard and disaster management- vulnerability and mitigation".J. P. Singhal, "Disaster Management", Laxmi Publications.

Web links and Video Lectures (e-Resources):
- **https://onlinecourses.nptel.ac.in/noc22_ge24/preview**
- **https://disastermanagement.berkeley.edu/disaster-managemenet-course/**
- **https://www.youtube.com/watch?v=cwxXY9Qe8ss**
- **https://www.youtube.com/watch?v=V2GvQXvjhLA**
- **https://ndrf-gov-resources.ndrf.gov/2023-03/Bio-inspired%20Design%20Workshop%20Report_2232327_October%202022_Final.508.pdf**

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Visit to any emergency fire station in the institute and conduct a fire drill.
- Demonstration of disaster management by taking any real time examples
- Demonstration of implementation of disaster response strategies by taking any practical examples.
- Demonstration of application of damage assessment techniques
- Motivational videos from survivals.
- Contents related activities (Activity-based discussions)
  - ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - ➢ Organizing Group wise discussions on issues
  - ➢ Seminars

AIR POLLUTION CONTROL

Course Code	22MEE464	CIE Marks	50
L:T:P:S	1:0:0:0	SEE Marks	50
Hrs / Week	01	Total Marks	100
Credits	01	Exam Hours	03

Course outcomes:
At the end of the course, the student will be able to:

22MEE464.1	Identify the major sources of air pollution and understand their effects on health and environment.
22MEE464.2	Understand the major meteorological factors affecting air pollution
22MEE464.3	Analyze control techniques for particulate and gaseous emissions
22MEE464.4	Understand NOx and SOx control technologies and control of motor vehicle emission

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE464.1	3	3	-	-	-	-	2	-	-	-	-	2	-	2
22MEE464.2	3	2	-	-	-	-	-	-	-	-	-	2	-	2
22MEE464.3	3	3	-	-	-	-	2	-	-	-	-	2	2	3
22MEE464.4	3	2	-	-	-	-	2	-	-	-	-	2	2	3

MODULE-1	INTRODUCTION AND SOURCES OF AIR POLLUTION	22MEE464.1	3 Hours

Structure and composition of atmosphere, sources and classifications of air pollutants and their effect on human health, vegetation, animals, materials, effects of air pollutants on the atmosphere, impacts on precipitation, global effects of air pollution, acid rain, ozone layer and depletion, photochemical smog,

Self-study / Case Study / Applications	The major pollutants from important industries
Text Book	Text Book 1: 1 .1, 1.2, 1.3, 1.4 Text Book 2: 2.1 , 2.2

MODULE-2	METEOROLOGY	22MEE464.2	3 Hours

Introduction, meteorology and climatology, major meteorological factors affecting air pollution, scales of meteorology, metrological parameter, rainfall and precipitation, maximum mixing depth, plume behavior, single stack and multiple source pollution

Self-study / Case Study / Applications	Effect of pollution on rainfall
Text Book	Text Book 1: Text Book 2: 3.1, 3.2, 3.3, 3.4, 3.5

MODULE-3	Control of Particulate Pollutants and Gaseous Pollutants	22MEE464.3	3 Hours

Particulate pollutants control technology: Particle characteristics, control of particles by filters, control of particulates by electrostatic precipitation, control of particles by mechanical collectors.

Control of gaseous pollutants: introduction, physical properties and occurrence of Sulphur compounds, nitrogen compounds, carbon compounds, hazardous air pollutants, Control of gases by absorption, adsorption and condensation

Self-study / Case	

Study	The type of particulate filter
Text Book	Text Book 1: 7 and 8

MODULE-4	NO$_X$ AND SO$_X$ CONTROL TECHNOLOGY	22MEE464.4	3 Hours

Control of NOx: Sources of nitrogen oxides, formation of NO and NO$_2$, factors affecting NOx formation, NOx control Methonds, Recent development in NOx control

Control of Sox: Introduction, H$_2$S control, SO$_2$ removal, dry methods, SO$_3$ and sulphuric acid

Self-study / Case Study / Applications	Case studies on recent developments in NOx control techniques
Text Book	Text Book 2: 10.1, 10.3, 10.5, 10.7

MODULE-5	CONTROL OF MOTOR VEHICLE EMISSIONS	22MEE464.4	3 Hours

Introduction, Motor vehicle engines, automotive fuels-gasoline, alternative fuels and alcohol fuels, low emission and zero emission vehicles, diesel exhaust particles and its health effects, emission control technologies.

Self-study/ Case Study / Applications	Case studies of petrol and diesel emission test
Text Book	Text Book 1: 14

CIE Assessment Pattern (50 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	-	-
L2	Understand	5	5	
L3	Apply	5	5	5
L4	Analyze	5	5	5
L5	Evaluate	5	-	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

RBT Levels		Exam Marks Distribution (50)
L1	Remember	10
L2	Understand	20
L3	Apply	10
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:
  Text Books:
1) Textbook of Air pollution and its control, S.C Bhatia, Atlantic Publishers and distributors (p) ltd., 2007, ISBN 9788176561886
2) Air Pollution, M N Rao, H V N Rao, McGraw Hill Education (India) Private ltd., 2013, ISBN 9780070678626
3) Air Pollution and control Technologies, Anjaneyulu, Allied Publishers (P) Ltd., India, 2002

Reference Books:
1) Sewage Disposal and Air Pollution Engineering, Santosh Kumar Garg, Khanna Publishers, 2012.ISBN 9788174092530
2) Environmental Pollution Control Engineering, C S Rao, New Age International (P) limited Publishers, 2006.
3) Air pollution, David H F Liu, Bela G Liptak, Lweis Publishers, 2000

Web links and Video Lectures (e-Resources):
- https://onlinecourses.nptel.ac.in/noc23_ce14/preview
- https://nptel.ac.in/courses/105102089
- https://nptel.ac.in/courses/105104099

