|| Jai Sri Gurudev ||

Sri Adichunchanagiri Shikshana Trust®

SJB Institute of Technology

An Autonomous Institution under VTU

No.67, BGS Health & Education City, Dr.Vishnuvardhan Rd, Kengeri, Bengaluru, Karnataka 560060

MECHANICAL ENGINEERING

Autonomous

SCHEME & SYLLABUS BOOKLET

2023 - SCHEME- [UG]

3RD & 4TH SEMESTER

SERVICE TO MANKIND IS SERVICE TO GOD

His Divine Soul Padmabhushana

Sri Sri Sri Dr. Balagangadharanath MahaSwamiji

Founder President, Sri Adichunchanagiri Shikshana Trust®

"Life needs mundane knowledge
Salvation needs spiritual knowledge
They together banish our pervading ignorance"

His Holiness Parama Pujya

Sri Sri Sri Dr. Nirmalanandanatha MahaSwamiji

President, Sri Adichunchanagiri Shikshana Trust ®

"Every youth wants to be unique - that is you!"

Revered Sri Sri Dr. Prakashanatha Swamiji

Managing Director, BGS & SJB Group of Institutions & Hospitals

"Knowledge gives discipline, from discipline comes worthiness, from worthiness one gets wealth, from wealth (one does) good deeds, from that (comes) joy."

Department Vision and Mission

Vision

To become a center of excellence and a platform in diversified fields for the aspirants in Mechanical Engineering

Mission

M1: To impart comprehensive education in the field of Mechanical Engineering to produce highly accomplished graduates

M2: To endow technical & soft skill trainings to foster professionalism and ethical values among students

M3: To induce innovative thinking among students through projects and research work

2023-SCHEME

3RD & 4TH SEMESTER

SCHEME & SYLLABUS

2023 Scheme – UG

Syllabus for 3rd & 4th Semester

The syllabus, scheme and guidelines are provided in detail.
The syllabus, scheme and guidelines are subjected to changes if any needed.
The updates will be done timely.
Regularly access the institution website for the updated information.

The Syllabus book is available on	www.sjbit.edu.in
For any queries, please write to	academicdean@sjbit.edu.in

UPDATES

Release / Revision	Date	Remarks
Release	03/09/2024	First release

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Sri Adichunchanagiri Shikshana Trust (R)

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 2nd Year ME

SCHEME: 2023 **SEM: III** **Revision date: 8/26/2024**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/ABL / SL/etc.		Dur.	Th.	Lab	Tot.
1	IBSC	3	23MEI301	Linear Programming & Statistical Methods	Maths	Maths	4	2	2	2	@	50	03	50	-	100
2	PCC	1	23MET302	Thermodynamics	ME	ME	3	2	2	0		50	03	50	-	100
3	IPCC	1	23MEI303	Manufacturing Technology	ME	ME	4	3	0	2		50	03	50	-	100
4	IPCC	2	23MEI304	Material Science and Metallurgy	ME	ME	4	2	2	2		50	03	50	-	100
5	PCCL	1	23MEL305	Mechanical Measurements and Metrology Lab	ME	ME	1	0	0	2		50	03	-	50	100
6	ETC	1	23MEE31y	Emerging Technology Course - 1	ME	ME	3	3	0	0	@	50	03	50	-	100
7	AEC	3	23MEAE31	Skill development Course - 3 - CATIA	I.E.	I.E.	1	1	0	0	3	50	02	50	-	100
8	NCMC	3	23PDSN03	Skill Full Futures : Empowering Aptitude And Soft Skills	I.E.	I.E.	PP/NP	0	0	0	2	50	-	-	-	50
9	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	PP/NP	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
						Total	**20**	**13**	**6**	**10**	**7**	**450**		**300**	**50**	**800**

BSC: Basic Science Course; PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; AEC: Ability Enhancement Course; {I.E.-Industry Experts};
{@ - Compulsory one activity}.
PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning

ETC (Emerging Technology Course):

For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

NCMC (Non Credit Mandatory Course): The following guidelines are applicable for the course type series-4 as mentioned above.

1) All students must register for any one of the course with the department during the first week of the III semester.
2) Once registered for a course in the III semester, the student shall continue and complete the same course in the remaining semesters. No provision for changing the courses after registration.
3) Activities shall be carried out by the students between III semester to VI semester (for 4 semesters).
4) The activities shall be organized, executed and monitored by the concerned department as mentioned above in coordination with the department level course coordinators. The same shall be reflected in the calendar of events of the above concerned departments.
5) Successful completion of the registered course and requisite CIE score (PP) is mandatory for the award of degree.
6) These courses are not considered for vertical progression, calculation of SGPA & CGPA, however it is mandatory for the award of degree.
7) The guidelines is applicable to all the remaining IV to VI semesters.

Additional courses for Lateral Entry students:

1) The lateral entry students getting admitted from the 2nd year of programme, shall register, study and complete additional courses prescribed & offered time to time.
2) Successful completion of the registered course and requisite CIE score (PP) is mandatory for the award of degree.
3) These courses are not considered for vertical progression, calculation of SGPA & CGPA, however it is mandatory for the award of degree.

Self-Learning Courses (SLC) as per the VIII Semester ST&E:

1) Offering and Registration of Self-learning Courses will commence from 3rd Semester itself and continues till the end of the duration of study.
2) Both regular & lateral entry students shall start registering for the self learning courses and complete as per the guidelines published separately. (Refer to the Self Learning Courses guidelines published).
3) These courses are not considered for vertical progression.
4) Calculation of SGPA & CGPA is considered for VIII Semester, irrespective of period or time of completion of the course.

Emerging Technology Course - 1	
Course Code	**Course Title**
23MEE311	Object Oriented Programming with JAVA* (L:T:P:O: 2:0:2:0)
23MEE312	Principles of Robotics * (L:T:P:O: 2:0:2:0)
23MEE313	Micro Electro Mechanical Systems (MEMS)
23MEE314	Industrial Design And Ergonomics

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AUTONOMOUS SCHEME (Tentative) UG - BE 2nd Year

SCHEME: 2023 **Date of release: 29/06/2024**

SEM: III **Additional courses for Lateral Entry students**

Note:

1) For the fulillment of successful completion of degree, lateral entry students, shall study & complete additional courses as per the guidelines released time to time.
2) Regular courses (SL No 1 to 8) are same as applicable to all defined in the scheme of teaching & examinations (ST&E).
3) The below prescribed courses has to be registered whenever they are offered and successfully completed before the end of Seventh Semester End Examinations.

SL No	Course Type	Course type Count	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE			Tot. Marks
								Lecture	Tutorial	Practical	PBL/ABL/ SL/othrs.		Dur.	Th. Mrks	Lab. Mrks.	
For CS stream (CSE/ISE/AIML/CSE(DS))																
9	BSC	-	23MAT31A	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For EE stream (ECE & EEE)																
9	BSC	-	23MAT31B	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For CV stream (Civil)																
9	BSC	-	23MAT31C	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50
For ME stream (Mechanical)																
9	BSC	-	23MAT31D	Additional mathematics-1	Maths	Maths	PP/NP	2	0	0	@	50	-	-	-	50

2023-SCHEME

SELF LEARNING COURSE

GUIDELINES

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Department of Mechanical Engineering

Self Learning course list for UG BE - ME

SCHEME: 2023 **Release date: 22-05-2024**

Self-Learning course - 1 (NPTEL) (23xxS1yy)			Self-Learning course - 2 (NPTEL) (23xxS2yy)		
Course Code	**Course Title**	**NPTEL Code**	**Course Code**	**Course Title**	**NPTEL Code**
23MES101	Programming in Java	noc24-cs105	23MES201	The Joy of Computing using Python	noc24-cs113
23MES102	Biomechanics of Joints and Orthopaedic Implants	noc24-me150	23MES202	Programming, Data Structures and Algorithms using Python	noc24-cs78
23MES103	Industrial Robotics : Theories for Implementation	noc24-me117	23MES203	Mechanism and Robot Kinematics	noc24-me155
23MES104	Robotics	noc24-me88	23MES204	Mechanics and Control of Robotic Manipulators	noc24-me92
23MES105	Fabrication Techniques for MEMs-Based Sensors : Clinical Perspective	noc24-ee108	23MES205	Foundations of Cognitive Robotics	noc24-me82
23MES106	Ergonomics Workplace Analysis	noc24-de10	23MES206	Ergonomics Research Techniques	noc24-de17
23MES107	Theory of Production Processes	noc24-me122	23MES207	Environmental & Resource Economics	noc24-ec12
23MES108	Laser Based Manufacturing	noc24-me153	23MES208	Power Plant Engineering	noc24-me89
23MES109	Steam Power Engineering	noc24-me87	23MES209	Fundamentals of Additive Manufacturing Technologies	noc24-me138

Academic Dean **Principal**

Guidelines for Self-learning courses – Under Graduation (UG)

1) As per the Scheme of Teaching & Examinations (ST&E) the UG students to earn totally 06 credits by studying and completing 02 NPTEL/SWAYAM courses of 12 weeks each earning 03 credits.
2) The credits so earned by successful completion of the courses will be credited in the 8th SEM grade card.
3) The successful completion of the courses means earning of the course completion certificates from NPTEL/SWAYAM.
4) The courses shall be studied and completed starting from 3rd Semester and shall be completed before the announcement of 8th Semester End Examinations. However, it is advised to complete both the courses before the 7th SEM of their graduation.
5) The respective department BOS shall identify the professional courses related to the respective discipline either core or multidisciplinary from the list of courses released by NPTEL/SWAYAM every season. At least ten such courses shall be identified and finalized after the discussions in the respective BOS meetings, and the list shall be approved by the Academic Dean.
6) The approved list shall be published by the departments to the students at the beginning of the 3rd SEM itself and the student shall be given an option to choose up to 02 courses for the study and earn certificates of completion.
7) The practicing of studying and completion of NPTEL/SWAYAM courses starting from 3rd SEM itself has multi-fold effect:
   i) Enhances the self-learning ability of the students.
   ii) Study of self-learning courses will have impact on the learning of other courses in the scheme of teaching & examinations.
   iii) Will address the real time challenges/difficulties/differences in the calendars of NPTEL/SWAYAM & Institution.
8) The respective departments shall make holistic efforts to bring awareness to the students about the objectives and importance of self-learning courses. The departments shall thrive towards fulfilment of the objectives.
9) The departments shall continuously monitor & track the progress of the accomplishment of the courses by the students.
10) The departments shall assign course mentors as per the guidelines of the NPTEL/SWAYAM.

11) The departments shall take care that the registered courses and the examinations shall be under the local chapter of the Institution.
12) Every care must be taken by the departments to guide, motivate, to help the students in completing the courses as the academic calendar of the institution and the calendar of the NPTEL/SWAYAM does not match. The faculty advisory system or Mentor System must play a significant role.
13) Every season new courses may be added to the identified list and a fresh list of courses shall be prepared based on the list announced by the NPTEL/SWAYAM every season. However, the courses published from the first list shall be maintained if the NPTEL/SWAYAM list has the courses.
14) If the students are unable to successfully complete the course, they shall be given an option to re-register for the same course multiple times if the courses are available during the respective seasons in NPTEL/SWAYAM list.
15) An option for making fresh choice shall be given to the students until the successful completion of the courses and earning of required number of credits within the defined time.
16) The list of students registered for the courses and completion of the courses shall be submitted to the dean office on completion of every season.
17) All the regulations such as "Dropping of courses", "Withdrawal of Courses", etc. as described in the academic regulations shall be applicable to the Self Learning Courses (SLC).
18) The performance of the students in the assignments and the certification exam of the NPTEL/SWAYAM shall be considered for awarding the grade points to the students in the self-learning courses.
19) If the students are successfully completing more than the prescribed number of courses in their period of study, best performed courses (group wise) may be considered for the award of credits.
20) The CIE & SEE marks as prescribed in the Scheme of Teaching & Examinations (ST&E) shall be considered as per the performance of the student in the successfully completed NPTEL/SWAYAM course. The obtained assignment marks in the successfully completed NPTEL/SWAYAM course shall be mapped to the CIE and obtained exam certification percentage in the successfully completed NPTEL/SWAYAM course shall be mapped for SEE marks.
21) The students unable to complete the self-learning courses and earn the required credits will not be awarded the degree. Degree shall be awarded only after successful completion and earning of credits.

Academic Dean
Dr. Babu N V

Principal
Dr. K V Mahendra Prashanth

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Autonomous Scheme of Teaching & Examinations (ST&E) (Tentative) UG - BE 2nd Year ME

SCHEME: 2023 **SEM: IV** **Revision date: 8/26/2024**

S. #	Course Type	Course type Series	Course Code	Course Title	Teaching Dept.	QP setting dept	Credits	Teaching Hrs/Week				Examinations				
								L	T	P	O	CIE Marks	SEE (Dur. & Marks)			
								Lecture	Tutorial	Practical	PBL/AB L/ SL/etc.		Dur.	Th.	Lab	Tot.
1	BSC	4	23MET401	Probability Distributions & Complex variables	Maths	Maths	**3**	2	2	0	@	50	03	50	-	100
2	PCC	2	23MET402	Mechanics of Materials	ME	ME	**3**	3	0	0	@	50	03	50	-	100
3	IPCC	3	23MEI403	Advanced Machining Science	ME	ME	**4**	3	0	2		50	03	50	-	100
4	IPCC	4	23MEI404	Fluid Mechanics	ME	ME	**4**	3	0	2		50	03	@	-	100
5	PCCL	2	23MEL405	Modelling And Design Of Mechanical Components	ME	ME	**1**	0	0	2		50	03	-	50	100
6	ETC	2	23MEE42y	Emerging Technology Course - 2	ME	ME	**3**	3	0	0	@	50	03	50	-	100
7	HSMC	5	23SFHH06/ 23UHVH07	Bioscience (or) UHV - Universal Human Values	any dept	any dept	**1**	0	2	0	@	50	02	50	-	100
8	AEC	4	23MEAE41	Creo with Hypermesh	I.E.	I.E.	**1**	1	0	0	3	50	02	50	-	100
9	NCMC	5	23PDSN04	Mindful Mastery: Aptitude And Softskill Integration	I.E.	I.E.	**PP/NP**	0	0	0	2	50	-	-	-	50
10	NCMC	4	23PASN01	Physical Education - Sports and Athletics	PED	PED	**PP/NP**	-	-	-	2	50	-	-	-	50
			23YOGN02	Yoga	PED	PED										
			23NSSN03	NSS - National Service Scheme	NSS	NSS										
			23NCCN04	NCC - National Cadet Corps	NCC	NCC										
			23IKSN05	Indian Knowledge System	HSS	HSS										
Total							**20**	**15**	**4**	**8**	**7**	**500**		**300**	**50**	**900**

BSC: Basic Science Course; PCC: Professional Course; IPCC: Integrated Professional Core Course; PCCL: Professional Core Course Laboratory; AEC: Ability Enhancement Course; HSMC: Humanities, Social Sciences & Management Course; NCMC: Non Credit Mandatory Course;
{@ - Compulsory one activity during the semester}
{I.E.-Industry Experts}.
PBL: project Based learning; ABL: Activity Based Learning; SL: Self-Learning

ETC (Emerging Technology Course):

For ETC (L:T:P:O) can be plaanned by the depts considering practicality & possibility of conduction, same shall be indicated along with course title in the list, if altered than above. If planned altering the prescription, the same shall be approved at the department BOS & authorities. Atleast one activity is mandatory during the delivery of the course. The guidelines is applicable to all the semesters III to VI semesters (ETC-1 to ETC-4).

Bioscience & UHV-Universal Human Values:

1) Any one of the course will be offered by the departments in each semester of IV & VI based on the institutional planning.
2) Both the courses shall be studied and completed by the students registering each in the two semesters. For example, if Bioscience is offered in the IV semester, UHV-Universal Human Values is offered in the V semester.

NCMC (Non Credit Mandatory Course) for course type series-4: Refer to guidelines in III SEM.

Emerging Technology Course - 2	
Course Code	**Course Title**
23MEE421	Database Management System * (L:T:P:O: 2:0:2:0)
23MEE422	Drive system for robotics
23MEE423	Microcontroller and its applications * (L:T:P:O: 2:0:2:0)
23MEE424	Inspection & quality control

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MECHANICAL ENGINEERING

3rd Semester Syllabus

Semester:	03	**Course Type:**	IBSC		
Course Title:	**LINEAR PROGRAMMING & STATISTICAL METHODS.**				
Course Code:	**23MEI301**			**Credits:**	4
Teaching Hours/Week (L: T: P: O)			2:2:2:@	**Total Hours:**	40 hours + Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives:

- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods.
- Partial differential equation in Vibration theory, fluid dynamics, Heat transform and thermodynamics.
- Analyze and Solve programming Module of real life situations learn about applications transportation and assignment problems
- Vector integration and applied to problem in Fluid mechanics.

II. Teaching-Learning Process (General Instructions):

1. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Grading assignments and quizzes and documenting student's progress.
4. Encourage the students for group learning to improve their creative and analytical skills.

