Department of Mechanical Engineering

COURSE PLAN 2022-23

III Semester

INSTITUTE VISION

"To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society"

INSTITUTE MISSION

"To continuously strive for the overall development of students, educating them in a state-of-the-art-infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals"

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

"To be the centre of excellence in providing education in the field of Mechanical Engineering to produce technically competent and socially responsible engineering graduates"

MISSION

"Educating students to prepare them for professional competencies in the broader areas of the Mechanical Engineering field by inculcating analytical skills, research abilities and encouraging culture of continuous learning for solving real time problems using modern tools"

Program Educational Objectives (PEOs)

The Graduates will be able to

PEO1: Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study

PEO2: Design, demonstrate and analyze the mechanical systems which are useful to society.

PEO3: Maintain professional & ethical values, employability skills, multidisciplinary approach & an ability to realize engineering issues to broader social context by engaging in lifelong learning.

Program Specific Outcomes (PSOs)

PSO1: Able to apply the basic principles of Mechanical Engineering in various practical fields to solve societal problems by engaging themselves in many state/national level projects.

PSO2: Able to analyze and design basic mechanical system using relevant tools and techniques.

PSO3: Able to resolve contemporary issues of industries through industry institute interaction and alumni social networks

Program Outcomes (POs)

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.

CONTENTS

Departmental Resources

Department of Mechanical Engineering was established in the year 1996 and is housed in a total area of **2584.5 Sq. Meters**.

Faculty Position

Sl. No.	Category	No. in position	Average experience
1	Teaching faculty	08	19
2	Technical staff	05	17
3	Helper / Peons	03	13

Major Laboratories

S.N.	Name of the laboratory	Area in Sq. Meters	Amount Invested (Rs.)
1	Basic Workshop Laboratory	170	428093
2	Fluid Mechanics Machinery Laboratory	172	775916.75
3	Energy Conversion Engg. Laboratory	173	1275603.2
4	Machine shop Laboratory	170	1372566.5
5	Foundry & Forging Laboratory	179	321057.11
6	Design Laboratory	73	365861.0
7	Heat & Mass Transfer Laboratory	148	524576.0
8	Metallography & Material Testing Laboratory	149	1102945.2
9	Mechanical Measurements & Metrology Laboratory	95	557593.75
10	CIM & Automation/CAMA Laboratory	66	3720793.1
11	Computer Aided Machine Drawing Laboratory	66	2014136.5
12	Computer Aided Engg Drawing Laboratory	66	1438121.3
13	Department/Other	--	2031766.2
	Total	**1527**	638297
			16567326.61

Teaching Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Teaching Exp (in years)	Contact Nos.
1	Dr. S. C. Kamate	Principal	Ph. D	Thermal(Cogeneration)	32	9480849331
2	Dr. S. N. Topannavar	Assoc. Prof.	Ph. D	Thermal Power Engg.	24	9482440235
3	Prof. K. M. Akkoli	Assoc. Prof.	Ph. D	Thermal Power Engg.	19	9739114856
4	Prof. D. N. Inamdar	Asst. Prof	M Tech.(Ph. D)	Tool Engg	20	9591208980
5	Prof.M.S.Futane	Asst. Prof	M Tech.	Computer Integrated Manufacturing	17	9164105035
6	Prof.S. A. Goudadi	Asst. Prof	M Tech.	Design Engineering	15	9448876682
7	Prof.M.M.Shivashimpi	Asst. Prof	M Tech.(Ph.D)	Thermal Power Engg.	16	9742197173
8	Prof.M.A.Hipparagi	Asst. Prof	M Tech.(Ph.D)	Production Technology	14	7411507405
9	Prof. G. M. Zulapi	Asst. Prof	M Tech.	Product Design & Manufacturing	15	9480213587

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2022-23 (Odd)