Activity-Based Learning (Suggested Activities in Class)/ Practical Based learning
- Video demonstration of latest trends in air pollution control
- Contents related activities (Activity-based discussions)
  - ➢ For active participation of students, instruct the students to prepare Flowcharts and Handouts
  - ➢ Organizing Group wise discussions on issues
  - ➢ Seminars

<table>
<tr><td colspan="5" align="center">INTRODUCTION TO EMBEDDED SYSTEMS</td></tr>
<tr><td>Course Code</td><td>22MEE465</td><td></td><td>CIE Marks</td><td>50</td></tr>
<tr><td>L:T:P:S</td><td>3:0:0:0</td><td></td><td>SEE Marks</td><td>50</td></tr>
<tr><td>Hrs / Week</td><td>3</td><td></td><td>Total Marks</td><td>100</td></tr>
<tr><td>Credits</td><td>03</td><td></td><td>Exam Hours</td><td>03</td></tr>
</table>

Course outcomes:

At the end of the course, the student will be able to:

22MEE465.1	Apply the features of processors, memory, input/output and communication interfaces in developing embedded systems.
22MEE465.2	Use software development tools to develop embedded systems.
22MEE465.3	Compare the programmer's model of Cortex M processors to give frugal solutions to real world problems.
22MEE465.4	Design computational models for hardware and software design.
22MEE465.5	Apply the concept of RTOS in embedded system applications.
22MEE465.6	Engage in self-learning in analyzing and carry out projects on embedded systems.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22MEE465.1	3	2	2	-	-	-	-	-	-	-	-	-	-	2
22MEE465.2	2	2	1	-	-	-	-	-	-	-	-	-	-	2
22MEE465.3	3	3	3	-	-	-	-	-	-	-	-	-	-	2
22MEE465.4	3	3	3	-	-	-	-	-	-	-	-	-	-	2
22MEE465.5	3	2	-	-	-	-	-	-	-	-	-	-	-	2
22MEE465.6	3	1	1	-	-	-	-	-	-	-	-	-	-	2

MODULE-1	INTRODUCTION	21MEE465.1	8 Hours

Embedded System, General Computing System, Classification, Applications, Purpose, Innovative Bonding, Core, Sensors and Actuators, Memory, Communication Interface, Embedded Firmware.

Self-study/Case Study/ Applications	Role of embedded operating systems in smartphones and smart TVs.
Text Book	Text Book 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 2.1, 2.2, 2.3.1, 2.3.2, 2.4, 2.4.1, 2.4.2, 2.5.

MODULE-2	ARM CORTEX M PROCESSORS	21MEE465.2	8 Hours

Meaning, Features, Advantages, Applications, Embedded Software Development, Software Development flow, Compiling applications, Microcontroller interfaces.

Self-study/Case Study/ Applications	Embedded systems in gaming consoles for tasks like rendering graphics, processing user input, network connectivity for online gaming.
Text Book	Text Book 1: 1.1, 1.2, 3.2, 1.3, 2.3, 2.4, 2.5, 2.8

MODULE-3	ARM- 32 BIT MICROCONTROLLER FAMILY	21MEE465.3, 21MEE465.4	8 Hours

Cortex M4 Basics, Architecture, Block diagram, Operation modes and states, Registers, Special Registers, Data type, Memory System, Exceptions and interrupts, Debug, Instruction Set Summary.

Self-study/Case Study/ Applications	Create a network of wireless sensors that monitor environmental parameters like temperature, humidity, and air quality.
Text Book	Text Book 2: 4.1, 4.2, 4.4, 4.5, 4.7, 5.6.1-5.6.15, 5.7.5

MODULE-4	**HARDWARE SOFTWARE CO-DESIGN AND PROGRAM MODELING**	**21MEE465.5**	**8 Hours**
Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language, Hardware Software Trade-offs.			
Self-study/Case Study/ Applications	Create a smart traffic management system and try to include the hardware-software co-design principles and program modeling.		
Text Book	Text Book 1: : 7.1, 7.2, 7.3, 7.4		
MODULE-5	**REAL TIME OPERATING SYSTEM (RTOS) BASED EMBEDDED SYSTEM DESIGN**	**21MEE465.6**	**8 Hours**
Operating system basics, Types, Tasks, Process and threads, Multiprocessing and Multitasking, Task Scheduling, Embedded product development lifecycle.			
Self-study/ Case Study/ Applications	Build a home automation system that controls lights, temperature, and security using an RTOS.		
Text Book	Text Book 1: 15.1-15.4		

CIE Assessment Pattern (50 Marks – Theory)

		Marks Distribution		
RBT Levels		**Test (s)**	**Qualitative Assessment (s)**	**MCQ's**
		25	**15**	**10**
L1	Remember	5	-	5
L2	Understand	5	-	5
L3	Apply	10	5	-
L4	Analyze	5	5	-
L5	Evaluate	-	5	-
L6	Create	-	-	-

SEE Assessment Pattern (50 Marks – Theory)

	RBT Levels	**Exam Marks Distribution (50)**
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	-
L6	Create	-

Suggested Learning Resources:
Text Books:
1) Introduction to Embedded Systems, Shibu K V,2nd Edition 2017, McGraw Hill. ISBN 9780070667811
2) The Definitive Guide to ARM Cortex –M3 and Cortex-M4 Processors Joseph Yiu, 3rd Edition, 2014, Elsevier, ISBN 9780124080829

Reference Books:
1) Embedded Systems – A contemporary Design Tool, James K Peckol, 2014, John Wiley.ISBN
9781118744938
2) Cortex M4 Technical Reference Manual, ARM.
3) M4 Programming manual, ST microelectronics.

Web links and Video Lectures (e-Resources):

• https://archive.nptel.ac.in/courses/106/105/106105193/
• https://embeddedcomputing.com/technology/software-and-os/introduction-to-realtime-
operatingsystems-rtos
• https://www.youtube.com/watch?v=dOiJuXYFMkE&list=PLqmN55CTOnLeArO1_td4vHkAY35h6GlH M
• https://www.arm.com/resources/education/education-kits/efficient-embedded-systems

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

- Visit to any ARM Company.
- Demonstration of STM ARM cortex M4.
- Course available at https://www.arm.com/resources/education/online-courses.
- Contents related activities (Activity-based discussions).
  .