III. COURSE CONTENT

III (A) Theory Part

Module-1:Numerical Solution of Partial Differential Equations	Hrs: 8
Classification of second –order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five –point formula. Solution of Heat equation by Schmidt explicit formula and Crank-Nicholson method, Solution of the Wave equation. Problems. **Text Book 1:Chapter 33-[Section 33.3 , 33.4 ,33.7 , 33.8 ,33.10 to 33.13]**	
Self Learning: Solution of Poisson equations using standard five point formula.	
RBT Levels: L1, L2 and L3	
Module-2:Linear Programming Problems [LPP]	Hrs: 8

General Linear programming problem, Canonical and standard forms of LPP. Basic feasible Solution, Optimal Solution, Simplex Method-problems. Artificial variables, Big –M method, Two-Phase method problems. **Textbook 1:Chapter: 34-[sections:34.5 , 34.6 , 34.7 , 34.8 34.9]**	
Self Learning: Formulation of an L.P.P and Optimal solution By Graphical method.	
RBT Levels:L1, L2 and L3	
Module-3: Transformation and Assignment Problems	Hrs: 8
Formulation of transportation problems, Methods of finding intial basic feasible solutions by North-west corner method, Least codt method, Vogel approximation method. Optimal solution – Problems. Formation of assignment problems, Hunagarian Method –problem. **Textbook 1:Chapter: 34-[sections:34.14 , 34.15 , 34.17]**	
Self Learning: Degeneracy in Transportation problem.	
RBT Levels: L1, L2 and L3	
Module-4: Vector integration& Applications.	Hrs:8
Line integrals-definition and problems, surface and volume integrals definition, Green's theorem in a plane, Stokes theorem (without proof) and problems. Application to problems in Fluid Mechanics, Continuity equations, Streamlines, Equations of motion. **Textbook 1: Chapter: 8-[sections:8.10 to 8.17] of Text Book 1 Chapter 35-[35.2 to 35.5]**	
Self Learning: Gauss-divergence	
RBT Levels: L2 and L3	
Module-5:Statistical methods	Hrs:8
Principles of least squares, Curve fitting by the method of least squares in the form $y = a$ + bx , $y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, rank correlation.	
Textbook 1:Chapter: 24[sections:24.5 , 24.6] of Text Book 1 Chapter 25[Section:25.12 to 25.14 , 25.16]	
Self Learning: Angle between two regression of lines and problems.	
RBT Levels: L1, L2 and L3	

III(B)
PRACTICAL PART

Sl.No	Experiments
1	Write a program to find Laplace's equation using standard five –point formula.
2	Write a program to find Heat equation by Schmidt explicit formula and Crank-Nicholson method
3	Write a MATLAB script to perform the simple method using the Big M method Test your script using the following examples Input the information manually Use inf (infinity in MATLAB) for the value of M Show the progress at each iteration Show the final solution **Example 1** :Solve the following problem using the Big M method. max:z = 3x1 + 2x2 + 6X3 Subject to 4x1 + x2 + x3 = 100 X1 + x2 > 40 X2 + x3 < 30 **Example 2**: Solve the following problem using the Big M method. max:z = 4x1 + 5x2 – 3x3 Subject to X1 + 2x2 + x3 = 10 X1 - X2+2 6 X1 + 3x2 + x3 = 14
4	Write a MATLAB script to solves the following linear programming problem using the two-phase simplex algorithm: Max Z = 3x1 + 5x2 subject to x1 ≤ 4 3x1 + 2x2 ≥ 18 2x2 ≤ 12 with x1, x2, ≥ 0

5 **Determine basic feasible solution the following transportation problem using North West corner rule**

Origin			Sink				Supply
		A	B	C	D	E	
	P	2	11	10	3	7	4
	Q	1	4	7	2	1	8
	R	3	9	4	8	12	9
Demand		3	3	4	5	6	

6	Write a programme to Find optimum solution for assignment problem by Hunagarian method by Matlab script
7	Write a program to find Green's theorem
8	Write a program to find Stokes theorem.
9	Write a program to find Curve fitting by the method of least squares in the form $y = a + bx, y = a + bx + cx^2 \text{ and } y = ax^b$
10	Write a program to find Correlation, Coefficient of correlation, Lines of regression, rank correlation

IV.COURSE OUTCOMES

CO1	To solve mathematical models represented by initial or boundary value problems involving partial differential equations
CO2	Analyze and Solve programming Module of real life situations learn about applications transportation and assignment problems
CO3	Learn Techniques to solve Transportation and assignment problems.
CO4	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors and also exhibit the inter dependence of line, surface and volume integrals.
CO5	Make use of Correlation and regression analysis to fit a suitable Mathematical Model for statistical data.

V.CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1		1							1				
CO2	3	2	1		1							1				
CO3	3	2	1		1							1				
CO4	3	2	1		1							1				
CO5	3	2			1							1				

VI .Assessment Details (CIE & SEE)

General Rules:

Continuous Internal Evaluation (CIE)& Rubrics:
Refer to Annexure Section-2

Semester End Examination (SEE)& Rubrics:
Refer to Annexure Section-2

VII. Learning Resources

VII(a): Textbooks:				
Sl. No.	**Title of the Book**	**Name of the author**	**Name of the publisher**	**Edition and Year**
1	"HigherEngineeringMathematics",	B.S.Grewal	Khannapublishers	44th Ed 2018
2	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Ed., 2016
3	Operation research	S D Sharma	Kedarnath Publishers	Ed., 2012
VII(b): Reference Books:				
1	Higher Engineering Mathematics	B.V.Ramana	Tata McGraw-Hill	11th Ed., 2017
2.	Linear Programming and Network flows	Mokthar S Bazara , John J. Javis&Hanife D Sharali	John Wiley & Sons	4th Edition 2010
3	Linear Programming	G Hadley	Narasa Publishing House	2002
4	"A textbook of Engineering Mathematics"	N.P Bali and Manish Goyal	Laxmi Publications,	Latest edition
VII(c): Web links and Video Lectures (e-Resources):				
1. https://en.wikipedia.org/wiki/Numerical_methods_for_partial_differential_equations 2. https://www.youtube.com/watch?v=lA-LVn5Rczo 3. https://math.libretexts.org/ 4. VTU EDUSAT programme-20				
VII(d): Activity Based Learning				
Assignments, Quiz, Presentation.				

SCHEME: 2023 DATE: 22-05-2024

Semester:	III	**Course Type:**	PCC		
Course Title: THERMODYNAMICS					
Course Code:	23MET302		**Credits:**		3
Teaching Hours/Week (L:T:P:O)			2:2:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3 Hours

I. Course Objectives:

This course will enable students to:

- State the governing laws of Thermodynamics and entropy.
- Explain the concepts and principles of pure substances.
- Describe gas power cycles used in prime movers and vapour power cycles used in power plants.
- Describe working principle of refrigeration and air conditioning system.

II. Teaching-Learning Process :

- Chalk and talk
- Power point presentations and Video demonstrations.
- Arrange visits to show the working models & processes.
- Adopt collaborative (Group Learning) Learning in the class.
- Adopt Activity Based Learning (ABL), which foster students' Analytical skills and develops thinking skills.

III. COURSE CONTENT

III (a). Theory PART

Module-1: Fundamental Concepts, work and Heat	8 Hrs

Fundamental Concepts: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Characteristics of system boundary, surrounding and control surface, examples. intensive, extensive thermodynamic properties, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium, Zeroth law of thermodynamics.

Work and Heat: definition of work and its limitations. Sign convention. Displacement work, expressions for displacement work in various processes through p-v diagrams Problems. Definition of heat and mode of heat transfer.

Fundamental Concepts –Text book:1, Chapter:1, sections: 1.1 to1.15
Fundamental Concepts – Text book:2, Chapter:1, sections: 1.1 to1.12
Work and Heat – Text book:1, Chapter:3, sections: 3.1 to1.10

Pre-requisites (Self Learning) : Basic knowledge of Energy

RBT Levels: L1, L2,L3

Module-2: Second Law of Thermodynamics and Entropy	8 Hrs

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, steady flow energy equation(SFEE), important applications.

Second Law of Thermodynamics: Limitations of first law of thermodynamics, heat engine and heat pump: Schematic representation, efficiency and COP. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements, Carnot cycle, Carnot principles. Problems

First Law of Thermodynamics –Text book:1, Chapter:4 &5, sections: 4.1 to1.9 & 5.1 to 5.8
Second Law of Thermodynamics – Text book:1, Chapter:6, sections: 6.1 to 6.18
Second Law of Thermodynamics – Text book:2, Chapter:6, sections: 6.1 to 6.11

Pre-requisites (Self Learning) : Basic knowledge of Heat interaction

RBT Levels: L1, L2,L3

Module-3: Entropy and Pure Substances	8 Hrs

Entropy: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate.
Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, Throttling calorimeter, separating and throttling calorimeter. Problems.

Entropy - Text book:1, Chapter:7, sections: 7.1 to7.16
Entropy - Text book:2, Chapter:7, sections: 7.1 to7.13
Pure Substances - Text book:1, Chapter:9, sections: 9.1 to 9.9
Pure Substances – Text book:2, Chapter:3, sections: 3.1 to 3.8

Pre-requisites (Self Learning): basics of IC Engine studied in first year mechanical engineering course.

RBT Levels: L1, L2,L3

Module-4: Vapour and Gas power cycles.	8 Hrs

Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-s diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Regenerative and Reheat Rankine cycle. Problems.

Gas Power Cycles: Air standard cycles; Carnot, Otto, Diesel, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles. Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Inter-cooling and reheating in gas turbine cycles. Problems.

Vapour Power Cycles - Text book:1, Chapter:12, sections: 12.1 to 12.16
Vapour Power Cycles - Text book:2, Chapter:10, sections: 10.1 to 10.9
Gas Power Cycles - Text book:1, Chapter:13, sections: 13.1 to 13.14
Gas Power Cycles - Text book:2, Chapter:9, sections: 9.1 to 9.12

Pre-requisites (Self Learning): basics about cyclic and noncyclic process**.**

RBT Levels: L1, L2,L3	
Module-5: Refrigeration Cycles	8 Hrs

Refrigeration Cycles: Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, Vapour absorption refrigeration system. Steam jet refrigeration. Problems

Psychrometrics and Air-conditioning Systems: Properties of Atmospheric air, and Psychometric properties of Air, Psychometric Chart, Analysing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams. Problems.

Refrigeration Cycles - Text book:1, Chapter:14, sections: 14.1 to 14.8
Refrigeration Cycles - Text book:2, Chapter:11, sections: 11.1 to 11.9
Psychrometrics - Text book:1, Chapter:15, sections: 15.1 to 15.3
Air-conditioning - Text book:2, Chapter:14, sections: 14.1 to 14.7

Pre-requisites: Basic knowledge of Refrigeration and Air-conditioning studied in first year Mechanical engineering subject.

RBT Levels: L1, L2,L3

IV. COURSE OUTCOMES

CO1	Analyse thermodynamics laws.
CO2	Apply thermodynamic cycles in practical applications.
CO3	Interpret the behaviour of pure substances and its application.
CO4	Analyse performance of refrigeration and air-conditioning systems.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Basic and Applied Thermodynamics	P.K.Nag	2018	Tata McGraw Hill 6th Ed.

2	Thermodynamics– An Engineering Approach	Y. A. Cengel	2012	Tata McGraw Hill 4th Ed.
3	An Introduction to Thermo Dynamics	Y.V.C.Rao	2003	Wiley Eastern Ltd
VII(b): Reference Books:				
1	Thermodynamics for engineers	Kenneth A. Kroos and Merle C Potter	2016	Cengage Learning,
2	A textbook of Engineering Thermodynamics	R K Rajput	Fifth edition, 2019.	Laxmi Publications
3	Applications of Thermodynamics.	Dr V Kadambi and Dr T R Seetharam,	2018	Wiley Publications,

Web links and video lectures (e-resources)

Fundamental Concepts : https://www.youtube.com/watch?v=9GMBpZZtjXM
Fundamental Concepts: https://archive.nptel.ac.in/courses/112/105/112105123/
Work and Heat: https://www.youtube.com/watch?v=5aasjWo9wuc
First Law of Thermodynamics: https://archive.nptel.ac.in/courses/112/105/112105123/
Second Law of Thermodynamics: https://youtu.be/lvy8h-yWhRQ
Entropy: https://www.youtube.com/watch?v=umV67dqWVKw
Pure Substances: https://archive.nptel.ac.in/courses/112/105/112105123/
Vapour Power Cycles: https://youtu.be/4-BI22Wx4Pc
Gas Power Cycles: https://youtu.be/7A2-n443sZg
Refrigeration Cycles: https://youtu.be/zl-D7nlr_NY
Pscychrometrics: https://youtu.be/es-2LA2bsu4

VIII: Activity Based Learning / Practical Based Learning/Experiential learning

1. Visit to thermal power plant.
2. Demonstration of refrigeration system.
3. Demonstration of working of Internal Combustion engine.
4. Demonstration of air conditioning system.

Semester:	III	**Course Type:**	IPCC		
Course Title:	**MANUFACTURING TECHNOLOGY**				
Course Code:	23MEI303			**Credits:**	04
Teaching Hours/Week (L:T:P:O)			3:0:2:0	**Total Hours: (Theory + Lab)**	40hrs + Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To provide knowledge of various casting process in manufacturing.
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys, also to provide detailed information about the moulding processes.
- To acquaint with the basic knowledge on fundamentals of metal forming processes and also to study various metal forming and finishing processes.
- To impart knowledge of various joining process used in manufacturing.
- To impart knowledge about behaviour of materials during welding, and the effect of process
- parameters in welding

II. Teaching-Learning Process (General Instructions):

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

1.Encourage collaborative (Group Learning) Learning in the class

2. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking

3. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.

4. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

III. COURSE CONTENT

III(a). Theory PART

Module-1: Introduction to basic materials used in foundry — 8 Hrs

Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Molding machines- Jolt type, squeeze type and Sand slinger.

Study of important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould.

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

Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind) Functions and types.

Textbook1: Chapter 2 : sections:2.1,2.2,2.4

Pre-requisites (Self Learning)

Identify materials used for pattern, preparation of sand mould and moulding process, core making and insertions

RBT Levels:L1,L2, L3

Module-2: Melting furnaces & Casting using metal moulds — 8 Hrs

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace. **Casting using metal moulds**: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Casting defects, their causes and remedies. **Textbook 1:Chapter 2:Sections 2.4, 2.7**	
Pre-requisites (Self Learning) Working of different types of Melting furnaces, castings**.**	
RBT Levels: L1,L2	
Module-3: Metal forming, Metal working and Sheet metal Processes	8 Hrs
Introduction of metal forming process*:* Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Yield criteria, Application to tensile testing, strain rate and temperature in metal working; Hot deformation, Cold working and annealing. ***Metal Working Processes****:* Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method, ***Other sheet metal processes****:* Sheet metal forming processes (Die and punch assembly, Blanking, piercing, bending etc., Compound and Progressive die), High Energy rate forming processes. **Textbook 1:Chapter 3, Section : 3.1,3.2,3.3,3.4,3.5**	
Pre-requisites (Self Learning) Mechanical behaviour of metals in elastic and plastic deformation, Sheet metal forming processes.	
RBT Levels: L1,L2,L3	
Module-4: Joining processes	8 Hrs
Welding: Weldability, Different types of weld joints, TIG Welding & MIG Welding, Laser Beam Welding, and Friction stir welding, Explosive welding, Resistance welding, Thermit welding. **Metallurgical aspect of Welding:** Metallurgical effects of welding, weld metal solidification, formation of different weld zones, Weld cracking, Corrosion of weld, defects in welding & remedies. **Textbook 2: Chapter 30,31 Section: 30.9,30.10, 31.1,31.2,31.3,31.4,31.5,31.6, 31.7,31.8**	
Pre-requisites (Self Learning); Metallurgical aspect of Welding and different types of welding	
RBT Levels: L1, L2, L3	
Module-5: Finishing processes	8 Hrs
Lapping And Honing Operations – Principles, arrangement of set up and application. **Super Finishing Process**: Polishing, buffing operation and application. **Broaching Machine** - Principle of broaching. Details of a broach. Types of broaching machines-constructional details, applications, advantages and limitations. **Textbook 2: Chapter 24,26 Section :24.4,26.7**	
Pre-requisites (Self Learning) Lapping, honing, super finishing, Broaching operations	
RBT Levels: L1,L2	

III(b). PRACTICAL PART

Sl. No.	**Experiments / Programs / Problems** (insert rows as many required)
1	Preparation of sand specimens and conduction of the following tests: Compression, Shear and Tensile tests on Universal Sand Testing Machine.
2	To determine permeability number of green sand, core sand and raw sand.

3	To determine AFS fineness no. and distribution coefficient of given sand sample.
4	Studying the effect of the clay and moisture content on sand mould properties
5	Arc welding tools and welding equipment Preparation of welded joints using Arc Welding equipment L-Joint, T-Joint, Butt joint, V-Joint, Lap joints on M.S. flats
6	Forging Operations: Use of forging tools and other forging equipment. Preparing minimum two forged models involving upsetting, drawing and bending operations.
Demo experiments for CIE	
7	Preparation of green sand molds kept ready for pouring in the following cases: 1. Incorporating core in the mold.(Core boxes). 2. Using two molding boxes (hand cut molds).
8	To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing
9	Mould preparation of varieties of patterns, including demonstration
10	Demonstration of material flow and solidification simulation using Auto-Cast software
Instructions for conduction of practical part:	

IV. COURSE OUTCOMES

CO1	Develop mould cavity using patterns made of wood, metal and plastics considering pattern allowances.
CO2	Compare the Gas fired pit, Resistance, Coreless, Electrical and Cupola Metal Furnaces. Compare the Gravity, Pressure die, Centrifugal, Squeeze, slush and Continuous Metal mold castings.
CO3	Apprehend the Solidification process and Casting of Non-Ferrous Metals.
CO4	Apply the knowledge of Metal Arc, TIG, MIG, Submerged and Atomic Hydrogen Welding processes etc. in manufacturing industries
CO5	Comprehend the functioning of metal finishing operations.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1										2	1		
CO2	3													2		
CO3	3	1	2										2			
CO4	2												2			
CO5	2												1			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 2

Continuous Internal Evaluation (CIE): Refer Annexure section – 2

Semester End Examination (SEE): Refer Annexure section – 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	Manufacturing Science	Ghosh, A. and Mallik, A. K.	2017	East-West Press.

2.	Manufacturing Engineering & Technology	Serope Kalpakjian & Steven R. Schmid	2020	Pearson
3.	'Welding and Welding Technology'	Little R. L.	2017	Tata McGraw Hill Publishing Company Limited
4.	'Metallurgical Modelling of Welding'	Grong O.	(1997) 2nd Edition	The Institute of Materials
5.	'Welding Metallurgy'	Kou S.	(2003) 2nd Edition	John Wiley Publications

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.

- MetaI casting- https ://nptel. ac. in/courses/ 112107083
- Introduction to casting- https://nptel. ac. In/courses/112107083
- (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112105127/)
- http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
- http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm
- MOOCs: http://nptel.ac.in/courses/112105126/
- https://www.youtube.com/watch?v=6doeORtYeU4
- https://www.youtube.com/watch?v=lTngKubuYjY
- https://www.youtube.com/watch?v=mmKy5PbndQI&list=PLyqSpQzTE6M-KwjFQByBvRx464XpCgOEC
- https://www.youtube.com/watch?v=KwRwjJKE27M
- lntroduction to Metal Forming - https://nptel.ac.in,/courses/112107145/4
- Plastic properties and processing- https://nptel.ac.in/courses/11210786)/13
- Types of Furnaces- https ://npteLac.in/courses/112107239/16

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Metal Casting: Design pattern/core for a given component drawing and develop a sand mould with optimum gating and riser system for ferrous and non-ferrous materials. Melting and casting, inspection for macroscopic casting defects.

• Welding: TIG and MIG welding processes – design weld joints – welding practice –weld quality inspection.

• Metal Forming: Press working operation – hydraulic and mechanical press -load calculation: blanking, bending and drawing operations – sheet metal layout design.

Semester:	3	**Course Type:**	**IPCC**		
Course Title:	**MATERIAL SCIENCE AND METALLURGY**				
Course Code:	23MEI304			**Credits:**	04
Teaching Hours/Week (L:T:P:O)			2:2:2:0	**Total Hours:**	40 hours +ab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To provide knowledge of geometrical crystallography, crystal structure and imperfections in Solids.
- To know the phase transformations and concept of diffusion in solids.
- To gain the knowledge the heat treatment, cooling method for controlling the microstructure and plastic deformation to modify their properties.
- To impart knowledge of the powder metallurgy process, types and surface modifications
- To provide trends in material technology with focus on composites materials.
- To inculcate knowledge on mechanical behaviour of engineering materials
- To equip students with the skills to determine the mechanical properties of engineering materials

II. Teaching-Learning Process (General Instructions):

•Adopt different types of teaching methods to develop the outcomes through Power Point presentations and Video demonstrations or Simulations.
•Chalk and Talk method for Problem Solving.
•Adopt flipped classroom teaching method.
•Adopt collaborative (Group Learning) learning in the class.