Date	Events
19-09-2022	Commencement of Classes for VII Semester
24-09-2022	NSS Foundation Day
02-10-2022	Gandhi Jayanthi
10-10-2022	Commencement of Classes for V Semester
24-10-2022 to 30-10-2022	Traffic Week
27-10-2022 to 29-10-2022	First Internal Assessment for VII Semester
31-10-2022	Feedback -I on Teaching-Learning for VII Semester
31-10-2022	National Integration Day
31-10-2022	Commencement of Classes for III Semester
01-11-2022	Kannad Rajyothsava
03-11-2022	Display of 1st Internal Assessment Marks and submission of Feedback-I of VII Semester to office
09-11-2022 to 18-11-2022	Environment Awareness Month
22-11-2022	World's Aids Day
26-11-2022	First Assignment Submission of III Semester (PCC + IPCC)
28-11-2022 to 30-11-2022	Second Internal Assessment for VII Semester & First Internal Assessment for III (PCC + IPCC) /V Semester
01-12-2022	Feedback –II on Teaching-Learning for VII Semester & Feedback – I on Teaching-Learning for III/V Semester
06-12-2022	Display of 2nd Internal Assessment Marks and submission of Feedback-II of VII Semester & Display of 1st Internal Assessment Marks and submission of Feedback-I of III/V Semester to office
10-12-2022	Human Rights Day
10-12-2022	Sports Day
23-12-2022 & 24-12-2022	First Lab Internal Assessment for III Semester (PCC+AEC)
26-12-2022 & 27-12-2022	Lab Internal Assessment for VII Semester
29-12-2022 to 31-12-2022	Third Internal Assessment for VII Semester & Second Internal Assessment for III (PCC + IPCC) /V Semester
31-12-2022	Last working day for VII Semester
02-01-2023	Feedback –II on Teaching-Learning for III/V Semester
05-01-2023	Display of Final IA Marks of VII Semester
05-01-2023	Display of 2nd Internal Assessment Marks and submission of Feedback-II of III/V Semester to office
07-01-2023	Second Assignment Submission of III Semester (PCC + IPCC)
12-01-2023	National Youth Day
15-01-2023	NSS Day
20-01-2023 & 21-01-2023	Lab Internal Assessment for V Semester
23-01-2023 to 25-01-2023	Third Internal Assessment for V Semester
26-01-2023	Republic Day
27-01-2023	Last working day for V Semester
30-01-2023 to 01-02-2023	Second Lab Internal Assessment for III Semester (PCC+IPCC+AEC)
31-01-2023	Display of Final IA Marks of V Semester
06-02-2023 to 08-02-2023	Third Internal Assessment for III Semester (PCC)
11-02-2023	Last working day for III Semester
14-02-2023	Display of Final IA Marks of III Semester

September-2022

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

October-2022

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

04- Mahanavami, Ayudhapooja 05- Vijayadashami
24- Naraka Chaturdashi, 26- Balipadyami Deepavalli

Novemner-2022

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

01- Kannada Rajyothsava, 11- Kanakadasa Jayanti

December-2022

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

January-2023

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

14-Makara Sankranti, 26- Republic Day

February-2023

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

18- Mahashivaratri

Dr. B. V. Madiggond
Dean (Academics)

Dr. S. C. Kamate
Principal

VTU Scheme of Teaching and Examination

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E. in MECHANICAL ENGINEERING
Scheme of Teaching and Examinations2021
Outcome Based Education(OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 - 22)

III SEMESTER

Sl. No	Course and Course Code	Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
				Theory Lecture	Tutorial	/	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S					
1	BSC 21MAT31	Transform Calculus, Fourier Series And Numerical Techniques	Maths	2	2	0	0	03	50	50	100	3
2	IPCC 21ME32	Metal casting, Forming and Joining Processes	TD: ME PSB: ME	3	0	2	0	03	50	50	100	4
3	IPCC 21ME33	Material Science and Engineering	TD: ME PSB ME	3	0	2	0	03	50	50	100	4
4	PCC 21ME34	Thermodynamics	TD: ME PSB ME	2	2	0	0	03	50	50	100	3
5	PCC 21MEL35	Machine Drawing and GD & T	TD: ME PSB ME	0	0	2	0	03	50	50	100	1
6	UHV 21UH36	Social Connect and Responsibility	Any Department	0	0	1	0	01	50	50	100	1
7	HSMC 21KSK37/47	Samskrutika Kannada	TD and PSB: HSMC	1	0	0	0	01	50	50	100	1
	HSMC 21KBK37/47	Balake Kannada										
	OR											
	HSMC 21CIP37/47	Constitution of India and Professional Ethics										
8	AEC 21ME38X	Ability Enhancement Course – III	TD: Concerned department PSB: Concerned Board	If offered as Theory Course: 0	2	0		01	50	50	100	1
				If offered as lab. course: 0	0	2		02				
								Total	400	400	800	18

Course	Transform Calculus, Fourier Series and Numerical Techniques		
Course Code	21MAT31	IA Marks	50
Number of Lecture Hrs / Week	04	Exam Marks	50
Total Number of Lecture Hrs	40	Exam Hours	03
		CREDITS – 03	

FACULTY DETAILS:		
Name: Prof. S.S.Thabaj	Designation: Asst. Professor	Experience: 10
No. of times course taught: 01	**Specialization:** Mathematics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engineering	II	Advanced Calculus & Numerical Methods

2.0 Course Objectives

Course Learning Objectives:

- To have an insight into solving ordinary differential equations by using Laplace transform techniques
- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis.
- To enable the students to study Fourier Transforms and concepts of infinite Fourier Sine and Cosine transforms and to learn the method of solving difference equations by the z transform method.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