UNIVERSAL HUMAN VALUES AND LIFE SKILLS

Course Code	22UHK47		CIE Marks	50
L:T:P:S	1:0:0:0		SEE Marks	50
Hrs / Week	2		Total Marks	100
Credits	01		Exam Hours	02

Course outcomes:
  At the end of the course, the student will be able to:

22UHK47.1	Understand the concept and significance of life skills and universal human values.
22UHK47.2	Develop Self-awareness and Self-management skills to promote personal growth.
22UHK47.3	Apply Critical and Creative thinking and ethical decision-making skills in various contexts.
22UHK47.4	Promote teamwork and collaboration while respecting diversity and inclusivity.

Mapping of Course Outcomes to Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22UHK47.1	-	-	-	-	-	3	1	3	-	2	-	2
22UHK47.2	-	-	-	-	-	1	2	1	-	2	-	2
22UHK47.3	-	-	-	-	-	3	1	3	1	2	-	2
22UHK47.4	-	-	-	-	-	2	2	1	3	3	-	3

MODULE-1	Self-Awareness and Self-Management		22UHK47.1 22UHK47.2	3 Hours

Emotional Intelligence, Techniques of self-awareness: SWOT and JOHARI WINDOWS, Stress management and coming out of comfort zone, managing failure, Time Management to recalibrate priorities.
Self-Exploration as a process of Value Education, the basic human Aspirations: Prosperity and Happiness, understanding infatuation.

Self-study / Role play	Understand qualities of Role Models, explore self and do SWOT analysis for growth; participate in role play and presentations to come out of comfort zone

MODULE-2	Towards Yourself		22UHK47.1 22UHK47.3	3 Hours

Exploring opportunities, understanding expectations and self for right fitment in profession, Goal Setting - Personal and Professional, aligning Personal and Professional goals for greater achievement, Mind-Maps as a tool for Goal Setting

Self-study / Mind Maps	Understand industry expectations to set professional goals; realizing connection between personal and professional goals for peaceful living

MODULE-3	Leading self to lead others		22UHK47.3 22UHK47.4	3 Hours

Quality analysis of leader and self-evaluation, Critical thinking, Creative thinking and Ethical decision making, Critical thinking and Creative thinking for contribution to technical world, Six thinking hats, Exploring ethical decision-making frameworks and principles.

Case study	Case studies for Critical thinking and activities for Creative thinking

MODULE-4	Ownership towards Family and Society		22UHK47.2 22UHK47.3 22UHK47.4	3 Hours

Responsibility, Diversity and Inclusivity: Understanding personal and social responsibility; Appreciating diversity and managing inclusivity, promoting teamwork and collaboration while respecting differences.			
Self-study / Interview with corporate people	Working on Task bar; team building activities; Interviewing Corporate experts to understand expectations		
MODULE-5	**Towards Nature and Industry**	**22UHK47.3 22UHK47.4**	**3 Hours**
Personal code of conduct for harmony between self and nature, resisting external pressures, negotiation and conflict resolution, assertiveness and empathy, change management			
Role play	Role play to understand contributions to nature and industry.		

CIE Assessment Pattern (50 Marks – Theory) –

		Marks Distribution	
RBT Levels		**Test (s)**	**Alternative Assessment (s)**
		25	**25**
L1	Remember	-	-
L2	Understand	5	5
L3	Apply	10	5
L4	Analyze	10	10
L5	Evaluate	-	5
L6	Create	-	-

SEE Assessment Pattern (50 Marks – Group Discussion)

RBT Levels		**Exam Marks Distribution (50)**
L1	Remember	10
L2	Understand	10
L3	Apply	20
L4	Analyze	10
L5	Evaluate	--
L6	Create	--

Suggested Learning Resources:

REFERENCE BOOKS:

1. The 7 Habits of Highly Effective People, Stephen R Covey, Neha publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to win friends and influence people, Dale Carnegie.
5. BHAGAVADGITA for college students, Sandeepa Guntreddy.

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

- Conduct interviews with HR personnel of corporates to understand expectations in terms of Soft Skills and Values
- Participate in role plays and presentations to come out of comfort zone
- Talk to industry people to understand opportunities available
- Make a short movie to display creativity
- Use Mind maps to plan successful completion of semester
- Actively participate in Group Discussions and JAM sessions

NATIONAL SERVICE SCHEME (NSS)

Course Code	22NSS30, 22NSS40, 22NSS50, 22NSS60	CIE Marks (each Semester)	50
L:T:P:S	0:0:0:0	SEE Marks	--
Hrs / Week	2	Total Marks	50 x 4 = 200
Credits	00	Exam Hours	02

Course outcomes:
At the end of the course, the student will be able to:

22NSSX0.1	Understand the importance of his / her responsibilities towards society.
22NSSX0.2	Analyse the environmental and societal problems/issues and will be able to design solutions for the same.
22NSSX0.3	Evaluate the existing system and to propose practical solutions for the same for sustainable development. Implement government or self-driven projects effectively in the field.
22NSSX0.4	Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22NSSX0.1	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.2	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.3	-	-	-	-	-	3	3	-	2	-	-	1
22NSSX0.4	-	-	-	-	-	3	3	-	2	-	-	1