III. COURSE CONTENT

III(a). Theory PART

Module-1 Crystal Structure & Mechanical Behaviour — 8 Hrs

Introduction to Crystal Structure: Coordination number, atomic packing factor, Simple Cubic, BCC,FCC and HCP Structures, Crystal imperfections–point, line, surface and volume imperfections. Atomic Diffusion: Phenomen on Fick's laws of diffusion (First and Second Law); Factors affecting diffusion.

Mechanical Behaviour: Stress-strain diagrams showing ductile and brittle behaviour of materials, Engineering stress and true strains, Linear and non- linear elastic behaviour and properties, Mechanical properties in plastic range: Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness. Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.

Textbook2 : Chapter 3,6,8,11 : sections 3.1,3.2,3.3,6.1,6.2,6.3,6.4,8.1.8.2,11.1,11.2,11.3

Pre-requisites (Self Learning) Concepts of unit cell, space lattice, Unit cells for cubic crystals (Simple cubic, BCC & FCC) and HCP structure and calculations of radius.

RBT Levels: L1, L2, L3

Module-2: Physical Metallurgy, Diffusion & Phase Diagrams — 8 Hrs

Heading:
Physical Metallurgy
Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules, Gibbs Phase Rule

Phase Diagrams:, Solubility limit, phase equilibrium and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions: Eutectic reaction, Eutectoid reaction and Peritectic reaction, Lever Rule, Iron-Carbon Diagram. Effect of common alloying elements in steel. Numerical on Lever rule**.(No Problems on Phase Daigrams)**

Textbook 2:Chapter: 7, 9 sections; 7.1, 7.2, 7.3,7.4,7.5,7.6, 9.1,9.2

Pre-requisites (Self Learning)
Phase Diagrams for different reaction and observing micro structure.

RBT Levels: L1,L2.L3

Module-3: Nucleation & growth and Heat treatment	8 Hrs

Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation.

Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, Recovery-Recrystallization-Grain Growth. Strengthening mechanisms: Strain hardening, Precipitation hardening (Solid-Solution Strengthening), Grain refinement.

Textbook 2: Chapter: 9 sections 9.1 to 9.8

Pre-requisites (Self Learning)
Nucleation and growth in different materials and Heat treatment process on other materials.

RBT Levels:L1,L2,L3

Module-4: Surface coating & Powder metallurgy	8 Hrs

Surface coating technologies: Introduction, coating materials, coating technologies, types of coating: Electro-plating, Chemical Vapor Deposition(CVD)- Hot-wall thermal CVD, & Plasma assisted CVD , Physical Vapor Deposition(PVD)- evaporation and sputtering,High Velocity Oxy-Fuel Coating, advantages and disadvantages of surface coating.

Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical methods: Chopping or Cutting, Abrasion methods, Machining methods, Ball Milling and Chemical method: Chemical reduction method. Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy.

Reference book 5: Chapters 14 Page No; 552-582, Chapters 17 Page No; 656-677

Pre-requisites (Self Learning)
Application and process of Surface coating technologies and Different types of Powder metallurgy techniques.

RBT Levels:L1,L2

Module-5: Engineering Materials	8 Hrs

Engineering Materials and Their Properties: Classification, Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel. Non-Ferrous materials: Properties, Compositions and uses of Copper, Brass, Bronze.

Composite Materials: Definition, classification. Properties and applications of FRPs, MMCs and Ceramic composites. Production methods of FRPs (Pultrusion, filament winding, hand lay-up, vacuum bag processes and spray forming processes) and MMCs (stir casting, squeeze casting).

Textbook1 : Chapter:11,16 sections; 11.1,11.2,11.3,16.1to 16.13

Pre-requisites (Self Learning):
Identify Ferrous materials and Non ferrous materials : Properties, Compositions and their uses.

RBT Levels: L1, L2

III(b). PRACTICAL PART

Sl. No.	Experiments
1	Specimen preparation for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys.
2	To determine the hardness values of Aluminium by Rockwell hardness/Vickers Hardness.
3	To determine the hardness values of Mild Steel Rockwell hardness/Vickers Hardness.
4	To determine the hardness values of Copper by Brinell's Hardness testing machine.
5	To determine the hardness values of Brass by Brinell's Hardness testing machine.
6	To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Cast Iron, Mild Steel/Brass/ Aluminium and to observe the necking.
7	To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction.
8	To determine the Impact strength of the mild steel using Izod test.
9	To determine the Impact strength of the mild steel using Charpy test.
10	Study the chemical corrosion and its protection. **Demonstration only.**

IV. COURSE OUTCOMES

CO1	Recognize the atomic arrangement in crystalline materials and to determine the tensile, elastic properties of mild steel
CO2	Comprehend the importance of phase diagrams and the phase transformations.
CO3	Explain the various heat treatment methods for controlling the microstructure.
CO4	Correlate between material properties with component design and identify various kinds of defects
CO5	Categorize the material properties with developments of latest materials.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3												1	2		
CO2	2												2			
CO3		2											1			
CO4		2											2			
CO5		2	2										1			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 2

Continuous Internal Evaluation (CIE): Refer Annexure section - 2

Semester End Examination (SEE): Refer Annexure section - 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	Materials Science and Engineering: An Introduction	Callister Jr, W.D., Rethwisch, D.G.,	10th,2018	Wiley.
2.	Materials science and Engineering	V.Raghavan	5th Edition (2011),	PHI learning Private Ltd.
3.	Introduction to solids	Azaroff, L.V.	1st Edition (2001)	McGraw Hill Book Company
4.	Introduction to Physical Metallurgy	Avner, S.H.	2nd Edition (2017)	McGraw Hill Education
VII(b): Reference Books:				
1.	Engineering Materials 1: An Introduction to Properties, Application and Design	Jones, D.R.H., and Ashby,M.F.	4th Edition (2011)	Butterworth-Heinemann
2.	Engineering Materials 2: An Introduction to Microstructure and Processing,	Jones, D.R.H., and Ashby,M.F.	4th Edition (2012)	Butterworth-Heinemann
3.	Physical Metallurgy Principles	Abbaschian, R., Abbaschian, L., Reed-Hill, R. E.	4th Edition (2009)	Cengate Learning
4.	Powder Metallurgy-Science, Technology and Applications, PHI	P. C. Angelo and R. Subramanian	2023	PHI learning
5	Material science & Metallurgy for Engineers	Sushile V kodigre & V D kodigre	44th edition 2020	Everest Publishing House

VII(c): Web links and Video Lectures (e-Resources):

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

Link 1 ; https://archive.nptel.ac.in/courses/112/106/112106293
Link 2 ; https://youtu.be/HRZpwNpopEg
Link 3 : https://youtu.be/6ObSmW8fYL0
Link 4; https://youtu.be/cJm-jeb_c9U?list=PLyqSpQzTE6M8o2DwfMWBWMoMUaReeGyYh
Link 5 ; https://youtu.be/0kB0G6WKhKE?list=PLSGws_74K01-bdEEUElQ9-obrujIKGEhg
Link 6; https://youtu.be/ohO6vdpOg2k

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Course seminar Industrial tour/Visit to Advanced Research Centres

Semester:	3	**Course Type:**	PCCL		
Course Title:	**MECHANICAL MEASUREMENTS AND METROLOGY LAB**				
Course Code:	**23MEL305**			**Credits:**	1
Teaching Hours/Week (L:T:P:O)			0:0:2:0	**Total Hours:**	Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Practical			**Exam Hours:**	3

I. Course Objectives:

1.To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
2.To illustrate the use of various measuring tools measuring techniques.
3.To understand calibration techniques of various measuring devices.

II. Teaching-Learning Process (General Instructions):

Mention the planned/proposed sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

III. PRACTICAL PART

Sl. No.	Experiments
	MECHANICAL MEASUREMENTS
1	Calibration of Pressure Gauge
2	Calibration of Thermocouple
3	Calibration of LVDT
4	Calibration of Load cell
5	Determination of modulus of elasticity of a mild steel specimen using strain gauges
	METROLOGY
6	Measurements using Optical Projector / Toolmaker Microscope
7	Measurement of angle using Sine Center / Sine bar / bevel protractor
8	Measurement of alignment using Autocollimator / Roller set
9	Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
10	Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micrometer
11	Measurements of Screw thread Parameters using two wire or Three-wire methods.
12	Measurement using optical flat
13	Measurement using slip gauges
Demonstration Experiments	
14	Measurement of cutting tool forces using a)Lathe tool Dynamometer OR b) Drill tool Dynamometer.

Instructions for conduction of practical part:

III. COURSE OUTCOMES

CO1	Calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer.
CO2	Measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/Roller set.
CO3	Demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats / Mechanical Comparator.
CO4	Measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier /Gear tooth micrometre.
CO5	Measure cutting tool forces using Lathe/Drill tool dynamometer

IV. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/ PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											2			
CO2	3	2											2			
CO3	3	2											2			
CO4	3	2											2			
CO5	3	2											2			

V. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 4

Continuous Internal Evaluation (CIE): Refer Annexure section - 4

Semester End Examination (SEE): Refer Annexure section - 4

SCHEME: 2023 DATE: 22-05-2024

Semester:	III	**Course Type:**	ETC		
Course Title:	**OBJECT ORIENTED PROGRAMMING WITH JAVA**				
Course Code:	23MEE311			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			2:0:2:0	**Total Hours:**	25 hours + Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions

II. Teaching-Learning Process (General Instructions):

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures

III. COURSE CONTENT

III(a). Theory PART

Module-1:	5Hrs

An Overview of Java: Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).

Data Types, Variables, and Arrays: The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.

Operators: Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.

Control Statements: Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).

Textbook 1: Chapter: 2, 3, 4, 5

RBT Levels:L1,L2

Module-2:	5Hrs

Introducing Classes: Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection. **Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes. **Textbook 1: Chapter 6, 7**
RBT Levels: L1,L2
Module-3: 5Hrs
Inheritance: Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class. **Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods. **Textbook 1: Chapter 8, 9**
RBT Levels: L1,L2,L3
Module-4: 5 Hrs
Packages: Packages, Packages and Member Access, Importing Packages. **Exceptions:** Exception-Handling Fundamentals**,** Exception Types**,** Uncaught Exceptions**,** Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions. **Textbook 1: Chapter 9, 10**
RBT Levels: L1,L2
Module-5: 5Hrs
Multithreaded Programming: The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State. **Enumerations, Type Wrappers and Autoboxing:** Enumerations (Enumeration Fundamentals**,** The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values). **Textbook 1: Chapter 11, 12**
RBT Levels: L1,L2

III(b). PRACTICAL PART

Sl. No.	Programs
1	Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments.
2	Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations
3	A class called Employee, which models an employee with an ID, name and salary, is designed as shown inthe following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration

4	A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows: • Two instance variables x (int) and y (int). • A default (or "no-arg") constructor that construct a point at the default location of (0, 0). • A overloaded constructor that constructs a point with the given x and y coordinates. • A method setXY() to set both x and y. • A method getXY() which returns the x and y in a 2-element int array. • A toString() method that returns a string description of the instance in the format "(x, y)". • A method called distance(int x, int y) that returns the distance from this point to another point at thegiven (x, y) coordinates • An overloaded distance(MyPoint another) that returns the distance from this point to the givenMyPoint instance (called another) • Another overloaded distance() method that returns the distance from this point to the origin (0,0) Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5	Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate polymorphism concepts by developing suitable methods, defining member data and main program
6	Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7	Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8	Develop a JAVA program to create a package named mypack and import & implement it in a suitable class
9	Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds)
10	Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently
IV. COURSE OUTCOMES	
CO1	Demonstrate proficiency in writing simple programs involving branching and looping structures.
CO2	Design a class involving data members and methods for the given scenario.
CO3	Apply the concepts of inheritance and interfaces in solving real world problems.
CO4	Use the concept of packages and exception handling in solving complex problem
CO5	Apply concepts of multithreading, autoboxing and enumerations in program development

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3			3											
CO2	3	3			3											
CO3	3	3			3											
CO4	3	3			3											
CO5	3	3			3											

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	Java: The Complete Reference	Herbert Schildt.	November 2021	McGraw-Hill, ISBN: 9781260463422
Reference Books				
2.	Programming with Java	E Balagurusamy	Mar-2019	McGraw Hill Education, ISBN: 9789353162337.
3.	Thinking in Java	Bruce Eckel.	4TH Edition, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)	Prentice Hall,

VII(c): Web links and Video Lectures (e-Resources):

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/

Java Tutorial: https://www.javatpoint.com/java-tutorial

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition andinheritance

Assessment Method

Programming Assignment / Course Project

Semester:	III	**Course Type:**	ETC		
Course Title: PRINCIPLES OF ROBOTICS					
Course Code:	23MEE312		**Credits:**		3
Teaching Hours/Week (L:T:P:O)			2:0:2:0	**Total Hours:**	25 hrs Theory + Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3 Hours

I. Course Objectives:

This course will enable students:

1. To introduce various types of Robots and the functional elements of Robotics
2. To impart knowledge of robot actuator and drive systems
3. To educate on various sensors used in Robotic automation and end effectors
4. To apply knowledge of the basics of Robot Programming and robotic Applications

II. Teaching-Learning Process (General Instructions):

- Power point presentations and Video demonstrations.
- Adopt collaborative (Group Learning) Learning in the class.
- Adopt Activity Based Learning (ABL), which foster students' Analytical skills and develops thinking skills.

III. COURSE CONTENT

III(a). Theory PART

Module-1: Fundamentals of Robotics	5 Hrs

Historical development of Robotics, Definitions of Industrial robots, Type and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot, Work cell control,

Textbook:1 Chapter:1 sections:1.1 to 1.17
Textbook:2 Chapter:1 sections:1.1 to 1.4

Pre-requisites (Self Learning): Elements of Mechanical engineering

RBT Levels: L1, L2,L3

Module-2: Robot actuators and Drive Systems	5 Hrs

Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC-Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Power transmission systems for robot, Motion conversion.

Textbook:1 Chapter:7 sections:7.1 to 7.13

Pre-requisites (Self Learning): Basic Electrical engineering

RBT Levels: L1, L2,L3

Module-3: End Effectors	5 Hrs
End Effectors Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; advanced grippers- Adaptive grippers, Soft Robotics Grippers. **End Effectors - Textbook:2 Chapter:4 sections:5.1 to 5.6**	
Pre-requisites (Self Learning) : Elements of Mechanical engineering	
RBT Levels: L1, L2,L3	
Module-4: Robot Sensors	5 Hrs
Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Position sensors – Piezo Electric Sensor, LVDT, Resolvers, Encoders – Absolute and Incremental: - Optical, Magnetic, Capacitive, pneumatic Position Sensors, Range Sensors- Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors. **Textbook:1 Chapter:8 sections:8.1 to 8.20** **Textbook:2 Chapter:6 sections:6.1 to 6.6**	
Pre-requisites (Self Learning) : Basic Electrical and Electronics Technology	
RBT Levels: L1, L2,L3	
Module-5: Fundamentals of Robot Programming and Languages	5 Hrs
Methods of robot programing, leadthrough programing methods, motion interpretation, wait, signal and delay commands, branching, capabilities and limitations of leadthrough method. The textual robot languages, generation of robot programing languages, robot language structure, constants variables and other data objects, motion commands, computations and operations, program control and subroutines, communication and data processing, monitor mode commands. **Robot Programming - Textbook:2 Chapter:8 sections:8.1 to 8.7** **Robot Languages - Textbook:2 Chapter:9 sections:9.1 to 9.10**	
Pre-requisites (Self Learning): basics about programing language.	

III(b). PRACTICAL PART

Sl. No.	**Experiments / Programs / Problems** (insert rows as many required)
1	Identify and selection of Sensors of IR sensors, Proximity Sensor based on given application.
2	Identify and selection of Sensors of Ultrasonic and capacitive Sensor based on given application.
3	Identify and selection of Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on application
4	Demonstration of various robotic configurations using industrial robot
5	Design and selection of Gripper / End effector.

6	Electro Hydraulic actuation system design.
7	Electro Pneumatic actuation system design.
8	One Industrial visit for Industrial robotic application
9	Demonstration of simple robotic system using Matlab/ MscAdam / RoboAnalyser software
10	Choose the right robot for given manufacturing and non- manufacturing applications

RBT Levels: L1, L2,L3

IV. COURSE OUTCOMES

CO1	APPLY the basic concepts of robots and its configuration.
CO2	ANALYSE appropriate drives and sensors for Robotic applications
CO3	RECOGNISE applications of robot end effectors for robot applications.
CO4	EXECUTE fundamentals of robot programming and languages.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3				2								3			
CO2	3	2			2								3	2		
CO3	3	2			2								3	2		
CO4	3	2			2								3	2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Introduction to Robotics, Analysis, Control, Applications	Saeed B Niku	2015	2nd Edition, Wiley Publication
2	Industrial Robotics, Technology, Programming & Applications	Groover, M.P. Weiss, M. Nagel, R.N. & Odrey, N.G., Ashish Dutta	2012	Tata McGraw Hill Education Pvt. Ltd. New Delhi
3	Fundamentals of robotics, analysis and control	Robort J schilling	2015	PHI Learning
4	R K Mittal & I. J. Nagrath	Robotics and Control	2015	McGraw Hill Publication,

VII(b): Reference Books:

1	Automation, production systems and computer integrated manufacturing	Groover M.P	2001	Prentice Hall of India
2	Robotics Technology and Flexible Automation	S. R. Deb	2017	Tata McGraw Hill
3	Introduction to Robotics, Mechanics and Control	John Craig	2009	3rd Edition, Pearson Education
4	Automation, Production Systems & Computer Integrated Manufacturing	Mikell P. Groover,	2012	PHI Learning Pvt. Ltd. , New Delhi, ISBN:987-81-203-3418-2,

E study material: NPTEL Course on Robotics:
https://onlinecourses.nptel.ac.in/noc19_me74/preview
https://onlinecourses.nptel.ac.in/noc20_de11/preview

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Conduction of Quiz, assignments & case studies

Semester:	3rd	Course Type:	ETC		
Course Title:	**MICRO ELECTROMECHANICAL SYSTEMS (MEMS)**				
Course Code:	23MEE313			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	**Theory**			**Exam Hours:**	

I. Course Objectives:

1. Understand the fundamental principles and working mechanisms of Micro Electromechanical Systems (MEMS) technology.
2. Gain knowledge of various MEMS fabrication techniques and processes used in industry.
3. Develop skills in designing MEMS devices, considering factors such as mechanical, electrical, and thermal properties.
4. Learn about the different types of MEMS sensors and actuators, their operating principles, and applications.
5. Explore MEMS packaging and integration techniques to ensure reliability and functionality of MEMS devices.