Semester/ Course Code	CONTENT	COs	HOURS
3RD 22NSS30	1. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing 2. Waste management–Public, Private and Govt organization, 5R's. 3. Setting of the information imparting club for women leading to contribution in social and economic issues.	22NSS30.1, 22NSS30.2, 22NSS30.3, 22NSS30.4	30 HRS
4TH 22NSS40	4. Water conservation techniques – Role of different stakeholders– Implementation. 5. Preparing an actionable business proposal for enhancing the village income and approach forimplementation. 6. Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	22NSS40.1, 22NSS40.2, 22NSS40.3, 22NSS40.4	30 HRS
5TH 22NSS50	7. Developing Sustainable Water management system for rural areas and implementationapproaches. 8. Contribution to any national level initiative of Government of India. Foreg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill developmentprograms etc.	22NSS50.1, 22NSS50.2, 22NSS50.3, 22NSS50.4	30 HRS

	9. Spreading public awareness under rural outreach programs. (minimum 5 programs).		
6TH 22NSS60	10. Organize National integration and social harmony events / workshops / seminars. (Minimum TWO programs). 11. Govt. school Rejuvenation and helping them to achieve good infrastructure.	22NSS60.1, 22NSS60.2, 22NSS60.3, 22NSS60.4	30 HRS

CIE Assessment Pattern (50 Marks – Activity based) –

CIE component for every semester	Marks
Presentation - 1 Selection of topic, PHASE - 1	10
Commencement of activity and its progress - PHASE - 2	10
Case study-based Assessment Individual performance	10
Sector wise study and its consolidation	10
Video based seminar for 10 minutes by each student at the end of semester with Report.	10
Total marks for the course in each semester	**50**

- 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.

Suggested Learning Resources:
Reference Books:
1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Pre-requisites to take this Course:
1. Students should have a service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, anytime with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the time and wishes to achieve service-oriented targets on time.

Pedagogy:
- In every semester from 3rd semester to 6th semester, each student should do activities according to the scheme and syllabus.
- At the end of every semester student performance has to be evaluated by the NSS officer for the assigned activity progress and its completion.
- At last, in 6th semester consolidated report of all activities from 3rd to 6th semester, compiled report should be submitted as per the instructions.
- State the need for NSS activities and its present relevance in the society and provide real-life examples.

- Support and guide the students for self-planned activities.
- NSS coordinator will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
- Encourage the students for group work to improve their creative and analytical skills.

Plan of Action:
- Student/s in individual or in a group Should select any one activity in the beginning of each semester till end of that respective semester for successful completion as per the instructions of NSS officer with the consent of HOD of the department.
- At the end of every semester, activity report should be submitted for evaluation.
- Practice Session Description:
  - Lecture session by NSS Officer
  - Students Presentation on Topics
  - Presentation - 1, Selection of topic, PHASE – 1
  - Commencement of activity and its progress - PHASE – 2
  - Execution of Activity
  - Case study-based Assessment, Individual performance
  - Sector/ Team wise study and its consolidation
  - Video based seminar for 10 minutes by each student at the end of semester with Report.

Sl No	Topic	Groupsize	Location	Activity execution	Reporting	Evaluation of the Topic
1.	Organic farming, IndianAgriculture (Past, Present and Future) Connectivity for marketing.	May be individual or team	Farmers land/Villages/ roadside / Community area / College campus	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 NSS officer
2.	Waste management– Public, Private and Govt organization, 5 R's.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	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 NSS officer

3.	Setting of the information imparting club for women leading to contributionin social and economic issues.	May be individual or team	Women empowerment groups/ Consulting NGOs & Govt Teams / College campus	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 NSS officer
4.	Water conservation techniques – Role of different stakeholders– Implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	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 NSS officer
5.	Preparing an actionable business proposal for enhancing the village income and approach for implementation.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	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 NSS officer
6.	Helping local schools to achieve good results and enhance their enrolment in Higher/ technical/ vocational education.	May be individual or team	Local government / private/ aided schools/Government Schemes officers	School 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 NSS officer
7.	Developing Sustainable Water management system for rural areas and implementation approaches.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	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 NSS officer

8.	Contribution to any national level initiative of Government of India.For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme,Skill development programs etc.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per 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 NSS officer
9.	Spreading public awareness under ruraloutreach programs. (minimum5 programs)	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Group selection/pro per 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 NSS officer
10.	Organize National integration and socialharmony events / workshops / seminars. (Minimum 02 programs).	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place 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 NSS officer
11.	Govt. school Rejuvenation and helping them to achieve good infrastructure.	May be individual or team	Villages/ City Areas /Grama panchayat/ public associations/ Government Schemes officers/ campus	Place 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 NSS officer

PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)

Course Code	22PED30, 22PED40, 22PED50, 22PED60	CIE Marks (each semester)	50
L:T:P:S	0:0:0:0	SEE Marks	--
Hrs / Week	02	Total Marks	50 x 4= 200
Credits	00	Exam Hours	02

Course outcomes:

At the end of the course, the student will be able to:

22PEDX0.1	Understand the fundamental concepts and skills of Physical Education, Health, Nutrition and Fitness
22PEDX0.2	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle
22PEDX0.3	Perform in the selected sports or athletics of student's choice and participate in the competition at regional/state / national / international levels.
22PEDX0.4	Understand the roles and responsibilities of organization and administration of sports and games

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22PEDX0.1	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.2	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.3	-	-	-	-	-	2	-	3	3	-	-	2
22PEDX0.4	-	-	-	-	-	2	-	3	3	-	-	2

Semester	CONTENT	COs	HOURS
3RD 22PED30	**Module 1: Orientation** A. Lifestyle, B. Fitness C. Food & Nutrition D. Health & Wellness E. Pre-Fitness test.	22PED30.1, 22PED30.2	5 HRS
	Module 2: 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	22PED30.2, 22PED30.3	15 HRS
	Module 3: Recreational Activities A. Postural deformities. B. Stress management. C. Aerobics. D. Traditional Games.	22PED30.3, 22PED30.4	10 HRS
4TH 22PED40	**Module 1: Ethics and Moral Values** A. Ethics in Sports B. Moral Values in Sports and Games	22PED40.1, 22PED40.2	5 HRS

	Module 2: Specific Games (Anyone to be selected by the student) A. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass. B. Throwball – 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 & Back Hand), Smash. F. Athletics (Track / Field Events) – Any event as per availability of Ground.	22PED40.3	20 HRS
	Module 3: Role of Organization and administration	22PED40.4	5 HRS

5ᵀᴴ
22PED50
	Fitness Components: Meaning and Importance, Fit India Movement, Definition of fitness, Components of fitness, Benefits of fitness, Types of fitness and Fitness tips.
	Practical Components: Speed, Strength, Endurance, Flexibility, and Agility
	Athletics:
	1. Track -Sprints:
	  • Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block.
	  • Acceleration with proper running techniques.
	  • Finishing technique: Run Through, Forward Lunging and Shoulder Shrug.
	2. Jumps- Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick)and Landing
	3. Throws- Shot Put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique)
	
	Handball OR Ball Badminton
	Handball:
	A. Fundamental Skills
	  1. Catching, Throwing and Ball control,
	  2. Goal Throws: Jumpshot, Centershot, Diveshot, Reverseshot.
	  3. Dribbling: High and low.
	  4. Attack and counter attack, simple counter attack, counter attack from two wings and center.
	  5. Blocking, Goal Keeping and Defensive skills.
	  6. Game practice with application of Rules and Regulations.
	B. Rules and their interpretations and duties of officials
	
	Ball badminton:
	A. Fundamental Skills
	  1. Basic Knowledge: Various parts of the Racket and Grip.
		22PED50.1,
		22PED50.2,
		22PED50.3,
		22PED50.4
			Total 30 Hrs/
			Semester
			
			2 Hrs/week

	2. Service: Short service, Long service, Long-high service. 3. Shots: Overhead shot, Defensive clearshot, Attacking clearshot, Dropshot, Netshot, Smash. 4. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials.			

6TH
22PED60
	Athletics:
	1. Track -110 Mtrs and 400Mtrs:
	    • Hurdling Technique: Lead leg Technique, Trail leg Technique, Side Hurdling, Over the Hurdles
	    • Crouch start (its variations)use of Starting Block.
	    • Approach to First Hurdles, In Between Hurdles, Last Hurdles to Finishing.
	2. Jumps- High jump: Approach Run, Take-off, Bar Clearance (Straddle) and Landing.
	3. Throws- Discus Throw: Holding the Discus, Initial Stance Primary Swing, Turn, Release and Recovery (Rotation in the circle).
	
	                    Football OR Hockey
	Football:
	 A. Fundamental Skills
	1. Kicking: Kicking the ball with inside of the foot, Kicking the ball with Full Instep of the foot, Kicking the ball with Inner Instep of the foot, Kicking the ball with Outer Instep of the foot and Lofted Kick.
	2. Trapping: Trapping- the Rolling ball, and the Bouncing ball with sole of the foot.
	3. Dribbling: Dribbling the ball with Instep of the foot, Dribbling the ball with Inner and Outer Instep of the foot.
	4. Heading: In standing, running and jumping condition.
	5. Throw-in: Standing throw-in and Running throw-in.
	6. Feinting: With the lower limb and upper part of the body.
	7. Tackling: Simple Tackling, Slide Tackling.
	8. Goal Keeping: Collection of Ball, Ball clearance-kicking, throwing and deflecting.
	9. Game practice with application of Rules and Regulations.
	
	 A. Rules and their interpretation and duties of officials.
	Hockey:
	A. Fundamental Skills
	  1. Passing: Short pass, Longpass, pushpass, hit
	  2. Trapping.
	 3. Dribbling and Dozing
	4. Penalty stroke practice.
	5. Penalty corner practice.
	6. Tackling: Simple Tackling, Slide Tackling.
	7. Goal Keeping, Ball clearance- kicking, and deflecting.
		22PED60.1,
		22PED60.2,
		22PED60.3,
		22PED60.4
			Total 30 Hrs/
			Semester
			
			2 Hrs/week	

	8. Game practice with application of Rules and Regulations. B. Rules and their interpretation and duties of officials		

CIE Assessment Pattern (50 Marks – Practical) –
  CIE to be evaluated every semester end based on practical demonstration of Sports and Athletics activities learnt in the semester.

CIE	Marks
Participation of student in all the modules	10
Quizzes – 2, each of 7.5 marks	15
Final presentation / exhibition / Participation in competitions/ practical on specific tasks assigned to the students	25
Total	**50**

Suggested Learning Resources:
Reference Books:
  1. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
  2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.
  3. Petipus, et.al., Athlete's Guide to Career Planning, Human Kinetics.
  4. Dharma, P.N. Fundamentals of Track and Field, Khel Sahitya Kendra, New Delhi.
  5. Jain, R. Play and Learn Cricket, Khel Sahitya Kendra, New Delhi.
  6. Vivek Thani, Coaching Cricket, Khel Sahitya Kendra, New Delhi.
  7. Saha, A.K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
  8. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata
  9. Naveen Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
  10. Dubey H.C., Basketball, Discovery Publishing House, New Delhi.
  11. Rachana Jain, Teach Yourself Basketball, Sports Publication.
  12. Jack Nagle, Power Pattern Offences for Winning basketball, Parker Publishing Co., New York.
  13. Renu Jain, Play and Learn Basketball, Khel Sahitya Kendra, New Delhi.
  14. SallyKus, Coaching Volleyball Successfully, Human Kinetics.