II. Teaching-Learning Process (General Instructions):

Chalk and talks ppt videos
Interactive discussions, brainstorming sessions, and peer-to-peer learning activities will be encouraged during lectures.
Continuous Assessment and Feedback:
Assessment will be conducted through a combination of quizzes, assignments

III. COURSE CONTENT

III(a). Theory PART

Module-1: **Introduction to MEMS**	08 Hrs

Heading: Introduction to MEMS technology Historical perspective and evolution
MEMS applications Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets trends EMS fabrication processes

MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering" by Tai-Ran Hsu
Chapter 1: Introduction to MEMS (Page 1-15)
Chapter 2: Basic MEMS Fabrication Techniques (Page 17-47)

- Prerequisites: None
- Description: This module serves as an introduction to MEMS technology and does not have any specific prerequisites. It provides foundational knowledge about MEMS, including historical context, basic fabrication techniques, and applications.

RBT Levels:L1

Module-2: **MEMS Design and Modeling**	08 Hrs

Working Principles of Microsystems: Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics.
MEMS design considerations and constraints Mechanical modeling of MEMS structures
- Electrical modeling of MEMS devices Finite Element Analysis (FEA) for MEMS design

Textbook: "MEMS Mechanical Sensors" by Steve P. Beeby and Graham M. Brodie **- Chapter 2: MEMS Design Principles (Page 33-65)** **- Chapter 3: Mechanical Modeling of MEMS Structures (Page 67-104)**	
Prerequisites: Basic understanding of engineering mechanics and solid mechanics concepts. - Description: This module focuses on the design and modeling aspects of MEMS devices. Students should have a grasp of engineering mechanics principles to understand mechanical modeling techniques for MEMS structures	
RBT Levels:L1	
Module-3: **MEMS Sensors and Actuators**	08 Hrs
Principles of sensing and transduction mechanisms - Types of MEMS sensors (accelerometers, gyroscopes, pressure sensors, etc.) - MEMS actuators (electrostatic, piezoelectric, thermal, etc.) - Interface electronics for MEMS devices **Textbook: "MEMS for Automotive and Aerospace Applications" by Michael Kraft and Neil M. White** **- Chapter 3: MEMS Sensors and Transduction Principles (Page 43-76)** **- Chapter 4: MEMS Actuators (Page 77-106)**	
Prerequisites: Basic knowledge of electronics and transduction principles. - Description: This module covers the principles of sensing and actuation mechanisms in MEMS devices. Students should have a basic understanding of electronics concepts to comprehend the operation of MEMS sensors and actuators.	
RBT Levels:L1,L2	
Module-4: **MEMS Packaging and Integration**	08 Hrs
- Packaging challenges and solutions for MEMS devices - Wafer-level packaging techniques - Integration of MEMS with electronics and microfluidics - Reliability and testing of MEMS devices **Textbook: "MEMS Packaging" by Rory A. Raftery and John H. Lau** **- Chapter 2: MEMS Packaging Fundamentals (Page 27-58)** **- Chapter 3: Wafer-Level Packaging Techniques (Page 59-92)**	
Prerequisites: Familiarity with semiconductor packaging concepts and materials science fundamentals. - Description: This module addresses the packaging and integration challenges in MEMS technology. Students should be familiar with semiconductor packaging principles and have a basic understanding of materials science to grasp the concepts covered in this module	
RBT Levels:L2	
Module-5: **Emerging Trends in MEMS**	08 Hrs
Advanced MEMS materials and fabrication techniques - MEMS for biomedical and healthcare applications - MEMS in Internet of Things (IoT) and wearable devices - Future directions and challenges in MEMS technology **Textbook: "Emerging Trends and Applications of MEMS" edited by Sundararajan V. Madihally and Donald Leo**	

- Chapter 1: Advanced MEMS Materials and Fabrication (Page 1-28)
- Chapter 5: MEMS for Biomedical Applications (Page 89-116)

Prerequisites: Completion of Modules 1-4 or equivalent background knowledge.
- Description: This module explores advanced topics and emerging trends in MEMS technology. Students should have a solid understanding of the fundamental principles covered in previous modules to engage with the advanced concepts presented in this module.

RBT Levels:L3

IV. COURSE OUTCOMES

CO1	Analyze the material properties and selection criteria used in MEMS manufacturing
CO2	Evaluate the integration of MEMS components with electronic circuits for signal processing and control.
CO3	Explore the application of MEMS technology in various fields such as biomedical devices, automotive systems, telecommunications, and consumer electronics.
CO4	Apply principles of mechanics, electronics, and thermodynamics to the design and analysis of MEMS devices
CO5	Solve complex engineering problems using MEMS technology by developing innovative solutions and prototypes.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2											1			
CO2	2	2											1			
CO3	2	2											1			
CO4	2	2											1			
CO5	2	2											1			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	MEMS and Microsystems: Design, Manufacture, and Nanoscale Engineering	Tai-Ran Hsu	2nd Edition, 2019	Wiley
2	"MEMS Mechanical Sensors"	Steve P. Beeby and Graham M. Brodie	1st Edition, 2004	artech House Publishers
3	MEMS for Automotive and Aerospace Applications"	Michael Kraft and Neil M. White	1st Edition, 2008	Woodhead Publishing

4	MEMS Packaging"	Rory A. Raftery and John H. Lau	1st Edition, 2011	McGraw-Hill Education
5	Emerging Trends and Applications of MEMS"	Sundararajan V. Madihally and Donald Leo	1st Edition, 2018	CRC Press
VII(b): Reference Books:				
1	Introduction to Micro electro mechanical Systems Engineering"	Nadim Maluf	First Edition, 2004	Artech House Publishers
2	MEMS: Design and Fabrication"	Mohamed Gad-el-Hak	Second Edition, 2018	McGraw-Hill Education
3	"Microsystem Design"	Stephen D. Senturia	First Edition, 2001	Springer
4	"MEMS Materials and Processes Handbook"	Reza Ghodssi and Pinyen Lin	First Edition, 2011	Springer
5	"MEMS Reliability"	Mohamed Gad-el-Hak	First Edition, 2003	Springer
VII(c): Web links and Video Lectures (e-Resources): https://www.youtube.com/watch?v=TB7NTcN9tAg&list=PL2UV2EJdMQmi8agtNEbP9dafjNB1cZ4sB				
http://nptel.iitm.ac.in, https://www.youtube.com/watch?v=LRXY8O8ZqkM https://www.youtube.com/watch?v=DOjT5r4cpNo				

Semester:	3	**Course Type:**	ETC		
Course Title:	**INDUSTRIAL DESIGN AND ERGONOMICS**				
Course Code:	**23MEE314**		**Credits:**		3
Teaching Hours/Week (L:T:P:O)		3:0:0:0	**Total Hours:**		40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives:

- To increase awareness of the need for and role of ergonomics in occupational health.
- To obtain knowledge in the application of ergonomic principles to design of industrial workplaces.
- To prevention of occupational injuries.
- To understand the breadth and scope of occupational ergonomics.

II. Teaching-Learning Process (General Instructions):

- Chalk and talk method
- PowerPoint Presentation
- Videos

III. COURSE CONTENT

III (a). Theory PART

Module-1: Introduction	08 Hrs

The focus of ergonomics, Ergonomics, and its areas of application in the work system, A brief history of ergonomics, attempts to 'humanise 'work, Modern ergonomics, Effectiveness and cost effectiveness, Future directions for ergonomics.

Textbook: 2 Chapter: 1

Pre-requisites (Self Learning): NA

RBT Levels: L1, L2

Module-2: Displays, controls and virtual environments	08 Hrs

Principles for the design of visual displays, Auditory displays, Design of controls, Combining displays and controls, Virtual ('synthetic') environments, Effectiveness, and cost-effectiveness.

Textbook: 2 Chapter: 13

Pre-requisites (Self Learning): NA

RBT Levels: L1, L2

Module-3: Vision, light, and lighting	08 Hrs

Vision and the eye, Measurement of light, Lighting design considerations, Visual fatigue, eyestrain and near work, Psychological aspects of indoor lighting, Effectiveness and cost - effectiveness.

Textbook: 2 Chapter: 10

Pre-requisites (Self Learning): NA

RBT Levels: L1, L2

Module-4: Static work: Design for standing and seated workers	08 Hrs

Fundamental aspects of standing and sitting, An ergonomic approach to workstation design, Design for standing workers, Design for seated workers, Work surface design, Visual display units, Guidelines for the design of static work, Effectiveness and cost-effectiveness.
Textbook: 2 Chapter: 4

Pre-requisites (Self Learning): NA

RBT Levels: L1, L2

Module-5: Industrial Design in Practice	08 Hrs

General design -specifying design equipment's- rating the importance of industrial design - industrial design in the design process
Textbook: 1 Chapter: 2

Pre-requisites (Self Learning): NA

RBT Levels: L1, L2

IV. COURSE OUTCOMES

CO1	Outline the concepts of Industrial design and man-machine relationship.
CO2	Choose the optimistic display and control devices for various applications.
CO3	Apply the anthropomorphic data in ergonomic design
CO4	Identify the visual effects of lines, form and color on engineering equipment
CO5	Select appropriate aesthetic aspects for design of industrial machinery and devices

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											1			
CO2	3	2											1			
CO3	3	2											1			
CO4	3	2											1			
CO5	3	2											1			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section -1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Industrial Design for Engineers	Mayall W.H	1988	London Hiffee books Ltd
2	Introduction to Ergonomics	R. C. Bridger	1995	McGraw Hill Publications.
VII(b): Reference Books:				
1	Applied Ergonomics Hand Book	Brain Shakel (Edited)		Butterworth scientific. London
2	Human Factor Engineering	Sanders & McCormick -	6^{th} edition, 2002.	McGraw Hill Publications –
VII(c): Web links and Video Lectures (e-Resources):				
VTU e-Shikshana Program https://onlinecourses.nptel.ac.in/noc19_de02/unit?unit=9&lesson=20 https://onlinecourses.nptel.ac.in/noc19_de02/unit?unit=25&lesson=27 https://onlinecourses.nptel.ac.in/noc19_de02/unit?unit=25&lesson=35 https://onlinecourses.nptel.ac.in/noc19_de02/unit?unit=47&lesson=49				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
• Quizzes • Assignments • Seminars				

Semester:	III	**Course Type:**	AEC		
Course Title:	**CATIA**				
Course Code:	**23MEAE31**			**Credits:**	01
Teaching Hours/Week (L:T:P:O)			1 : 0 : 0 : 3	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	02

IV. Course Objectives:

1) **Gain proficiency in understanding and navigating the CATIA interface**
2) **Usage of various tools, techniques and features in CATIA for designing and modelling.**
3) **Develop the ability to create complex 3D Models.**
4) **Understanding usage of CATIA for Solid and Surface modelling**
5) **Acquire skills in creating detailed 2D drawings from 3D models.**

V. Teaching-Learning Process (General Instructions):

Mention the planned/proposed sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
Chalk & Talk Method
Power Point Presentation
Keynotes
Hands-on Practice
Problem-solving Exercises
Presentations
Assignment

VI. COURSE CONTENT

III(a). Theory PART

Module-1: Introduction to CATIA	4 Hrs

Introduction to CATIA, CATIA Workbenches, System Requirements, Getting Started with CATIA (User Interface), Understanding the Functions of the Mouse Buttons, Toolbars, Colour Scheme, Specification tree, Compass, Zoom, Viewports, Hiding and Showing Geometric Elements, Swapping Visible space, Units and Grid settings

RBT Levels: L1,L2, L3

Module-2: Drawing and Modifying Sketches in Sketcher WorkBench	8 Hrs

Drawing Sketches Using Sketcher Tools

Drawing Lines, Rectangles, Oriented Rectangles, Parallelograms Circles, Arcs, Profiles, Creating Points Ellipses, Splines, Connecting Two Elements by a Spline or an Arc, Elongated Holes, Cylindrical Elongated Holes, Keyhole Profiles, Hexagons, Centred Rectangles, centred Parallelograms, Conics

Modifying Sketches

Trimming Unwanted Sketched Elements, Extending Sketched Elements, Trimming by Using the Quick Trim Tool, Filleting Sketched Elements, Chamfering Sketched Elements, Mirroring Sketched Elements

Mirroring Elements without Duplication, Translating Sketched Elements, Rotating Sketched Elements

Scaling Sketched Elements, Offsetting Sketched Elements, Modifying Sketched Elements Deleting Sketched Element,	
RBT Levels: L2,L3	
Module-3: Constraining Sketches and Creating Sketch-Based Features	10 Hrs
Constraining Sketches **Concept of Constrained Sketches** Iso-Constraint, Under-Constraint, Over-Constrained, Inconsistent. Applying Geometrical Constraints, Dimensional Constraints, Contact Constraints, Fix Together Constraints, Auto Constraints. **Analyzing and Deleting Over-Defined Constraints** using the Sketch Analysis Tool **Exiting the Sketcher Workbench** **Creating Base Features by pad** Creating a Thin Extruded Feature Extruding Sketch Using the Profile Definition Dialog Box along a Directional Reference Creating Drafted Filleted Pad Features, Multi-Pad Features, Pocket Features, Drafted Filleted Pocket Features, Multi-Pocket Features, Groove Features, Extruding and Revolving Planar and Non-planar Faces. **Other Modelling Tools** -Hole Features, Fillets, Chamfers, Adding a Draft to the Faces of the Model	
RBT Levels: L2,L3,L6	
Module-4: Editing Features, Advanced Modelling Tools and Transformation Features	10 Hrs
Editing Features : Editing Using the Definition Option, Editing by Double-Clicking, Editing the Sketch of a Sketch-Based Feature, Redefining the Sketch Plane of Sketches, Deleting Unwanted Features, Managing Features and Sketches by using the Cut, Copy, And Paste Functionalities. **Advance Modelling Tools:** Creating Rib Features, Creating Slot Features, Creating Multi-Sections Solid Features. **Transformation Features:** Translating Bodies, Rotating Bodies, Creating Symmetry Features, Transforming the Axis System, Mirroring Features and Bodies, Creating Rectangular Patterns, Creating Circular Patterns, Creating User Patterns, Uniform Scaling of Model, Non-uniform Scaling of Model.	
RBT Levels: L2,L3,L6	
Module-5: Working with Surface Design Workbench, Editing and Modifying Surfaces	Hrs
Need of Surface Modeling Starting the Wireframe and Surface Design Workbench **Creating Wireframe Elements** **Creating Circles, Creating Splines, Creating a Helix, Creating Surfaces** Extruded Surfaces, Revolved Surfaces, Spherical Surfaces, Cylindrical Surfaces, Offset Surfaces, Sweep Surfaces, Fill Surfaces, Multi-Sections Surfaces, Blended Surfaces **Operations on Shape Geometry** Joining Surfaces, Splitting Surfaces, Trimming Surfaces	
Surface Operations	

Creating Projection Curves, creating Intersection Elements, Healing Geometries, Disassembling Elements, Untrimming a Surface or a Curve, Creating Boundary Curves, Extracting Geometry, Transformation Features, Extrapolating Surfaces and Curves, Splitting a Solid Body with a Surface

Solidifying Surface Models

Adding Thickness to a Surface, creating a Solid Body from a Closed Surface Body, Sewing a Surface to a Solid Body

RBT Levels: L6

VII. COURSE OUTCOMES

CO1	**Proficient in understanding and navigating through CATIA.**
CO2	**Proficiently employ various tools, techniques and features in CATIA for designing and modelling.**
CO3	**Independently create complex 3D Models**
CO4	**Demonstrate and use CATIA for Solid and Surface modelling**
CO5	**Effectively deliver detailed 2D drawings from 3D models.**

VIII. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1	2		2					2		1				2
CO2	2				3				1				2	
CO3	3		2		1									2
CO4													2	2
CO5	2		1		2							2		

IX. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 5

Continuous Internal Evaluation (CIE): Refer Annexure section - 5

Semester End Examination (SEE): Refer Annexure section -5

X. Learning Resources

VII(a): Reference Books: (Insert or delete rows as per requirement)

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	**CATIA V5-6R2023 for Designers**	**Prof. Sham Tickoo**	**21th Edition**	**CADCIM Technologies**

VII(b): Web links and Video Lectures (e-Resources):

CATIA V5 Reference

SCHEME: 2023 DATE: 22-05-2024

Semester:	III	**Course Type:**	NCMC		
Course Title:	**SKILL FULL FUTURES : EMPOWERING APTITUDE AND SOFT SKILLS**				
Course Code:	**23PDSN03**			**Credits:**	PP/NP
Teaching Hours/Week (L:T:P:O)			0:0:0:2	**Total Hours:**	24
CIE Marks:	50	**SEE Marks:**	----	**Total Marks:**	50
SEE Type:	Theory			**Exam Hours:**	00

I. Course Objectives:

- Strengthen logical and analytical thinking skills required to solve quantitative problems.
- Discuss the importance of ethical considerations in leadership and negotiation, emphasizing integrity, fairness, and accountability in decision-making and interactions.
- Apply problem-solving strategies to real-world situations.
- Crafting Effective Openings and Closings.
- Develop a systematic approach to creative problem solving

II. Teaching-Learning Process (General Instructions):

Mention the planned/proposed sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

III. COURSE CONTENT

III(a). Theory PART

Module-1: (Quantitative Aptitude-1)	06 Hrs
Problems on Permutation and Combination. Problems on Surds and Indices	
Pre-requisites (Self Learning)	
Module-2: (Leadership and Negotiation skills)	04 Hrs
Leader skills, Persuasion Skills, Negotiation Skills and Conflict Resolving Skills	
Pre-requisites (Self Learning)	
Module-3: (Quantative aptitude - 02)	06 Hrs
Problems on Percentage, Problems on Profit and Loss , Problems on cubes and Dices	
Pre-requisites (Self Learning)	
Module-4: (Letter and Writing Skills)	04 Hrs
Writing Skills, Formal, Informal Letters, Sample Letters, Business Professional writings and Adaptability in writing style	
Pre-requisites (Self Learning)	
Module-5: (Logical Reasoning)	04 Hrs
Syllogism Concepts and Logical Deduction	
Pre-requisites (Self Learning)	

IV. COURSE OUTCOMES

CO1	Understand Mathematical Concepts such as Arithmetic, algebra, geometry and Statistics
CO2	Develop decision-making abilities by learning techniques for making informed and timely decisions, considering various factors and perspectives.
CO3	Develop problem-solving skills to tackle various quantitative problems efficiently and accurately.
CO4	Develop skills in writing clear and concise letters, conveying the intended message effectively without ambiguity or unnecessary details.

CO5	Understanding Syllogistic Reasoning

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2						2				1				
CO2								2	2			2				
CO3	2	2						2				2				
CO4										2		2				
CO5	2	2										1				

VI. Assessment Details of CIE

Continuous Internal Evaluation (CIE):

CIE will be conducted by Ethnotech as per the scheduled timetable, with common question papers for the subject.

- The question paper will have 50 questions. Each question is set for 01 mark.
- CIE Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks. The duration of the examination is 01 Hour.