YOGA				
Course Code	22YOG30, 22YOG40, 22YOG50, 22YOG60	**CIE Marks**	50	
L:T:P:S	0:0:0:0	**SEE Marks**	--	
Hrs / Week	2	**Total Marks**	50 x 4 = 200	
Credits	00	**Exam Hours**	02	

Course outcomes:

At the end of the course, the student will be able to:

22YOGX0.1	Understanding the origin, history, aim and objectives of Yoga
22YOGX0.2	Become familiar with an authentic foundation of Yogic practices
22YOGX0.3	Practice different Yogic methods such as Suryanamaskara, Pranayama and some of the Shat
22YOGX0.4	Use the teachings of Patanjali in daily life.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22YOGX0.1	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.2	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.3	-	-	-	-	-	3	-	-	-	-	-	1
22YOGX0.4	-	-	-	-	-	3	-	-	-	-	-	1

Semester / Course Code	CONTENT	COs	HOURS
3rd **22YOG30**	**Introduction of Yoga:** Aim and Objectives of yoga, Prayer: Yoga, its origin, history and development. Yoga, its meaning, definitions. Different schools of yoga, importance of prayer **Brief introduction of yogic practices for common man:** Yogic practices for common man to promote positive health **Rules and regulations:** Rules to be followed during yogic practices by practitioner **Misconceptions of yoga:** Yoga its misconceptions, Difference between yogic and non-yogic practices. **Suryanamaskara:** 1. Suryanamaskar prayer and its meaning, Need, importance and b of Suryanamaskar. 2. Suryanamaskar 12 count,2rounds **Different types of Asanas**: 1. Sitting: Padmasana, Vajrasana, Sukhasana 2. Standing: Vrikshana, Trikonasana, Ardhakati Chakrasana 3. Prone line: Bhujangasana, Shalabhasana 4. Supineline: Utthitadvipadasana, Ardhahalasana, Halasana	22YOG30.1, 22YOG30.2, 22YOG30.3, 22YOG30.4	Total 32 Hrs/ Semester 2 Hrs/week

4TH
22YOG40
	Suryanamaskara: Suryanamaskar 12 count,4rounds
	Brief introduction and importance of:
	Kapalabhati: Revision of Kapalabhati -40strokes/min3rounds
	Different types of Asanas:
	  1. Sitting: Paschimottanasana, Ardha Ushtrasana, Vakrasana, Aakarna Dhanurasana
	  2. Standing: Parshva Chakrasana, Urdhva Hastothanasana, Hastapadasana
	  3. Prone line: Dhanurasana
	  4. Supine line: Karna Peedasana, Sarvangasana, Chakraasana
	Patanjali's Ashtanga Yoga: Asana, Pranayama
	Pranayama: Chandra Bhedana, Nadishodhana, Surya Bhedana
		22YOG40.1,
		22YOG40.2,
		22YOG40.3,
		22YOG40.4
			Total 32 Hrs/
			Semester
			2 Hrs/week

5TH
22YOG50
	Kapalabhati: Revision of Kapalabhati - 60strokes/min3rounds
	Brief introduction and importance of:
	Different types of Asanas:
	  1. Sitting: Yogamudra in Padmasana, Vibhakta Paschimottanasana, Yogamudra in Vajrasana
	  2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana
	  3. Prone line: Padangushtha Dhanurasana, Poorna Bhujangasana / Rajakapotasana
	  4. Supine line: Navasana/Noukasana, Pavanamuktasana, Sarvanga
	Patanjali's Ashtanga Yoga: Pratyahara, Dharana
	Pranayama: Ujjayi, Sheetali, Sheektari
		22YOG50.1,
		22YOG50.2,
		22YOG50.3,
		22YOG50.4
			Total 32 Hrs/
			Semester
			2 Hrs/week

6TH
22YOG60
	Kapalabhati: Revision of Kapalabhati – 80 strokes/min3rounds
	Brief introduction and importance of:
	Different types of Asanas:
	  1. Sitting: Bakasana, Hanumanasana, Ekapada Rajakapotasana
	  2. Standing: Parivritta Trikonasana, Utkatasana, Parshvakonasana
	  3. Supine line: Setubandhasana, Shavasanaa (Relaxation posture)
	  4. Balancing: Sheershasana
	Patanjali's AshtangaYoga: Dhyana (Meditation), Samadhi
	Pranayama: Bhastrika, Bhramari, Ujjai
	Shat Kriyas: Jalaneti and sutraneti, Sheetkarma Kapalabhati
		22YOG60.1,
		22YOG60.2,
		22YOG60.3,
		22YOG60.4
			Total 32
			Hrs/
			Semester
			2 Hrs/week

CIE Assessment Pattern (50 Marks – Practical)

CIE to be evaluated every semester based on practical demonstration of Yogasana learnt in the semester and internal tests (objective type)

CIE	Marks
Avg of Test 1 and Test 2	25
Demonstration of Yogasana	25
Total	**50**

Suggested Learning Resources:
Reference Books:

       1. Swami Kuvulyananda: Asma (Kavalyadhama, Lonavala)

       2.Tiwari, O P: Asana Why and How

       3.Ajitkumar: Yoga Pravesha (Kannada)

       4.Swami Satyananda Saraswati: Asana Pranayama, Mudra, Bandha (Bihar School of yoga, Munger)

       5.Swami Satyananda Saraswati: Surya Namaskar (Bihar School of yoga, Munger)

       6.Nagendra H R: The art and science of Pranayama

       7.Tiruka: Shatkriyegalu (Kannada)

       8.Iyengar B K S: Yoga Pradipika (Kannada)

       9.Iyengar B K S: Light on Yoga (English)

Web links and Video Lectures (e-Resources):
- **https://youtu.be/KB-TYlgd1wE**
- **https://youtu.be/aa-TG0Wg1Ls**

BASIC APPLIED MATHEMATICS-I

Course Code	22DMAT31	CIE Marks	100
L:T:P:S	0:0:0:0	SEE Marks	--
Hrs. / Week	3	Total Marks	100
Credits	00	Exam Hours	--

Course outcomes:

At the end of the course, the student will be able to:

22DMAT31.1	Know the principles of engineering mathematics through calculus
22DMAT31.2	Determine the power series expansion of a function
22DMAT31.3	Find the definite integrals with standard limits and also develop the ability to solve different types of differential equations
22DMAT31.4	Apply ideas from linear algebra in solving systems of linear equations and determine the Eigen values and Eigen vectors of a matrix

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22DMAT31.1	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.2	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.3	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT31.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**DIFFERENTIAL CALCULUS**	**22DMAT31.1 22DMAT31.2**	**8 Hours**

Polar Curves-Problems on angle between the radius vector and tangent, Angle between two curves-Problems, Pedal equation for polar curves-Problems. Maclaurin's theorem for function of one variable (statement only)-Problems.

Text Book	Text Book 1: 4.4, 4.7, 4.8, Text Book 2: 15.4

MODULE-2	**PARTIAL DIFFERENTIATION**	**22DMAT31.1**	**8 Hours**

Definition and Simple problems, Euler's theorem for Homogeneous function (NO Derivation and NO extended theorem Problems, Jacobians of order two - definition and problems.

Text Book	Text Book 1: 5.4, 5.7,

MODULE-3	**INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS**	**22DMAT31.3**	**8 Hours**

Problems on evaluation of sin n x and cos n x integrals with standard limits (0 to $\pi/2$). Solution of first order and first-degree differential equations-Variable separable, Linear and Exact differential equations.

Text Book	Text Book 1: 6.2, 11.6, 11.9, 11.11, Text Book 2: 1.3, 1.4, 1.5

MODULE-4	**LINEAR ALGEBRA-1**	**22DMAT31.4**	**8 Hours**

Problems on rank of a matrix by elementary transformations, Solution of system of linear equations by Gauss elimination method-Problems.

Text Book	Text Book 1: 2.7, 28.6, Text Book 2: 7.3, 7.4

MODULE-5	**LINEAR ALGEBRA-2**	**22DMAT31.4**	**8 Hours**

Linear transformation, Eigen values and Eigen Vectors of square matrix-Problems.

Text Book	Text Book 1: 2.11, 2.13, Text Book 2: 7.9, 8.1.

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

	RBT Levels	Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
L6	Create	-	-	-

Suggested Learning Resources:

Text Books:
1) B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, Forty fourth Edition, 2022, ISBN: 9788193328491.
2) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley-India Publishers, Tenth Edition, Reprint 2016, ISBN: 9788126554232.

Reference Books:
1) Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, Fourth Edition, 2015, ISBN: 9780273719236.
2) B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education (India) Private Limited, Fourth Edition, 2017, ISBN: 9780070634190.
3) H. K. Dass, Advanced Engineering Mathematics, S. Chand & Company Ltd., Twenty Second Edition, 2018, ISBN: 9789352533831.
4) N.P.Bali and Manish Goyal, A Text Book of Engineering Mathematics, Laxmi Publications (P) Ltd., Ninth Edition, 2014, ISBN: 9788131808320.

Web links and Video Lectures (e-Resources):
1) https://youtu.be/IUV0_Nj4d1s?si=eO3s7keCbCO1_jcz
2) https://youtu.be/VzUcs7aiqgg?si=YLtTUGr4Xp88KGY3
3) https://youtu.be/LDBnS4c7YbA?si=udUOdJ-u0ZxFmBAW
4) https://youtu.be/palSdK9P-ns?si=7A8_VSxEI4lGvksB
5) https://youtu.be/Bw5yEqwMjQU?si=jzbklZmVev1w8K2S
6) https://youtu.be/LBqdGn1r_fQ?si=DWcAIiFnosT7zikY
7) https://youtu.be/N5YCGOyTSuU?si=Wsf75V5fkUpfVVxr
8) https://youtu.be/gd1FYn86P0c?si=7drzBEqVFSv6sQeZ
9) https://youtu.be/cSj82GG6MX4?si=4QN1DFXEqaJoUBn7
10) https://youtu.be/0c3yq9btr3A?si=jIoz8eu5TgV7mh8G
11) https://youtu.be/PhfbEr2btGQ?si=HVK1uk65oHph0t8G

Activity-Based Learning (Suggested Activities in Class)/Practical Based Learning:
- Contents related activities (Activity-based discussions)
  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

BASIC APPLIED MATHEMATICS-II			
Course Code	**22DMAT41**	**CIE Marks**	**100**
L:T:P:S	**0:0:0:0**	**SEE Marks**	**--**
Hrs. / Week	**3**	**Total Marks**	**100**
Credits	**00**	**Exam Hours**	**--**

Course outcomes:

At the end of the course, the student will be able to:

22DMAT41.1	Gain knowledge of basic operations of vectors
22DMAT41.2	Use curl and divergence of a vector function in three dimensions
22DMAT41.3	Develop the ability to solve higher order Linear differential equations
22DMAT41.4	Know the basic concepts of Laplace transform to solve the Periodic functions and also solve initial and boundary value problems using Laplace transform method.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
22DMAT41.1	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.2	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.3	3	3	-	-	-	-	-	-	-	-	-	-
22DMAT41.4	3	3	-	-	-	-	-	-	-	-	-	-

MODULE-1	**VECTORS**	**22DMAT41.1**	**8 Hours**

Definition of scalar and vector, Vector addition, Subtraction
and Multiplication-Dot product, Cross product, Scalar triple product. Orthogonal, Co-planar and Angle between vectors-Problems.

Text Book	Text Book 1: 3.1, 3.5, 3.6, 3.9, Text Book 2: 7.1, 9.2, 9.3, 9.4.		
MODULE-2	**VECTOR DIFFERENTIATION**	**22DMAT41.2**	**8 Hours**

Vector differential operator-Gradient of a scalar function, Divergence of a vector function, Curl of a vector function-Problems. Solenoidal and irrotational vector fields-Problems.

Text Book	Text Book 1: 8.5, 8.6, 8.7, Text Book 2: 9.7, 9.8, 9.9.		
MODULE-3	**LINEAR DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS**	**22DMAT41.3**	**8 Hours**

Solution of initial and boundary value problems, Inverse differential operator techniques for the functions-e^{ax}, $\sin(ax + b)$ and $\cos(ax + b)$.