VII. Learning Resources

VII(b): Reference Books:

1	Quantitative Aptitude for Competitive examination	R S Agarwal	2017	S Chand
2	Are we leading ?	Kaushik Mahaputhra	2020	Notion press
3	A modern approach to logical reasoning	R S Agarwal	2019	S Chand

VII(c): Web links and Video Lectures (e-Resources):

https://swayam.gov.in/explorer
https://nptel.ac.in/courses

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Mention suggested Activities like
seminar / assignments / quiz /mini projects

|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)
SJB Institute of Technology
BGS Health and Education City, Dr. Vishnuvardhana Road, Kengeri, Bengaluru-560060
Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

MECHANICAL ENGINEERING

4th Semester Syllabus

Semester:	04	**Course Type:**	BSC		
Course Title:	**PROBABILITY DISTRIBUTIONS & COMPLEX VARIABLES.**				
Course Code:	**23MET401**			**Credits:**	3
Teaching Hours/Week (L: T: P: O)			2:2:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives:

- Apply the knowledge of theory of probability in the study of uncertainties
- Understand the concepts of sampling distributions.
- Use probability and sampling theory to solve random physical phenomena and implement appropriate distribution models
- Understand theory of complex Integral.

II. Teaching-Learning Process (General Instructions):

1. In addition to the traditional lecture method, innovative teaching methods shall be adopted.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Grading assignments and quizzes and documenting students' progress.
4. Encourage the students for group learning to improve their creative and analytical skills.

III. COURSE CONTENT

Module-1 Probability Distributions	Hrs: 8
Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson, and normal distributions- Illustrative examples.	
Textbook 1: Chapter:26-[Section 26.7 to 26.10, 26.14 to 26.16]	
Self Learning: Exponential distribution	
RBT Levels:L1, L2 and L3	
Module-2 Joint probability distribution & Markov Chain	Hrs: 8
Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation. **Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **Textbook 3:Chapter:31-[sections:31.1 & 31.2]**	
Self Learning: Point estimation & Interval estimation.	

RBT Levels:L1, L2 and L3	
Module-3: Hypothesis and statistical Testing.	Hrs: 8
Sampling, Sampling distributions, standard error, test of significance for large samples: test of hypothesis for means and proportions, Test of Significance for means of two Large samples: students't' distribution, Chi-square distribution as a test of goodness of fit.Test of independence of attributes, ANOVA for one –way and two way classified data. **Textbook 1:Chapter:27-[sections 27.1 to 27.7 , 27.12 to 27.19]**	
Self Learning:.z-Distribution.	
RBT Levels: L1, L2 and L3	
Module-4: Advanced Statistical Methods.	Hrs:8
Bracketing methods-Graphical method, Bisection method, Multiple roots, Muller's method, Statistical Quality methods, Methods for preparing control charts, Problems using X-bar,p,R charts and attribute charts, **Textbook 2:Chapter:2-[Page 20-62]**	
Self Learning: Quotient Difference-method	
RBT Levels: L1, L2 and L3	
Module-5: Complex Variables &Transformations	Hrs:8
Complex Variables: Analytic function , Cauchy- Riemann equation in Cartesian and polar form and Application to flow problems, Conformal transformations: Introduction. Discussion of transformations: $w = e^z$, $w = z^2$ *and* $w = z + \frac{1}{z}$. Bilinear transformations- Problems.	
Textbook 1:Chapter: 20-[sections:20.420.5 ,20.6, 20.9 , 20.12 to 20.24]	
Self Learning: Complex Line Integral.	
RBT Levels: L1, L2 and L3	

IV. COURSE OUTCOMES

CO1	Apply discrete and continuous probability distributions in analyzing the probability models arising in the engineering field..
CO2	Construct a Joint probability Distribution and demonstrate the validity of testing the hypothesis. Describe and calculate with discrete time/space Markov chains, including the calculation of absorption probabilities
CO3	Use the concepts of sampling to make decision about the hypothesis.
CO4	Use the concepts of charts to collect data and quality standards to find new ways to improve products and services
CO5	Use the concepts of analytical function and complex potentials to solve the problems in aerofoil theory, fluid flow visualization and imaging process.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	1		1							1				
CO2	3	2	1		1							1				
CO3	3	2	1		1							1				
CO4	3	2	1		1							1				
CO5	3	2	1		1							1				

VI. **Assessment Details (CIE & SEE)**
Continuous Internal Evaluation (CIE)& Rubrics: ***Refer to Annexure Section -1***
Semester End Examination (SEE)& Rubrics: ***Refer to Annexure Section -1***

XIV .Learning Resources

XIV(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Name of the publisher	Edition and Year
1	"HigherEngineeringMathematics"	B.S.Grewal	Khannapublishers	44th Ed 2018
2	Introductory Methods of Numerical Analysis	S.S.Sastry	PHI Learning	Ed., 2005
4	Higher Engineering Mathematics	B.V.Ramana	Tata McGraw-Hill	11th Ed., 2017

XIV(b): Reference Books:

1	Operation research	S D Sharma	Kedarnath Publishers	Ed., 2012
2	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw – Hill Book Co.,	6th Ed., 2017
3	Probability & Statistics for Engineers & Scientists	Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye	Pearson Education	9th Ed., 2023.

XIV(c): Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. https://www.aerostudents.com/courses/applied-numerical-analysihttps://www.youtube.com/watch?v=WMmqxcgvo4Y
3. VTU EDUSAT programme-20

XV: Activity Based Learning

Assignments, Quiz, Presentation.

Semester:	4th	**Course Type:**	PCC		
Course Title:	**MECHANICS OF MATERIALS**				
Course Code:	**23MET402**			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			3:0:0:@	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3 Hrs

I. Course Objectives:

- To understand the behaviour of materials under various types of loads on different condition.
- To know the different types of loads and stresses in designing mechanical component.
- To analyse and evaluation of mechanical components under bending, shear and torsional loads
- To understand the failure phenomena of the materials by knowing different strain energy and failure theories.

II. Teaching-Learning Process (General Instructions):

1. Chalk and talk.
2. Activity based learning
3. Beyond syllabus presentation
4. Self learning videos
5. Conduction of quiz in module wise
6. Regular in submission of assignments (One assignment will be given in each module and students to submit the same immediately after completion of the respective module)
7. Assigning industrial application problems to solve

III. COURSE CONTENT

III(a).Theory PART

Module-1:Simple Stress and Strain — 8 Hrs

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, , Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them, Principle of super position, Stresses due to temperature change

Textbooks:

1. Text Book 1, Chapter 1, Pg. No. 1 to 15
2. Text Book 3, Chapter 1, section 1.10.1
3. Text Book 3, Chapter 2, section 2.1 to 2.13

Pre-requisites (Self Learning)

Students should be knowing the properties of different materials

1. Making a list of properties of different engineering materials
2. Making a list of practical applications of different engineering materials

RBT Levels: L1, L2

Module-2:Analysis of Stress and Strain, Thick and Thin cylinders — 8 Hrs

Analysis of Stress and Strain: Introduction to three-dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear stress, Mohr circle for plane stress conditions.
Thick and Thin cylinders: Stresses in thin cylinders, Lame's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), simple numerical.

Textbooks:

1. Text Book 3, Chapter 3, Section 3.1 to 3.6
2. Text Book 3, Chapter 17, section 17.1 to 17.5
3. Text Book 3, Chapter 18, section 18.1 to 18.3

Pre-requisites (Self Learning)

1. Making a list applications of pressure vessels
2. Making a list of companies who manufactures pressure vessels

RBT Levels: L1, L2, L3

Module-3: Shear Force and Bending Moment	8 Hrs

Shear Force and Bending Moment: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant / varying loads.

Textbook:

1. Text Book 2, Chapter 6, Section 6.1 to 6.3
2. Text Book 3, Chapter 7, section 7.1 to 7.9
3. Text Book 3, Chapter 8, section 8.1 to 8.3

Pre-requisites (Self Learning)

1. Solving simple industrial problems of SF and BM. Report to be submitted on the same.
2. Listing out the various sections of beams which can be used for industrial applications

RBT Levels: L2, L3

Module-4: Shear Stresses, Torsion	8 Hrs

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams.
Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections,

Textbooks:

1. Text Book 2, Chapter 9, Section 9.1 to 9.5
2. Text Book 3, Chapter 8, section 8.1 to 8.3

Pre-requisites (Self Learning)

1. Identification of importance and practical applications of shafts. Student Presentation on the same.
2. Writing a note on the procedure to manufacture a shaft.

RBT Levels: L1, L2, L3

Module-5: Theory of columns, Strain Energy	8 Hrs

Theory of Columns: Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns.

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I and II and their applications.

Textbooks:

1. Text Book 1, Chapter 2, Pg. No 83 to 102
2. Text Book 1, Chapter 14, Pg. No 757 to 797

Pre-requisites (Self Learning)

1. Identification of importance and practical applications of industrial columns (Applications of columns in various machineries). Student presentation on the same.

RBT Levels: L1, L2, L3

IV. COURSE OUTCOMES

At the end of the course, student to:

CO1	Understand the importance of stress and strain in various mechanical elements.
CO2	Determination of various dimensions and stresses in mechanical components like thin and thick cylinders, shafts, columns etc.
CO3	Apply the knowledge to understand the load transferring mechanism in beams and stress distribution
CO4	Evaluate the stresses induced in different cross sectional members subjected to shear loads

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	1											-			
CO2	2	3											2			
CO3	2	2											2			
CO4	2	2											2			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section - 1

Semester End Examination (SEE): Refer Annexure section - 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Strength of Material	S. Ramamrutham	14th Edition/2003	Dhanpat Rai Publishing Company
2	Strength of Material	Dr. Sadhu Singh	8th Edition/2003	Khanna Publication
3	Strength of Material	Dr. R K Bansal	4th Edition/2010	Lakshmi Publications Pvt. Ltd

VII(c): Web links and Video Lectures (e-Resources):

Link1: https://www.youtube.com/watch?v=zAbxJ33qT-A
Link 2: https://www.youtube.com/watch?v=cUMCi3S8zcM
Link3: https://youtu.be/UEmgT1JhMYs?si=k1XfRGWPW2EgmnQq

Link 4:https://www.youtube.com/live/oWmhzP0g5JU?si=ZTOML6KFi1ZpiX3S
Link5: https://youtu.be/J7nyhgiJFmQ?si=ssxJLcm5neoNaz3B

Link 6: https://youtu.be/uGqQADFkWfo?si=Lx4ujCkLhw0Mg3GY
Link7:https://youtube.com/playlist?list=PLkGKbLCammgkUyjsmN0hyrcOQRbiauFHU&si=gC3-6m812JSGwZNK
Link 1: https://youtu.be/3FNEV6yNUFY?si=Dq1GDfM4UobBIQ3c

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

1. Visit to Material Testing laboratory to understand the various testing performed on different materials for different applications.
2. Conduction of a Quiz on modules
3. Student presentation about the various companies manufactures pressure vessels for industrial applications

Semester:	4	**Course Type:**	IPCC		
Course Title:	**ADVANCED MACHINING SCIENCE**				
Course Code:	**23MEI403**			**Credits:**	04
Teaching Hours/Week (L:T:P:O)			3:0:2:0	**Total Hours:**	40hrs+Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3hrs

I. Course Objectives:

- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To introduce students to different machine tools to produce components having different shapes and sizes.
- To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
- To know various non-conventional machining and hybrid machining processes.

II. Teaching-Learning Process (General Instructions):

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

1. Adopt different teaching methods to develop the outcomes through presentations/ video demonstrations/ simulations.
2. Chalk and talk method for problem-solving.
3. Adopt collaborative learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
6. Conduct laboratory demonstrations and practical experiments to enhance experiential skills.

III. COURSE CONTENT

III(a). Theory PART

Module-1: Introduction to Metal cutting	8Hrs

Introduction to Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications.

Basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings.

Textbook: 1-Chapter:1 Page no: 1-8, Chapter:2 Page no: 9-14, Chapter:3 Page no: 15-38,
Textbook: 2-Chapter:4 Page no: 154-165
Textbook: 3-Chapter:1 Page no: 5-43

Pre-requisites: Basic knowledge of materials and their properties

RBT Levels: L1,L2	

Module-2: Introduction to Machine tools

Introduction to basic metal cutting machine tools:
Lathe- Parts of lathe machine, accessories of lathe Machine and various operations carried out on lathe.

Milling Machines: up milling & down milling, classification of milling machines, constructional features (Column and Knee and vertical milling machine), milling cutter nomenclature, various milling operations-(Plain milling, Angular milling, gang milling, straddle milling, end milling, gear milling(types of gears)). **Indexing:** Need of indexing Simple, compound and differential indexing calculations. **Shaping Machines Tools:** Driving mechanisms of Shaper,Operations done on Shaper **Drilling Machines:** Constructional features (Radial & Bench drilling Machines), operations, types of drill & drill bit nomenclature. **Grinding**: Grinding operation, classification of grinding processes: cylindrical, surface & centerless grinding
Textbook: 3-Chapter:2 Page no: 80-83, Chapter:3 Page no: 106-136, Chapter:6 Page no: 177-195, Chapter:7 Page no: 199-236
Pre-requisites : Basic knowledge on application of operation carried on machine tools
RBT Levels:L1,L2
Module-3: Thermal aspects, Tool wear, and Finishing Process
Temperature in Metal Cutting: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures Tool life and tool Wear. The work material and its machinability **Cutting fluids:** Action of coolants and application of cutting fluids. **Forms of wear in metal cutting:** crater wear, flank wear, tool-life criteria **Finishing Process:** Importance of surface finishing processes, Grinding, Abrasive Flow Machining, Honing. Sanding, Abrasive blasting, Polishing, Lapping. **Surface Finishing and Protection**: Powder Coating, Liquid Coating, Electroplating, Galvanizing, Anodizing
Textbook: 1-Chapter:11 Page no: 170-205, Chapter:12 Page no: 206-263, Chapter:13 Page no: 265-308 **Textbook: 2-Chapter:3 Page no: 121-133, Chapter:4 Page no: 141-151** **Textbook: 3-Chapter:1 Page no: 44-69, Chapter:9 Page no: 271-300**
Pre-requisites Basic knowledge of cutting fluids, machining & finishing operation
RBT Levels:L1,L2
Module-4: Advanced Machining Process
Advanced Machining Process Importance and classification of advanced machining process; **Principal, process parameters, and application of**: - Abrasive Jet Machining (AJW), Water Jet Machining (WJM),Abrasive Water Jet Machining (AWJM); Ultrasonic Machining (USM);Electrical Discharge Machining (EDM); Wire Electrical Discharge Machining (WEDM); Electro Chemical Machining (ECM). Laser Beam Machining (LBM), Electron Beam Machining (EBM), and Plasma Arc Machining (PAM).
Textbook: 2-Chapter:14 Page no: 505-547 **Textbook: 3-Chapter:11 Page no: 324-375,**
Pre-requisites : Basic of machining process
RBT Levels:L1,L2

Module-5: Hybrid Machining Process & CNC	
Importance of hybrid machining process; Process principal, process parameters, and application of: - Electrochemical Discharge Machining (ECDM), Ultrasonic Assisted Electric Discharge Machining (UAEDM), Electrochemical Discharge Grinding (EDG), Powder Assisted Electric Discharge Machining (PAEDM). **Computer Numerical Control:** Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning and milling systems.	
Textbook: 2-Chapter:12 Page no: 415-423 **Textbook: 3-Chapter:16 Page no: 453-503**	
Pre-requisites : Basics of machining process, NC machine	
RBT Levels:L1,L2	
III(b). PRACTICAL PART	
Sl. No.	**Experiments / Programs / Problems** (insert rows as many required)
1	Study of tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system
2	Preparation of one model on lathe involving - Facing, Plain turning, Taper turning, Drilling, Knurling
3	Preparation of One model on lathe involving - Facing, Step turning, Thread cutting, and Eccentric turning.
4	One Job, Cutting of V Groove/ dovetail / Rectangular groove using a shaper
5	Cutting of Gear Teeth using Milling Machine.
6	Simple operations and One Job on the drilling
7	Simple operations and One Job on the grinding machine.
8	Experiment on simple programming of CNC machine operations-Turning
9	Experiment on simple programming of CNC machine operations-Milling
10	Cutting force measurement with dynamometers for turning, drilling, operations. (Demo)
Instructions for conduction of practical part: • On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day. • The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report	
IV. COURSE OUTCOMES	
CO1	Demonstrate a comprehensive understanding of the basic principles of metal cutting, including cutting mechanics, tool geometry, and chip formation.
CO2	Assess the impact of various machining parameters on surface integrity and quality, and develop methods to control and improve these characteristics.
CO3	Analyze the properties and behavior of various materials during the cutting process, including the effects of material hardness, toughness, and microstructure on machinability.
CO4	Explain the material removal mechanisms associated with different advanced machining processes.
CO5	Utilize advanced computer-aided manufacturing (CAM) software to design and simulate machining processes.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	1											3			
CO2	3	1											3			
CO3	3	1											3			
CO4	3				2								3			
CO5	3				2								3			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 2

Continuous Internal Evaluation (CIE): Refer Annexure section - 2

Semester End Examination (SEE): Refer Annexure section - 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Metal Cutting Principles	Shaw, M C,	2nd edition, 2014	Oxford University Press
2	Fundamentals of Machining and Machine Tools	Boothroyd, G., and Knight, W. A.,	3rd edition	CRC Press.
3	Manufacturing Technology II,	Rao P. N.,	4th edition	Tata McGraw Hill.

VII(b): Reference Books:

1	Fundamentals of Modern Manufacturing: Materials, Processes, and Systems,	Mikell P. Groover	7th edition 2019	Wiley Publications.
2	Modern Machining Processes	P.C Panday and H. S Shah	2017	Tata McGraw-Hill Education, India Pvt.Ltd.

VII(c): Web links and Video Lectures (e-Resources):

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

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Mention suggested Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	IV	**Course Type:**	IPCC		
Course Title:	**FLUID MECHANICS**				
Course Code:	23MEI404			**Credits:**	04
Teaching Hours/Week (L:T:P:O)			3:0:2:0	**Total Hours:**	40+Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To have a working knowledge of the basic properties of fluids and understand the continuum approximation
- To Calculate the forces exerted by a fluid at rest on submerged surfaces and understand the force of buoyancy
- To understand the flow characteristic and dynamics of flow field for various Engineering applications.
- To understand the main properties of laminar and turbulent pipe flow and appreciate their differences and the concept of boundary layer theory.
- Understand the concept of dynamic similarity and how to apply it to experimental modelling.

II. Teaching-Learning Process (General Instructions):

Mention the planned/proposed sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Power-point Presentation
- Video demonstration or Simulations
- Chalk and Talk are used for Problem Solving
- Laboratory Demonstrations and Practical Experiments

III. COURSE CONTENT

III(a).Theory PART

Module-1: Introduction and Fluid Statics	8 Hrs

Introduction: Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc, pressure at a point in the static mass of fluid, variation of pressure, Pascal's law,Absolute, gauge, atmospheric and vacuum pressures pressure measurement by simple, differential manometers and mechanical gauges.