Text Book	Text Book 1: 13.3, 13.4, 13.5, 13.6,		
MODULE-4	**LAPLACE TRANSFORM**	**22DMAT41.4**	**8 Hours**

Definition and Laplace transforms of elementary functions-Problems. Properties of Laplace transforms (Shifting property-without proof), Periodic functions (without proof)-problems.

Text Book	Text Book 1: 21.3, 21.4, 21.5, Text Book 2: 6.1.		
MODULE-5	**INVERSE LAPLACE TRANSFORM**	**22DMAT41.4**	**8 Hours**

Inverse Laplace Transform by partial fractions-Problems. Solution of linear differential equations using
Laplace Transforms-Problems.

Text Book	Text Book 1: 21.12, 21.15, Text Book 2: 6.4.		

CIE Assessment Pattern (50 X 2=100 Marks – Theory)

RBT Levels		Marks Distribution		
		Test (s)	Qualitative Assessment (s)	MCQ's
		25	15	10
L1	Remember	5	5	-
L2	Understand	5	5	-
L3	Apply	10	5	10
L4	Analyze	2.5	-	-
L5	Evaluate	2.5	-	-
L6	Create	-	-	-

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1) https://youtu.be/SaNDPSk1UVM?si=FRxMnRi1btCUIscK
2) https://youtu.be/HxrLu-qRJKc?si=pKc9XOCllBx-H4Wp
3) https://youtu.be/ma1QmE1SH3I?si=Hoo3_cjiIds203os
4) https://youtu.be/TKBXey91Gc4?si=JjZfQvJxdxN8I6YQ
5) https://youtu.be/1THkFmuIPXM?si=pc9VvmZ-9cQe_Wr_
6) https://youtu.be/m7jH0jfRf2I?si=OOEWttfQhieJ9wih
7) https://youtu.be/qFnoRfZknBY?si=BeMrhMF3LML4hBGa
8) https://youtu.be/n9XP6pljtw8?si=3gU-XKgt5JIZe9LE

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  - For active participation of students, instruct the students to prepare Algorithms/Flowcharts/Programming Codes
  - Organizing Group wise discussions on related topics
  - Seminars

Appendix A: List of Assessment Patterns

S.NO	Pattern of Assessments
1	Assignments
2	Group Discussions
3	Case Study / Caselets
4	Practical-Orientation on Design Thinking
5	Participatory & Industry-Integrated Learning
6	Practical Activities / Problem Solving Exercises
7	Class Presentations
8	Analysis of Industry / Technical / Business Reports
9	Reports on Industrial Visit
10	Industrial / Social / Rural Projects
11	Participation in external seminars / Workshops
12	Any Other Academic Activity
13	Online / Offline Quizzes

APPENDIX B: Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes

COURSE OUTCOME
↓
PROGGRAM OUTCOME
↓
PROGRAM EDUCATIONAL OBJECTIVES
↓
DEPARTMENTAL MISSION
↓
DEPARTMENTAL VISION
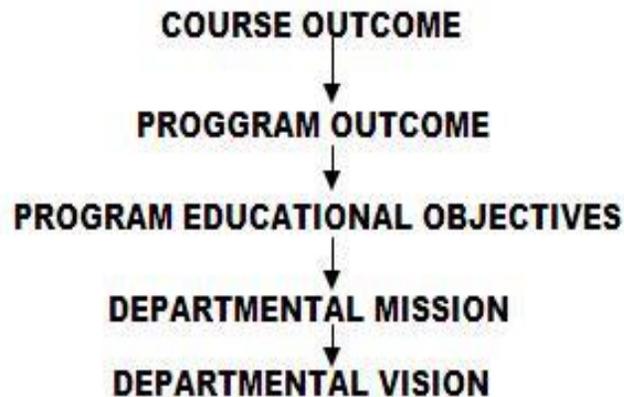
<h1 style="text-align: center">APPENDIX C: The Graduate Attributes of NBA</h1>

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX D: BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.

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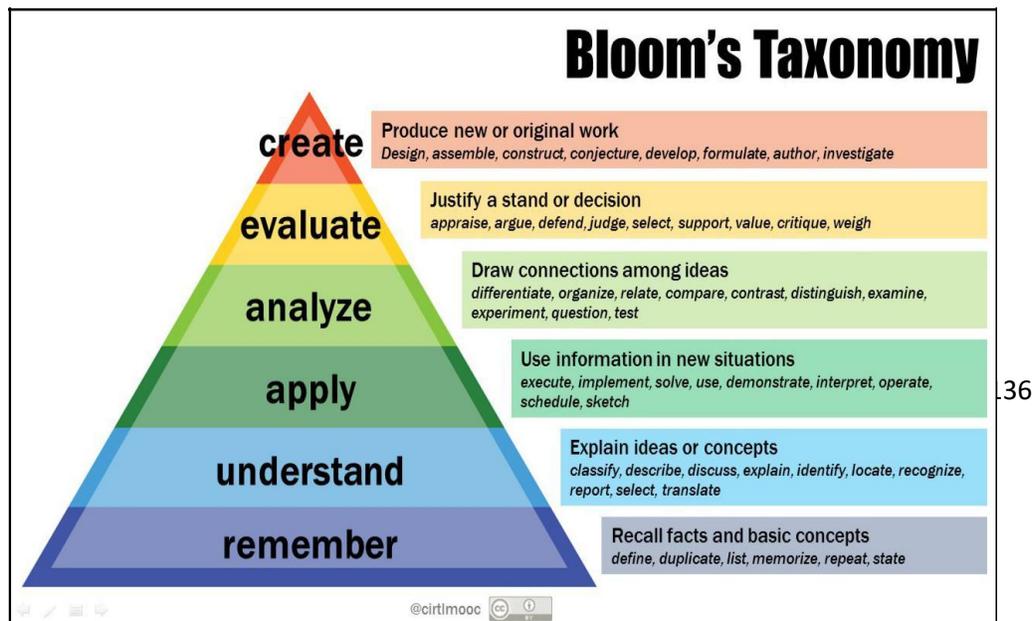
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