Fluid Statics: Total pressure and center of pressure for horizontal plane, vertical plane surface a

Textbook: 1 Chapter: 1,2 and 3 sections 1.1 to 3.4

Pre-requisites (Self Learning) : Fluid properties

RBT Levels: L1, L2, L3

Module-2:Fluid Kinematics	8 Hrs

Fluid Kinematics: Types of Flow-steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, stream lines, path lines, streak lines, velocity components, convective and local acceleration, velocity

potential, stream function, continuity equation in Cartesian co-ordinates. Rotation, vorticity and circulation, Laplace equation in velocity potential and Poisson equation in stream function, flow net, Problems. Laminar and Turbulent flow: Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, Poiseuille equation.

Textbook:1 Chapter 5 :sections 5.1 to 5.8

Pre-requisites (Self Learning): Types of fluid flow

RBT Levels: L1, L2, L3

Module-3: Fluid Dynamics	8 Hrs

Fluid Dynamics: Momentum equation, Impacts of jets- force on fixed and moving vanes, flat and curved. Numericals.Euler's equation, Integration of Euler's equation to obtain Bernoulli's equation, Annexure-III 2 Bernoulli's theorem, Application of Bernoulli's theorem such as venture meter, orifice meter, rectangular and triangular notch, pitot tube, orifices etc., related numericals. Loss of head due to friction in pipes, Major and minor losses, pipes in series and parallel.

Textbook: 1 Chapter 6 and 11 :sections 6.1 to 6.9 and 11.1 to 11.11

Pre-requisites (Self Learning): Basics of flow measurement

RBT Levels: L1, L2, L3:

Module-4: Flow over bodies and Dimensional Analysis	8 Hrs

Flow over bodies: Development of boundary layer, Lift and Drag, Flow around circular cylinders, spheres, aerofoils and flat plates, Streamlined and bluff bodies, boundary layer separation and its control.

Dimensional Analysis: Derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh method, Buckingham Pi-theorem, dimensionless numbers, similitude, types of similitude

Textbook1 :Chapter 14 and12 :sections14.1to 14.8.1 and 12.1 to 12.4.4

Pre-requisites (Self Learning): Basics about units & dimensions

RBT Levels: L1, L2, L3

Module-5: Compressible flows and Introduction to CFD	8 Hrs

Compressible flows: Speed of sound, adiabatic and isentropic steady flow, Isentropic flow with area change stagnation and sonic properties, normal and oblique shocks, flow through nozzles.

Introduction to CFD: Necessity, limitations, philosophy behind CFD, applications

Textbook:1 Chapter: 15 sections 15.1 to 15.9.4

Pre-requisites (Self Learning): Basic knowledge of fluid dynamics

RBT Levels: L1, L2, L3

III (b). PRACTICAL PART

Sl. No.	**Experiments / Programs / Problems**(insert rows as many required)
1	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.
2	Determination of head loss in pipes and pipe fittings having different diameters, different materials and different roughness
3	Effect of change in cross section and application of the Bernoulli equation

4	Impact of jet on flat and curved plates
5	Working principle of different flow meters for open channel and their calibration
6	Working principle of different flow meters and their calibration (orifice plate, venture meter, turbine, Rota meter, electromagnetic flow meter)
7	Determine the viscosity of oil using Red wood viscometer and Say-bolt viscometer.

Instructions for conduction of practical part:

IV. COURSE OUTCOMES

CO1	Identify and calculate the key fluid properties used in the analysis of fluid behaviour.
CO2	Apply the knowledge of fluid dynamics while addressing problems of mechanical and chemical engineering
CO3	Understand the concept of boundary layer in fluid flow and apply dimensional analysis to form dimensionless numbers in terms of input output variables.
CO4	Understand the basic concept of compressible flow and CFD
CO5	Conduct basic experiments of fluid mechanics and understand the experimental uncertainties

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2											3			
CO2	3	2											3			
CO3	3	2											3			
CO4	3	2											3			
CO5	3	2											3			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 2

Continuous Internal Evaluation (CIE): Refer Annexure section – 2

Semester End Examination (SEE): Refer Annexure section - 2

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Fluid mechanics and Hydraulic Machine	Dr. R K Bansal	2002	Laxmi publication Ltd
2	Fundamentals of Fluid Mechanics,	Munson, Young Okiishi&Hebsch	7th Edition	John Wiley Publicationss

VII(b): Reference Books:

1	Engineering fluid Mechanics	K L Kumar	2008	S.Chand and Company

VII(c): Web links and Video Lectures (e-Resources):

https://youtu.be/CwQSikdU8EQ?si=VzCzmZXLCIo8J6Q3
https://youtu.be/aShONtHloUk?si=FsgpV4zxtnwTMvwO
https://youtu.be/oQL4CFbHY_g?si=CSCd-ThiMu7ZgRER

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies

Semester:	4	**Course Type:**	PCCL		
Course Title:	**MODELLING AND DESIGN OF MECHANICAL COMPONENTS**				
Course Code:	**23MEL405**			**Credits:**	01
Teaching Hours/Week (L:T:P:O)			0:0:2:0	**Total Hours:**	28
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Practical			**Exam Hours:**	03

I. Course Objectives: Student will be able to

1. To acquire the knowledge of CAD software and its features
2. To familiarize the students with Indian Standards on Drawing Practice
3. To make students to analyse and interpret drawing of machine components to 3D-model the assembly drawing manually and using CAD packages
4. Learn and apply best practices to create designs that are robust adaptable and cost effective
5. Gain hands on experience in practical exercises and projects to reinforce theoretical concepts

Pre requisites (Self Learning)

1. Basic engineering drawing
2. CAD package usage in 2d mode
3. Visualization of 3D components

Sl. No.	Exercises
1	Hexagonal headed bolt and nut with washer (assembly)
2	Square headed bolt and nut with washer (assembly)
3	Joints: Knuckle joint
4	Joints: Spigot and cotter joint
5	Couplings: Flanged coupling,
6	Couplings: Universal coupling
7	Assembly of Machine Components using 3D environment - Plummer Block
8	Assembly of Machine Components using 3D environment - Screw Jack
9	Assembly of Machine Components using 3D environment – Square Tool Post
10	Assembly of Machine Components using 3D environment - Connecting Rod

Teaching Learning Process

Project based learning: Engage students in hands on projects that simulate real world design scenarios, enabling practical application of concepts and fostering deeper understanding
Interactive workshops: conduct collaborative workshops where the students work together to solve design challenges, encouraging active participation and knowledge sharing
Multidisciplinary Teams: Form diverse teams for group projects, allowing students to leverage different skill sets

RBT Levels: L1, L2, L3, L4

II. COURSE OUTCOMES

CO1	Apply standards in machine drawing components.
CO2	Impart and analyze the joints and coupling assembly
CO3	Interpret drawing of machine components leading to preparations of assembly drawing by CAD packages.

CO4	Inculcate bill of materials during the design and development of production drawing

III. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2			3							1	2			
CO2	3	2			3							1	2			
CO3	3		3		3							1	2			
CO4	3				3							1	2			
Avg.	3	2			3							1	2			

IV. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 4

Continuous Internal Evaluation (CIE): Refer Annexure section – 4

Semester End Examination (SEE): Refer Annexure section – 4

Rubrics:

Questions from excises	**Evaluation weightage in marks**		**Maximum marks**
	Manual Sketching	**Computer Print out**	
1 or 2	10	10	20
(3/4) or 5/6	10	20	30
7 to 10 any one	15	35	50
Total	35	65	100

V. Learning Resources

VII(a): Textbooks:

Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**
1	Machine Drawing	N.Siddeshwar, P.Kannaih V.V.S. Sastri	ISBN-10 ,ISBN-13, July 2017	Tata Mc.Grawhill
2	Machine Drawing	K R Gopalkrishna	January 2018	Subhas publication

VII(b): Reference Books:

1	A Text Book of Computer Aided Machine Drawing	S. Trymbakaa Murthy	2019	CBS Publishers

VII(c): Web links and Video Lectures (e-Resources):

Mention the links of the online resources, video materials, etc.

1. https://www.youtube.com/watch?v=Bi4sZBUku5Q Bolt and Nut assembly
2. https://www.youtube.com/watch?v=go0-YHQC_MI Design of universal coupling using Fusion 360
3. https://www.youtube.com/watch?v=_W8H7YkBsP0 Flange coupling
4. https://www.youtube.com/watch?v=Fm9gmIWTALU Plummer Block
5. https://youtu.be/eAN2RWzuwMw?si=u1KCdyokXIIw8fEf: Screw jack assembly

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

suggested Activities: case studies, mini projects, self-study activities, etc.

Semester:	IV	**Course Type:**	ETC		
Course Title:	**DATABASE MANAGEMENT SYSTEM**				
Course Code:	23MEE421			**Credits:**	03
Teaching Hours/Week (L:T:P:O)			2:0:2:0	**Total Hours:**	25 hours +Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

- To Provide a strong foundation in database concepts, technology, and practice.
- To Practice SQL programming through a variety of database problems.
- To Understand the relational database design principles.
- To Demonstrate the use of concurrency and transactions in database.
- To Design and build database applications for real world problems.
- To become familiar with database storage structures and access techniques

II. Teaching-Learning Process (General Instructions):

Teaching-Learning Process (General Instructions)

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

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding

Use any of these methods: Chalk and board, Active Learning, Case Studies

III. COURSE CONTENT

III(a). Theory PART

Module-1:	5 Hrs

Introduction to Databases: Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications. Overview of Database Languages and Architectures: Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment. Conceptual Data Modelling using Entities and Relationships: Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams,Specialization and Generalization. **Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10**	
RBT: L1, L2, L3	
Module-2:	5 Hrs
Relational Model: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations. Relational Algebra: Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra. Mapping Conceptual Design into a Logical Design: Relational Database Design using ER-to-Relational mapping. **Textbook 1: Ch 5.1 to 5.3, Ch 8.1 to 8.5; Ch 9.1 to 9.2 Textbook 2: 3.5**	
RBT: L1, L2, L3	
Module-3:	5 Hrs
Normalization: Database Design Theory – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. SQL: SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL **Textbook 1: Ch 14.1 to 14.7, Ch 6.1 to 6.5**	
RBT: L1, L2, L3	
Module-4:	5 Hrs
SQL: Advanced Queries: More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL. Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL. **Textbook 1: Ch 7.1 to 7.3, Ch 20.1 to 20.6**	
RBT: L1, L2, L3	
Module-5:	5 Hrs
Concurrency Control in Databases: Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple	

Granularity Locking. NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems **Textbook 1:Chapter 21.1 to 21.5, Chapter 24.1 to 24.6**	
RBT: L1, L2, L3	
III(b). PRACTICAL PART	
Sl. No.	**Programs /Experiments**
1	Create a table called Employee & execute the following. **Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)** 1. Create a user and grant all permissions to theuser. 2. Insert the any three records in the employee table contains attributes EMPNO,ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result. 3. Add primary key constraint and not null constraint to the employee table. Insert null values to the employee table and verify the result.
2	Create a table called Employee that contain attributes EMPNO,ENAME,JOB, MGR,SAL & execute the following. 1. Add a column commission with domain to the Employeetable. 2. Insert any five records into the table. 3. Update the column details of job 4. Rename the column of Employ table using alter command. Delete the employee whose Empno is 105
3	Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby. **Employee(E_id, E_name, Age, Salary)** 1. Create Employee table containing all Records E_id, E_name, Age, Salary. 2. Count number of employee names from employeetable 3. Find the Maximum age from employee table. 4. Find the Minimum age from employeetable. 5. Find salaries of employee in Ascending Order. Find grouped salaries of employees
4	Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary. **CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)**
5	Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extrct the values from the cursor. Close the cursor. **Employee(E_id, E_name, Age, Salary)**
6	Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped

IV. COURSE OUTCOMES

CO1	Describe the basic elements of a relational database management system
CO2	Design entity relationship for the given scenario.
CO3	Apply various Structured Query Language (SQL) statements for database manipulation and normalization forms for the given application .
CO4	Develop database applications for the given real world problem.
CO5	Understand the concepts related to NoSQL databases

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	3			3								2			
CO2	3	3			3								2			
CO3	3	3			3								2			
CO4	3	3			3								2			
CO5	3	3			3								2			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	Fundamentals of Database Systems	Ramez Elmasri and Shamkant B. Navathe	7th Edition, 2017	Pearson
2.	Database management systems	Ramakrishnan, and Gehrke	3rd Edition, 2014	McGraw Hill

VII(c): Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/dbms/
- https://byjus.com/govt-exams/database-management-system-dbms/

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activity Based Learning (Suggested Activities)/ Practical Based learning

1. **Mini Project:**

Project Based Learning

Semester:	IV	**Course Type:**	ETC		
Course Title:	**DRIVE SYSTEMS FOR ROBOTICS**				
Course Code:	**23MEE422**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives:

This course will enable students:

1. To introduce various types of drive systems used in Robot development
2. To impart knowledge of Hydraulic &Pneumatic Drive systems
3. To educate on various Electrical Actuation Systems used in robot application
4. To apply knowledge of the basics of Troubleshooting in robot application

II. Teaching-Learning Process (General Instructions):

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

1. Adopt different teaching methods to develop the outcomes through presentations/ video demonstrations/ simulations.
2. Chalk and talk method for problem-solving.
3. Adopt collaborative learning in the class.
4. Conduct laboratory demonstrations and practical experiments to enhance experiential skills.

III. COURSE CONTENT

III(a).Theory PART

Module-1:Introduction to drive system — 8 Hrs

Introduction of drive system, structure of drive system, Necessity of drive system, different types of drive system,

Robot Actuators: types of actuators, Actuators Quality, Characteristics of acting systems, design consideration of drive system, Advantages and limitations of drive system.

Actuators & Drive Systems Textbook:4, Chapter:7, sections:7.1 to 7.11

Pre-requisites (Self Learning): Elements of Mechanical Engineering

RBT Levels: L1,L2,L3

Module-2: ROBOT KINEMATICS AND CONTROL — 8 Hrs

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3Dimensional), Deviations and Problems. Control of robot manipulators – Point to point, Continuous Path Control.

Textbook:1, Chapter: 8, sections: 8.1 to 8.4

Pneumatic Valves : Textbook:2, Chapter: 6, sections: 6.1 to 6.12	
Pre-requisites (Self Learning): Elements of Mechanical Engineering	
RBT Levels: L1, L2,L3	
Module-3: Hydraulic Drive system	8 Hrs
Linear hydraulic actuators, Types of hydraulic cylinders, Single acting, Double acting special cylinders like tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators –Fluid motors, Gear, Vane and Piston motors, Motor performance, Filtration systems and maintenance of system. **Hydraulic actuators: Textbook:3, Chapter:3, sections:3.1 to 3.5** **Hydraulic Motors: Textbook:3, Chapter:4, sections4.1 to 4.6** **Hydraulic Circuits & Analysis: Textbook:3, Chapter:6, sections:6.1 to 6.9** **Maintenance of Hydraulic system: Textbook:3, Chapter:7, sections:7.1 to 7.11**	
Pre-requisites (Self Learning): Elements of Mechanical Engineering	
RBT Levels: L1, L2,L3	
Module-4: Pneumatic Drive system	8 Hrs
Properties of air, Compressor, Filter, Regulator, and Lubricator Unit, Compressed Air distribution system, Pneumatic actuators- Linear and Rotary, Tie rod cylinders, Rodless actuators with magnetic linkage or rotary cylinders, Rodless actuators with mechanical linkage, Pneumatic artificial muscles, Vane Motors, Speciality actuators that combine rotary and linear motion—frequently used for clamping operations, Vacuum generators **Pneumatic Components: Textbook:1, Chapter: 13, sections:13.2 to 13.10** **Pneumatic Components: Textbook:1, Chapter: 14, sections: 14.6**	
Pre-requisites (Self Learning): Elements of Mechanical Engineering	
RBT Levels: L1, L2,L3	
Module-5: Electrical Actuation System and Troubleshooting of the drive system	8 Hrs
Solid State Switches, Solenoids, D.C. motors, A.C. motors, Stepper motors, Servomotors, stepper motors; ac servomotors, dc servomotors, Troubleshooting of drive systems Identifying root cause, suggest remedies, steps to be followed in troubleshooting. **Electrical Actuation System : Textbook:1, Chapter:15, sections:15.1 to 15.2** **Electrical Actuation System : Textbook:2, Chapter:11, sections:11.1 to 11.7** **Troubleshooting of the drive system : Textbook:2, Chapter:12, sections:12.1 to 12.9**	
Pre-requisites (Self Learning): Elements of Mechanical Engineering	
RBT Levels:L2,L3	
IV. COURSE OUTCOMES	

CO1	IMPART fundamental of drive systems and kinematics in robotics.
CO2	APPLY Hydraulic and Pneumatic drive systems in robot design.
CO3	INCORPORATE the concepts of electrical Actuation System in robots.
CO4	ANALYSE the Troubleshooting in robot drive system

V. CO-PO-PSO MAPPING(mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2			2								1	2		
CO2	3	2	1		2								1	2		
CO3	3	2			2								1	2		
CO4	3	2			2								1	2		

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section - 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Fluid Power with Applications	Anthony Esposito	7th Edition,2014	Pearson Education
2	Pneumatic systems – Principles and Maintenance	Majumdar S.R.		Tata McGraw-Hill.
3	Hydraulics and Pneumatics	Jagadeesha T	1st Edition,2020	Dreamtech Press
4	Introduction to Robotics	Saeed B Niku	2nd Edition,2013	Wiley India Pvt Ltd

VII(b): Reference Books:

1	Power Hydraulics	Michael J, Prinches and Ashby J. G	-	Prentice Hall
2	Basic Fluid Power	Dudelyt, A. Pease and John T. Pippenger	-	Prentice Hall
3	Fundamentals of Pneumatics/electro-pneumatics	Hasebrink J.P., and Kobler R	-	FESTO Didactic PublicationNo. 7301, Esslingen Germany
4	Pneumatic Controls	Joji P.	2008	John Wiley & Sons

5	Introduction To Fluid Power	Johnson, James L.	2003	Delmar Publishers

VII(c): Web links and Video Lectures (e-Resources):

Robot Drive Systems : https://www.youtube.com/watch?v=wHNq8SEPZHA
Introduction to Hydraulic and Pneumatic Systems : https://nptel.ac.in/courses/112105047
Electrical Actuation System : https://www.youtube.com/watch?v=YBpfLWTE6ak

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Activities like seminar, assignments, quiz, case studies, mini projects, industry visit, self-study activities, group discussions, etc

Semester:	4	**Course Type: ETC**			
Course Title:	**MICROCONTROLLERS AND ITS APPLICATIONS**				
Course Code:	23MEE423			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			2:0:2:0	**Total Hours:**	25 hours+Lab slots
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	03

I. Course Objectives:

1.Understand the difference between Microprocessor and Microcontroller and embedded microcontrollers.
2. Analyze the basic architecture of 8051microcontroller.
3. Program 8051 microcontroller using Assembly Language and C.
4. Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051
5. Understand the interrupt structure of 8051 and Interfacing I/O devices using I/O ports of 8051

6.Understand the role of Embedded system and its applications.

II. Teaching-Learning Process (General Instructions):

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

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students understanding. .

III. COURSE CONTENT

III(a). Theory PART

Module-1 Microcontroller	5 Hrs

Microcontroller: Microprocessor Vs Microcontroller, Micro controller & Embedded Processors, Processor Architectures-Harvard Vs Princeton & RISC Vs CISC , 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.
(Text book 1-1.1,Text book 2-1.0,1.1,3.0,3.1,3.2,3.3 Text book 3-Pg 5-9)

Pre-requisites (Self Learning). Microprocessor and Microcontroller

RBT Levels: L1, L2,

Module-2: Instruction Set	5 Hrs

Instruction Set: 8051 Addressing Modes, Data Transfer Instructions, Arithmetic instructions, Logical Instructions, Jump & Call Instructions Stack & Subroutine Instructions of 8051 (with examples in assembly Language). **(Text book 2- Chapter 5,6,7,8, Additional reading Refer Textbook 3, Chapter 3 for complete understanding of instructions with flow diagrams)**

Pre-requisites (Self Learning) Data Transfer Instructions, Arithmetic instructions, Logical Instruction

RBT Levels: L1,L2	
Module-3: Timers/Counters & Serial port programming	5 Hrs
Timers/Counters & Serial port programming: Basics of Timers & Counters, Data types & Time delay in the 8051 using C, Programming 8051 Timers, Mode 1 & Mode 2 Programming, Counter Programming (Assembly Language only). (Text book 2- 3.4, Text book 1-7.1, 9.1,9.2) Basics of Serial Communication, 8051 Connection to RS232, Programming the 8051 to transfer data serially & to receive data serially using C. **(Text book 2- 3.5, Text book 1- 10.1,10.2,10.3 except assembly language programs, 10.5)**	
Pre-requisites (Self Learning): Programming 8051 Timers	
RBT Levels:L1,L2	
Module-4:	5 Hrs
Interrupt Programming: Basics of Interrupts, 8051 Interrupts, Programming Timer Interrupts, Programming Serial Communication Interrupts, Interrupt Priority in 8051(Assembly Language only) **(Text book 2- 3.6, Text book 1- 11.1,11.2,11.4, 11.5)**	
Pre-requisites (Self Learning) Programming Timer Interrupts, Programming Serial Communication Interrupts	
RBT Levels:L1,L2,L3	
Module-5: Introduction to Arduino-uno board	5 Hrs
Introduction to Arduino-uno board, Analog and Digital pins, programming structure of Arduino, introduction to sensors and actuators , Sensor interfacing, programming to sensors, Motor interfacing, LCD interfacing. **Reference book 3: Chapter 2**	
Pre-requisites (Self Learning): Arduino-uno board and its applications **RBT Levels: L1, L2,**	
PRACTICAL COMPONENT OF IPCC -10 hours	
1	Using Keil software, observe the various Registers, Dump, CPSR, with a simple Assembly Language Programs (ALP).
2	Develop and simulate ARM ALP for Data Transfer, Arithmetic and Logical operations (Demonstrate with the help of a suitable program).
3	Develop an ALP to multiply two 16-bit binary numbers.
4	Develop an ALP to find the sum of first 10 integer numbers.
5	Develop an ALP to find the largest/smallest number in an array of 32 numbers.
6	Develop an ALP to count the number of ones and zeros in two consecutive memory locations
7	Simulate a program in C for ARM microcontroller using KEIL to sort the numbers in ascending/descending order using bubble sort
8	Simulate a program in C for ARM microcontroller to find factorial of a number.

9	Simulate a program in C for ARM microcontroller to demonstrate case conversion of characters from upper to lowercase and lower to uppercase.
10	Write an 8051 C Program to rotate stepper motor in Clock & Anti-Clockwise direction.
11	Write an 8051 C program to Generate Sine & Square waveforms using DAC interface.

IV. COURSE OUTCOMES

CO1	Describe the difference between Microprocessor and Microcontroller, Types of Processor Architectures and Architecture of 8051Microcontroller.
CO2	Discuss the types of 8051 Microcontroller Addressing modes & Instructions with Assembly Language Programs.
CO3	Illustrate the Interrupt Structure of 8051 Microcontroller & its programming.
CO4	Explain the programming operation of Timers/Counters and Serial port of 8051 Microcontroller.
CO5	Demonstrate the role of embedded system using Arduino –uno

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3															
CO2	3	2	1													
CO3	3	2	1													
CO4	3	2	1													
CO5	3															

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VI. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1.	The "8051 Microcontroller and Embedded Systems – Using Assembly and C"	Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollind. Mckinlay;	2011	Pearson
2.	The 8051 Microcontroller	Kenneth j. Ayala,	3rd edition,	Thomson/Cengage Learning
3.	Programming And Customizing The 8051 Microcontroller".,Myke Predko Tata Mc Graw-Hill Edition 1999 (reprint 2003).	Myke Predko	Edition 1999 (reprint 2003).	Tata Mc Graw-Hill .

VII(b): Reference Books:

1.	The 8051 Microcontroller Based Embedded Systems	Manish K Patel	2007	McGraw Hill

2.	"Microcontrollers: Architecture, Programming, Interfacing and System Design	Raj Kamal	2011	Pearson Education
3.	Programming Arduino: Getting Started with Sketches	Simon Monk	3rd Edition 2023	Tata Mc Graw-Hill .

VII(c): Web links and Video Lectures (e-Resources):

https://www.the8051microcontroller.com/web-references
https://www.freebookcentre.net/Electronics/Microcontroller-Books.html
https://www.freebookcentre.net/Electronics/Microcontroller-Application-Books.html
https://nptel.ac.in/courses/117/104/117104072

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

Quiz and seminar

Semester:	4	**Course Type:**	ETC		
Course Title:	**INSPECTION AND QUALITY CONTROL**				
Course Code:	**23MEE424**			**Credits:**	3
Teaching Hours/Week (L:T:P:O)			3:0:0:0	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	3

I. Course Objectives:

- The student should learn different inspection procedures, objectives in industry and economic aspects.
- To impart definition of quality, components, concepts and different approaches followed like quality circles, cost of quality and economic considerations in quality.
- To impart knowledge on various quality standards followed.
- To impart fundamentals of statistical quality control charts, and process capability.
- To impart different sampling techniques and reliability.

II. Teaching-Learning Process (General Instructions):

• Chalk and talk method • PowerPoint Presentation	
III. COURSE CONTENT	
III(a). Theory PART	
Module-1: Industrial Inspection and Concept Of Quality In Engineering	08 Hrs
Industrial inspection: Objectives and functions of inspection in industry, types of inspection, production / inspection interaction, organization for industrial inspection, inspection procedures, economic aspect of inspection. **Concept of Quality in Engineering:** Meaning and significance of quality; essential components of quality; phases or elements for building quality; evolution of the concepts of quality; spiral of progress of quality; quality cost, hidden quality costs; economic models of quality costs, changing scope of quality activities. **Textbook: 01, Chapter: 19, sections: 19.1 – 19.15**	
RBT Levels: L1, L2	
Module-2: Quality Management Systems, Quality Control Function And Aspects of Specification And Tolerances	08 Hrs
Quality Control Function: Inspection versus quality control techniques, quality planning activities, organization for quality control. Fundamentals of statistical quality control, Juran's quality trilogy. **Aspects Of Specification And Tolerances:** Aspects of Specification and Tolerances: purpose of specification and tolerances, effect of careless setting of specification limits, setting realistic tolerances, statistical tolerancing, statistical theorem, Precision. Reproducibility and Accuracy, **Textbook: 02, Chapter: 09, sections: 9.1 – 9.5**	
RBT Levels: L1, L2	
Module-3: Control Charts	08 Hrs
Control Charts: Basics of Control Chart: Variability, Kinds of variations, Types of errors, Control limits specification limits and Natural Tolerance limits, Charts for variables and attributes, application of control charts for averages, range, standard deviation, Interpretation of X-bar and R Charts- cyclic patterns, mixture, shift, trend and stratification, fraction defectives (p Chart) and number of nonconformities per unit (c Chart), process capability analysis and simple numerical problems. **Textbook: 01, Chapter: 17, sections: 17.1 – 17.17**	
RBT Levels: L1, L2, L3	
Module-4: Acceptance Sampling & Reliability	08 Hrs
Acceptance Sampling: Elementary concepts, sampling by attributes, single, double and multiple sampling plans, construction and use of operating characteristic curves and simple problems. **Reliability:** Reliability engineering, rectification processes in industries, practical activity – quality report building, reliability function, failure rate, mean time between failures (MTBF), mean time to failure (MTTF), mortality curve, useful life availability, maintainability, system effectiveness and simple numerical problems on reliability, MTBF and MTTF **Textbook: 02, Chapter: 11, sections: 11.1 – 11.5**	
RBT Levels: L1, L2, L3	
Module-5: Quality Tools and Systems & Total Quality Management	08 Hrs

Quality Management Systems: Introduction to various quality standards – ISO 9000, BIS.
Quality Tools: Ishikawa's seven quality tools; Quality Circles; Quality system economics.
Total Quality Management (TQM) – definition, objectives, philosophy, and total productive maintenance (TPM) – definition, objectives, principles, implementation of TPM. Difference between TQM and TPM.
Textbook: 02, Chapter: 10 & 16,

RBT Levels: L1, L2

IV. COURSE OUTCOMES

CO1	Gain a knowledge on industrial inspection activity and concept of quality in engineering.
CO2	Understand various quality systems, quality control function, specification and tolerances prevalent in industry.
CO3	Construct various control charts based on data available in an industrial production, can also dwell upon the status of a process whether in control or out of control and find number of defectives
CO4	Carry out sampling, reliability techniques with an industrial application.
CO5	Learn about applying different quality tools and total quality management.

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	3	2	2										1			
CO2	3	2	2										1			
CO3	3	2	2										1			
CO4	3	2	2										1			
CO5	3	2	2										1			

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 1

Continuous Internal Evaluation (CIE): Refer Annexure section – 1

Semester End Examination (SEE): Refer Annexure section – 1

VII. Learning Resources

VII(a): Textbooks:

Sl. No.	Title of the Book	Name of the author	Edition and Year	Name of the publisher
1	Quality Planning & Analysis	Juran, J. M. and Gryna, F. M	1995	Tata McGraw Hill, New Delhi
2	Statistical Quality Control	Grant, E. L	2005	McGraw Hill International, New York.

VII(b): Reference Books:

1	Total Quality Control	Feignbaum, A. V	1995	McGraw Hill International, New York
2	Total Quality Management	Besterfield, D.H	2003	Pearson Education Asia, New Delhi

VII(c): Web links and Video Lectures (e-Resources):

VTU e-Shikshana Program

VIII: Activity Based Learning / Practical Based Learning/Experiential learning:

- Quizzes
- Assignments
- Seminars

Semester:	IV	**Course Type:**	AEC		
Course Title:	**CREO WITH HYPERMESH**				
Course Code:	**23MEAE41**			**Credits:**	01
Teaching Hours/Week (L:T:P:O)			1:0:0:3	**Total Hours:**	40
CIE Marks:	50	**SEE Marks:**	50	**Total Marks:**	100
SEE Type:	Theory			**Exam Hours:**	02
Semester:	IV	**Course Type:**			

I. Course Objectives:

II. Teaching-Learning Process (General Instructions):

Mention the planned/proposed sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.
Chalk & Talk Method
Power Point Presentation
Keynotes
Hands-on Practice
Problem-solving Exercises
Feedback and Assessment
Presentations

Assignment	
III. COURSE CONTENT	
III(a). Theory PART	
Module-1: (**Introduction and Basic Sketching in Creo**)	Hrs: 07
Introduction to Creo Parametric (Overview and system requirements, Feature-based nature, bidirectional associative property), Getting Started with Creo Parametric (User interface and navigation, Important terms and definitions, managing files, menu manager, model tree) Basic Sketching (Invoking the Sketch Mode, Sketcher environment, Drawing basic shapes: points, lines, centrelines, rectangles, circles, ellipses, arcs, Dimensioning sketches and modifying dimensions, Applying constraints) Mini Project: Design and model a basic mechanical part (e.g., a bracket) with proper dimensioning and constraints, and create detailed 2D drawings	
Pre-requisites (Self Learning) Familiarity with engineering drawings and drafting principles is beneficial but not mandatory	
RBT Levels: L1,L2,L3,L4,L6	
Module-2: (**Advanced Sketching and Part Modelling**)	Hrs: 07
Advanced Sketching Techniques (Dimensioning using baseline and replace tools, Creating fillets (circular and elliptical), splines, and text and other modifiers, Importing 2D drawings) Creating Base Features(Invoking the part mode, Creating protrusions (extrude, revolve),Understanding datum planes and parent-child relationships) Datum and Feature Construction (Creating datum planes, axes, and points Creating cuts using extrude and revolve Adding construction features: holes, rounds, chamfers, ribs) Mini Project: Design a simple mechanical part (e.g., a Ball bearing) and use baseline and replace dimensioning tools to add precise measurements to key features	
Pre-requisites (Self Learning) Familiarity with engineering drawings and drafting principles is beneficial but not mandatory	
RBT Levels: L2,L3,L4,L6	
Module-3: (**Advanced Modelling and Assembly**)	Hrs: 06
Advanced Modelling Tools (Sweep and blend features (parallel, rotational, general), Shell features, datum curves, and draft features, Variable section sweep and helical sweep) Assembly Modelling (Top-down and bottom-up approaches, Placement constraints and assembling components, Exploded views) Drawing and Detailing (Generating different drawing views, Dimensioning and adding annotations, Modifying and editing drawing views.) Mini Project: Develop a comprehensive project involving the design, assembly (Ex: a Flange Coupling Assembly, Or Real world component)	
Pre-requisites (Self Learning) Familiarity with engineering drawings and drafting principles is beneficial but not mandatory.	
RBT Levels: L2,L3,L4,L6	
Module-4: (**Introduction to HyperMesh and Pre-processing**)	Hrs: 10
Introduction to HyperMesh:(Overview of HyperMesh and its applications in finite element analysis, Understanding the HyperMesh user interface and layout.), Geometry Import and Clean-up:(Importing CAD models into HyperMesh, Geometry clean-up techniques including healing, repairing, and simplification)	

Mesh Generation:(Introduction to meshing and its importance in finite element analysis, meshing techniques including element types, mesh controls, and quality checks.)
Boundary Conditions and Loads:(Applying boundary conditions such as constraints and supports to the model, defining loads including point loads, distributed loads, and surface loads)
Element Properties: Assigning material properties and section properties to the elements.
Solver Setup: Configuring solver settings and defining analysis parameters.

Pre-requisites (Self Learning)
Basic understanding of FEA and structural mechanics concepts is recommended.

RBT Levels: L2,L3,L4,L6

Module-5: (**Analysis and Post processing**) | Hrs: 10

Static Analysis:(Introduction and applications of static analysis, setting up and solving static analysis problems.)
Results Interpretation: (Understanding and interpreting analysis results, Visualization techniques, contour plots, deformed shapes.)
Optimization:(Introduction to optimization techniques, Topology and shape optimization, setting up studies.)
Mini Project: Static Analysis and Result Interpretation on a simple part or assembly, interpreting results, Generating a comprehensive report.

Pre-requisites (Self Learning)
Basic understanding of FEA and structural mechanics concepts is recommended.

RBT Levels: L2,L3,L4,L6

III(b). PRACTICAL PART

(Fill this portion III(b) if course type is integrated or else delete this portion, if course type is only practical, delete the theory part III(a) and retain this section)

IV. COURSE OUTCOMES

CO1	Develop proficiency in navigating the Creo Parametric interface.
CO2	Learners will proficiently employ advanced sketching techniques and create precise base features
CO3	Learners will efficiently create and manage assemblies in Creo Parametric, integrating diverse components, establishing placement constraints, and visualizing assemblies through exploded views
CO4	Students will demonstrate proficiency in importing CAD models into HyperMesh and applying geometry clean-up techniques to ensure accurate and efficient finite element analysis.
CO5	Students will demonstrate expertise in utilizing HyperMesh to create detailed simulations and conduct accurate analyses

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	2	2	1		2									1
CO2	2		2										1	2
CO3	2	1	3		3				2				2	2
CO4	1	2		1	2			1	2					1
CO5		2	2	2	1			2						2

VI. Assessment Details (CIE & SEE)

General Rules: Refer Annexure section – 5

Continuous Internal Evaluation (CIE): Refer Annexure section - 5

Semester End Examination (SEE): Refer Annexure section - 5

VII. Learning Resources				
VII(a): Textbooks: (Insert or delete rows as per requirement)				
Sl. No.	**Title of the Book**	**Name of the author**	**Edition and Year**	**Name of the publisher**
1	creo-parametric-5-0-for-designers	CADCIM Technologies, USA Prof. Sham Tickoo	5th Edition	CADCIM Technologies
2	Practical-Aspects-of-Finite-Element-Simulation	A study Guide	5th Edition	Altair University
VII(c): Web links and Video Lectures (e-Resources):				
Altair Hypermesh tutorials PTC Creo Tutorials				

Semester:	IV	**Course Type:**	NCMC		
Course Title:	**MINDFUL MASTERY : APTITUDE AND SOFTSKILL INTEGRATION**				
Course Code:	**23PDSN04**			**Credits:**	PP/NP
Teaching Hours/Week (L:T:P:O)			0:0:0:2	**Total Hours:**	24
CIE Marks:	50	**SEE Marks:**	----	**Total Marks:**	50
SEE Type:	Theory			**Exam Hours:**	00

I. Course Objectives:

- To comprehend numerical relationships, place value, fractions, decimals, percentages, ratios, and proportions.
- Learn how to prioritize tasks and activities based on importance and urgency..
- Understanding of different types of data representations, such as tables, charts, graphs, and diagrams.
- Learn how to interpret different body language signal and their meanings.
- Learn Strategies for breaking down complex problems into manageable steps

II. Teaching-Learning Process (General Instructions):

Chalk and Talk
Video Demonstration
Pictorical representation
PPT presentation and Activity based learning

III. COURSE CONTENT

III(a). Theory PART

Module-1: (Arithmetical Ability)	06 Hrs
Problems on Pipes Cisterns , Time , Work and Averages	
Pre-requisites (Self Learning)	

Module-2: (Time management and Presentation skills)	04 Hrs
Misconceptions of Time, Symptoms of Poor Time Management, the 'Five Time Zone' Concept, Elements of Effective Time Management. ABC of presentation / Accent and pronunciation / Practice to Perform / Impact of voice modulation, eye contact and body language during presentation. Evaluation, Feed back	
Pre-requisites (Self Learning)	
Module-3: (Quantitave section and Data Interpretation**)**	06 Hrs
Simple interest and compound interest problems, Bar graphs, Pie charts and Line graphs concepts and problem	
Pre-requisites (Self Learning)	
Module-4: (Body language and Postures)	04 Hrs
Facial expressions, Gestures, Handshakes, tone of voice, Attitude, Universal vs. Culture specific	
Pre-requisites (Self Learning)	
Module-5: (Mental ability)	04 Hrs
Puzzle based question and Psychometric based interview Question	
Pre-requisites (Self Learning)	

IV. COURSE OUTCOMES

CO1	Understand Mathematical Concepts such as Arithmetic, algebra, geometry and Statistics
CO2	Develop decision-making abilities by learning techniques for making informed and timely decisions, considering various factors and perspectives.
CO3	Develop problem-solving skills to tackle various quantitative problems efficiently and accurately.
CO4	Understand data types, data Collection and cleaning
CO5	Understanding Non-Verbal Communication

V. CO-PO-PSO MAPPING (mark H=3; M=2; L=1)

PO/PSO	1	2	3	4	5	6	7	8	9	10	11	12	S1	S2	S3	S4
CO1	2	2						2				1				
CO2								2	2			2				
CO3	2	2						2				2				
CO4										2		2				
CO5	2	2										1				

VI. Assessment Details of CIE

Continuous Internal Evaluation (CIE): CIE will be conducted by Ethnotech as per the scheduled timetable, with common question papers for the subject.

- The question paper will have 50 questions. Each question is set for 01 mark.
- CIE Pattern will be in MCQ Model (Multiple Choice Questions) for 50 marks. The duration of the examination is 01 Hour.

VII. Learning Resources

VII(b): Reference Books:

1	Quantitative Aptitude for Competitive examination	R S Agarwal	2017	S Chand

2	Gestures and Body Language	Aparna majumdar	2017	V& S Publisher
3	A modern approach to logical reasoning	R S Agarwal	2019	S Chand
VII(c): Web links and Video Lectures (e-Resources):				
https://swayam.gov.in/explorer and https://nptel.ac.in/courses				
VIII: Activity Based Learning / Practical Based Learning/Experiential learning:				
Mention suggested Activities like Seminar, assignments , quiz, mini projects				

2023-SCHEME

ANNEXURE

CIE & SEE EVALUATION

GUIDELINES

ANNEXURE

|| Jai Sri Gurudev ||
Sri Adichunchanagiri Shikshana Trust (R)

SJB Institute of Technology

BGS Health and Education City, Dr. Vishnuvardhana Road, Kengeri, Bengaluru-560060
Approved by AICTE, New Delhi.
Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 – 2015
Recognized by UGC, New Delhi with 2(f) & 12 (B)

CIE & SEE Evaluation strategy for Autonomous Scheme 2023 (Tentative)

Revised/updated on 29/06/2024; the update modifies the practical component evaluation of integrated courses & laboratory courses involving the mini projects or course projects.

Sl. No.	Course Type /Credits	Continuous Internal Evaluation (CIE)																		Semester End Examination (SEE)									Total Marks (CIE+SEE)
				I. Theory Component							II. Practical Component											Theory				Practical				
		Total CIE marks	Min. Eligty.	Marks	Min. Eligty.	A. Unit test		B. Formative Assessments		Tot. Theory marks (I)	Marks	Min. Eligty.	C. Weekly Evaluation		D. Internal Test			E. Prj	Tot. marks (II)	Total CIE marks	Dur. In hrs.	Max. cond. marks	Max. considered marks	min. pass %	Max. cond. marks	Max. considered marks	min. pass %	Total SEE marks	
						Nos.	Marks / Each	Nos.	Marks / Each				Each week	Tot. marks	Nos.	Marks / Each	Total marks	Marks												
1	BSC/ESC/PCC/ETC/ PEC/OEC (3 or 4 Credit courses)	50	50%	50	50%	3	50	2	50	50 (avg. of 5)	--	--	--	--	--	--	--	--	--	50 (I)	03	100	50	40%	--	--	--	50	100
2	IBSC/IESC/IPCC (4 Credit courses)	50	50%	50	50%	3	50	--	--	50 (avg. of 3)	50	50%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (Avg. of I & II)	03	100	50	40%	--	--	--	50	100
3	IESC - CAED (4 credit course)	50	50%	--	--	--	--	--	--	--	50	50%	50	50 (Avg. of all)	1	50	50	--	50 (Avg. of C & D)	50	03	--	--	--	100	50	40%	50	100
4	PCCL (1 Credit courses)	50	50%	--	--	--	--	--	--	--	50	50%	50	50 (Avg. of all)	1	50	50	50	50 (Avg. of C & [D or E])	50 (II)	03	--	--	--	100	50	40%	50	100
5	AEC- IDT, Skill Development courses (1 credit course)	50	50%	50	50%	2	50	1	50	50 (Avg. of 3)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	40%	--	--	--	50	100
6	HSMC- CIP, Env studies, SFH, UHV (1 credit course)	50	50%	50	50%	2	50	1	50	50 (Avg. of 3)	--	--	--	--	--	--	--	--	--	50 (I)	02	50	50	40%	--	--	--	50	100
7	HSMC - English, Kannada (No credits)	50	50%	50	50%	2	50	1	50	50 (Avg. of 3)	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	50
8	NCMC - Personality Development courses, PE, Yoga, NCC, NSS, IKS (No credits)	50	50%	50	50%	--	--	1	50	50	--	--	--	--	--	--	--	--	--	50 (I)	--	--	--	--	--	--	--	--	50

 # Formative (Successive) Assessments: Assignments/quiz/ seminars/field survey and report presentation/course project/etc. based on the faculty & dept. planning. **# Practical Conduction:** The conduction of each experiment/program per week should evaluate for 50 Marks and average of all shall be taken. **# In case of Integrated course,** minimum eligibility shall be attained as prescribed in both the theory and practical components. **# Self Learning Courses (SLC) Courses, Internship, Mini project & Major Project: Rubrics & Methodology shall be defined seperately**

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25.6.2024
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ANNEXURE

|| Jai Sri Gurudev ||
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Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi
Accredited by NAAC with 'A+'grade, Certified by ISO 9001 - 2015
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CIE and SEE guidelines based on course Type for Autonomous Scheme 2023

Revised/updated on 29/06/2024; the update modifies the practical component evaluation of integrated courses & laboratory courses involving the mini projects or course projects.

Note:

- **The CIE conduction coordination will be done by the office of Controller of Examination (COE).**
- **The SEE will be conducted by the office of Controller of Examination (COE).**

Continuous Internal Evaluation (CIE)	Semester End Examination (SEE)	Final Passing requirement
1. BSC/ESC/PCC/ ETC/PEC/OEC – Theory Course (03 & 04 Credit courses)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test B. Formative assessments	The minimum passing mark for SEE is 40% of the maximum marks (20 out of 50 marks). **Semester-End Examination:** Duration of 03 hours and total marks of 100. • The question paper will have ten questions. Each question is set for 20 marks. • There will be 2 questions from each module. Each of the two questions under a	The student is declared as a pass in the course if he/she secures a minimum of 45% (45 marks out of 100) in the sum total of the CIE and SEE taken together.

week & 15th week, respectively. • The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. • The student must answer 2 full questions (one from 1st& 2nd questions and another from 3rd& 4th question). • Internal Assessment Test question paper shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. **B. Formative assessments:** • 02 formative assessments each of 50 marks shall be conducted by the course coordinator based on the dept. planning during random times. • One formative assessment shall be completed before 5th week and second shall be completed before 12th week. • The syllabus content for the formative assessment shall be defined by the course coordinator. • The formative assessments include Assignments/ Quiz/ seminars/case study/field survey/ report presentation/ course project/etc. • The assignment QP or Quiz QP shall indicate marks of each question and the relevant COs & RBT levels. • The rubrics required for the other formal assessments shall be defined by the departments along with mapping of relevant COs & POs and get it approved from academic dean. **The final CIE marks will be 50:** Average of all 05 events of Internal Assessment test and formative assessments. **The documents of all the assessments shall be maintained meticulously.**	module (with a maximum of 3 sub-questions), should have a mix of topics under that module. • The students have to answer 5 full questions, selecting one full question from each module. • Marks scored shall be proportionally reduced to 50 marks.	

2. IBSC/IESC/IPCC – Integrated with Theory & Practical (04 credit courses)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). Minimum eligibility of 50% marks shall be attained separately in both the theory component and practical component. **Continuous Internal Evaluation:** CIE will be conducted by the department and it will have 02 component: I. Theory Component. II. Practical Component. I. Theory Component will consist of A. Internal Assessment Test B. Formative assessments (Not required for Integrated courses) **A. Internal Assessment Test:** • There are 03 tests each of 50 marks conducted during 6th week, 10th week & 15th week, respectively. • The question paper will have four questions (max of 3 sub questions) from the notified syllabus. Each question is set for 25 marks. • It is suggested to include questions on laboratory content in the Internal Assessment test Question papers. • The student must answer 2 full questions (one from 1st& 2nd questions andanother from 3rd& 4th question). • Internal Assessment Test question paper shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course. **B. Formative assessments:** • Not required for Integrated courses.	The minimum passing mark for SEE is 40% of the maximum marks (20 out of 50 marks). **Semester-End Examination:** Only theory SEE for duration of 03 hours and total marks of 100. • The question paper will have ten questions. Each question is set for 20 marks. • There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module. • The laboratory content must be included in framing the theory question papers. • The students have to answer 5 full questions, selecting one full question from each module. • Marks scored shall be proportionally reduced to 50 marks. **No Practical SEE for Integrated Course.** Note: CAED Course shall not be considered here, it shall be considered as in sl. No. 3 in the next row	The student is declared as a pass in the course if he/she secures a minimum of 45% (45 marks out of 100) in the sum total of the CIE and SEE taken together.

II. Practical Component: **C.** Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/programs shall be taken.(rubrics will be published by the lab conduction committee) **D.** One laboratoryInternal Assessment test will be conducted during the 14th week for 50 marks.(rubrics will be published by the lab conduction committee) **E.** If the course project / mini project is involved in the laboratory component.**The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POsand get it approved from academic dean. **Note:** • If component 'E' is involved in the course either component 'D' or 'E' along with component 'C' shall be considered for average of item II. • Otherwise, components 'C' & 'D' shall be considered for average of item II. **The final CIE marks will be 50 =** Avg. {**I** [Avg. of 03 Internal assessment tests] + **II** [Avg. of (C&(Dor E))]} **The documents of all the assessments shall be maintained meticulously.** Note: CAED Course shall not be considered here, it shall be considered as in sl. No. 3 in the next row		
3. IESC: CAED Course (4 credits)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). • CIE shall be conducted for max. marks of 100 and shall be scaled down to 50 marks • CIE component should comprise of both Manual and computer drafting i.e. 50% manual and 50% computer drafting out of total 100 marks	The minimum passing mark for SEE is 40% of the maximum marks (20 out of 50 marks). **Semester-End Examination:** SEE for duration of 03 hours and total marks of 100.	The student is declared as a pass in the course if he/she secures a minimum of 45% (45 marks out of 100) in the sum total of the CIE and SEE taken together.

- CIE component should comprise of Continuous evaluation of drawing work of students as and when the modules are covered based on below detailed weightage.

Module	Module Max. Marks	Evaluation Weightage in marks	
		Computer display and print out	Manual Sketching
Module 1	20	10	10
Module 2	20	10	10
Module 3	20	10	10
Module 4	20	10	10
Module 5	20	10	10
TOTAL	**100**	**50**	**50**

- At least one Test covering all the modules is to be conducted for 100 marks during 14th week and the same is to be scaled down to **25 Marks.**
- Assignments = **10 Marks from each module. (50 marks scaled down to 25 Marks)**
- The final CIE 50 marks = Test (25 marks) + Assignment (25 marks).

- SEE shall be conducted and evaluated for maximum marks of 100 and shall be scaled down to 50 marks.
- Question paper shall be made available for each batch asper schedule.
- Evaluation shall be carried jointly by both theinternal & external examiners.
- Scheme of Evaluation: To be defined by both the examiners jointly.
- Maximum 3 questions shall be set as per the following pattern.

From Module			Marks Allotted
Module 01 (Choice between Lines or Planes)			30
Module 02 (Compulsory question)			40
Module 03 or Module 04 or Module 05			30
TOTAL			**100**
Q. No.	**Manual Sketching**	**Computer display and print out**	**TOTAL MARKS**
1	15	15	30
2	20	20	40
3	15	15	30
TOT.	**50**	**50**	**100**

4. PCCL: Laboratory course (01 credit course)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50).

The minimum passing mark for SEE is 40% of the maximum marks (20 out of 50 marks).

The student is declared as a pass in the course if he/she secures a

Continuous Internal Evaluation: CIE will be conducted by the department and it will have only 01 component: I. Theory Component. (Not required for Laboratory course) II. Practical Component. **II. Practical Component:** **C.** Conduction of each experiment/program should be evaluated for 50 marks and average of all the experiments/program shall be taken (rubrics will be published by the lab conduction committee). **D.** One laboratory Internal Assessment test will be conducted for 50 marks (rubrics will be published by the lab conduction committee). **E.** If the course project / mini project is involved in the laboratory component.**The evaluation shall be completed by 14th week of the semester.** The rubrics required for the evaluation of the project shall be defined by the departments along with mapping of relevant COs & POsand get it approved from academic dean. **Note:** • If component 'E' is involved in the course either component 'D' or 'E' along with component 'C'shall be consideredfor average of item II. • Otherwise, components 'C' & 'D' shall be considered for average of item II. **The final CIE marks will be 50** = Avg. of (C &[D or E]) **The documents of all the assessments shall be maintained meticulously.**	**Semester-End Examination:** Only laboratory SEE will be conducted jointly by the internal examiner and external examiner appointed by COE as per the scheduled timetable for duration of 03 hours. • The examination shall be conducted for 100 marks and shall be reduced to 50 marks proportionately. • All laboratory experiments/programs are to be included for practical examination. • Breakup of marks (Rubrics) and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners (OR) based on the course requirement evaluation rubrics shall be decided jointly by examiners. • Students can pick one question (experiment/program) from the questions lot prepared by the internal /external examiners jointly. • Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners. • General rubrics suggested for SEE: writeup-20%, Conduction procedure and results -60%, Viva-voce 20% of maximum marks. • Change of experiment is allowed only once and shall be assessed only for 85% of the maximum marks.	minimum of 45% (45marks out of 100) in the sum total of the CIE and SEE taken together.
5. AEC: Ability Enhancement Courses (01 credit courses)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		
The minimum passing mark for the CIE is 50% of the maximum marks	The minimum passing mark for SEE is 40%	The student is declared

(25 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test B. Formative assessments **A. Internal Assessment Test:** • There are 02 tests each of 50 marks conducted during 6th week & 15th week, respectively. • The question paper will be of Multiple-Choice Questions (MCQ). • The student must answer all questions. • Internal Assessment Test question paper shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** • 01 formative assessments of 50 marks shall be conducted by the Course coordinator based on the dept. planning before 14th week. • The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. • The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. • The rubrics required for the other formal assessments shall be defined by the departments along with mapping of relevant COs &POs. **The final CIE marks will be 50:** Average of all 03 events (02 Internal Assessment test and 01 formative assessment). **The documents of all the assessments shall be maintained meticulously.**	of the maximum marks (20 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. • Multiple choice Question paper. • The students have to answer all questions.	as a pass in the course if he/she secures a minimum of 45% (45marks out of 100) in the sum total of the CIE and SEE taken together.
6. HSMC: (01 credit course)		
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.		

The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and will have only 01 component: **I. Theory component.** Theory Component will consist of A. Internal Assessment Test B. Formative assessments **A. Internal Assessment Test:** • There are 02 tests each of 50 marks conducted during 6th week & 15th week, respectively. • The question paper will be of Multiple-Choice Questions (MCQ). • The student must answer all questions. • Internal Assessment Test question paper shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** • 01 formative assessments of 50 marks shall be conducted by the faculty based on the dept. planning before 14th week. • The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. • The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. • The rubrics required for the other formal assessments shall be defined by the departments along with mapping of relevant COs &POs. **The final CIE marks will be 50:** Average of all 03 events (02 IA test and 01 formative assessment). **The documents of all the assessments shall be maintained meticulously.**	The minimum passing mark for SEE is 40% of the maximum marks (20 out of 50 marks). **Semester-End Examination:** Theory SEE will be conducted by COE as per the scheduled timetable for duration of 02 hours and total marks of 50. • Multiple choice Question paper. • The students have to answer all questions. • Marks scored shall be proportionally reduced to 50 marks.	The student is declared as a pass in the course if he/she secures a minimum of 45% (45 marks out of 100) in the sum total of the CIE and SEE taken together.
7. HSMC: (0 credit courses)		

The weightage is only for Continuous Internal Evaluation (CIE).		
The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of C. Internal Assessment Test D. Formative assessments **A. Internal Assessment Test:** • There are 02 tests each of 50 marks conducted during 6th week & 15th week, respectively. • The question paper will be of Multiple-Choice Questions (MCQ). • The student must answer all questions. • Internal Assessment Test question paper shall be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course **B. Formative assessments:** • 01 formative assessments of 50 marks shall be conducted by the faculty based on the dept. planning during random times. • The formative assessments include Assignments/seminars/case study/field survey/ report presentation/course project/etc. • The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. • The rubrics required for the other formal assessments shall be defined by the departments along with mapping of relevant COs &POs. **The final CIE marks will be 50** = Average of all 03 events (02 IA test and 01 formative assessment). **The documents of all the assessments shall be maintained meticulously.**	• No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 50% (25 marks out of 50) in the CIE.
8. NCMC: (0 credit course)		
The weightage is only for Continuous Internal Evaluation (CIE).		

The minimum passing mark for the CIE is 50% of the maximum marks (25 marks out of 50). **Continuous Internal Evaluation:** CIE will be conducted by the department and it will have only 01 component: **I. Theory component.** Theory Component will consist of only 01 assessment A. Internal Assessment Test (not required for NCMC course). B. Formative assessments. **B. Formative assessments:** • 01 formative assessments of 50 marks shall be conducted by the faculty based on the dept. planning during random times. • The formative assessments include Quiz/Assignments/seminars/case study/field survey/ report presentation/course project/etc. • The assignment QP shall indicate marks of each question and the relevant COs & RBT levels. • The rubrics required for the other formal assessments shall be defined by the departments along with mapping of relevant COs &POs. **The final CIE marks will be 50** **The documents of all the assessments shall be maintained meticulously.**	• No Semester End Examination.	The student is declared as a pass in the course if he/she secures a minimum of 50% (25 marks out of 50) in the CIE.

Academic Dean
Dr. Babu N.V

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25.6.2019

Principal
Dr. K V Mahendra Prashanth

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PROGRAM OUTCOMES

PO/ PSO Number.	A. PROGRAM OUTCOMES
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**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.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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
	B. PROGRAM SPECIFIC OUTCOMES
PSO1	Apply the Knowledge & Skill of Mechanical Engineering on Design, Manufacturing and Thermal platforms to address the real life problem of the society.
PSO2	Design and implement new ideas with the help of CAD/CAM and Industrial Automation tools.

|| Jain Sri Gurudev ||

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