Course Code	Course Outcome	RBTL	POs
C201.1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.	L1,L2,L3	1,2,3,12
C201.2	Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.	L1,L2,L3	1,2,3,12
C201.3	To use Fourier transforms to analyze problems involving continuous-time signals and to apply Z-Transform techniques to solve difference equations	L1,L2,L3	1,2,3,12
C201.4	To solve mathematical models represented by initial or boundary value problems involving partial differential equations	L1,L2,L3	1,2,3,12
C201.5	Determine the externals of functional using calculus of variations and solve problems arising in dynamics of rigid bodies and vibration analysis.	L1,L2,L3	1,2,3,12
Total Hours of instruction		**40**	

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4.0 Course Content

Module-1: Laplace Transform:

Definition and Laplace transforms of elementary functions (statements only). Problems on Laplace's Transform of $e^{at}f(t), t^n f(t), \frac{f(t)}{t}$. Laplace transforms of Periodic functions (statement only) and unit-step function – problems.

Inverse Laplace Transform: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Laplace transforms of derivatives, solution of differential equations.

Self-study: Solution of simultaneous first-order differential equations. **(8 Hours)**

Module -2: Fourier Series:

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

Self-study: Convergence of series by D'Alembert's Ratio test and, Cauchy's root test. **(8 Hours)**

Module -3: Infinite Fourier Transforms and Z-Transforms

Infinite Fourier transforms definition, Fourier sine and cosine transforms. Inverse Fourier transforms, Inverse Fourier cosine and sine transforms. Problems. Difference equations, z-transform-definition, Standard z-transforms, Damping and shifting rules, Problems. Inverse z-transform and applications to solve difference equations. **(8 Hours)**

Self Study: Initial value and final value theorems, problems.

Module -4: Numerical Solution of Partial Differential Equations

Classifications of second-order partial differential equations, finite difference approximations to derivatives, Solution of Laplace's equation using standard five-point formula. Solution of heat equation by Schmidt explicit formula and Crank- Nicholson method, Solution of the Wave equation. Problems. **(8 Hours)**

Self Study: Solution of Poisson equations using standard five-point formula.

Module -5: Numerical Solution of Second-Order ODEs and Calculus of Variations

Second-order differential equations - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). Calculus of Variations: Functionals, Euler's equation, Problems on extremals of functional. Geodesics on a plane, Variational problems. **(8 Hours)**

Self Study: Hanging chain problem

5.0 Relevance to future subjects

Sl. No.	Semester	Subject	Topics
01	Common to all	Common to all engineering Subjects	Circuit Analysis, Field Theory, control Engg , signal analysis, Fluid Dynamics Thermodynamics, etc

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Numerical methods are used to solve engineering problems. For examples will be drawn from a

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	variety of engineering problems, including heat transfer, vibrations, dynamics, fluid mechanics, etc.
02	Laplace transform are used in various areas of physics, electrical engineering, control engineering, optics, mathematics and signal processing. Laplace Transform is widely used by electronic engineers to solve quickly differential equations occurring in the analysis of electronic circuits
03	Fourier series is that very little information is lost from the signal during the transformation. The Fourier transform maintains information on amplitude, harmonics, and phase and uses all parts of the waveform to translate the signal into the frequency domain.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Calculus of Variations

8.0 Books Used and Recommended to Students

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition 2018, Khanna Publishers.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed., 2016.
3. Srimanta Pal et al Engineering Mathematics, 3rd Edition, 2016, Oxford University Press.

Reference Books

1. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11th Ed.
2. Srimanta Pal & Subodh C. Bhunia: "Engineering Mathematics" Oxford University Press,3rd Reprint, 2016.
3. N.P Bali and Manish Goyal: "A textbook of Engineering Mathematics" Laxmi Publications, Latest edition.
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw – Hill Book Co. New York, Latest ed.
5. Gupta C.B, Sing S.R and Mukesh Kumar: "Engineering Mathematic for Semester I and II", McGraw Hill Education (India) Pvt. Ltd 2015.
6. H. K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S. Chand Publication (2014).
7. James Stewart: "Calculus" Cengage publications,7th edition, 4th Reprint 2019.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU Edusat Programme
5. VTU e-Shikshana Program
6. http://www.bookstreet.in.

10.0 Magazines/Journals Used and Recommended to Students

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Sl. No	Magazines/Journals	website
1	+ Plus Magazine	https://plus.maths.org/issue44.
2	Mathematics Magazine	www.mathematicsmagazine.com

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weight age of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks** (duration 01 hour)
2. First test at the end of 5th week of the semester
3. Second test at the end of the 10th week of the semester
4. Third test at the end of the 15th week of the semester.

Two assignments each of 10 Marks

5. First assignment at the end of 4th week of the semester
6. Second assignment at the end of 9th week of the semester
7. Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**
8. At the end of the 13th week of the semester The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks** (to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject **(duration 03 hours)**

- The question paper will be set for 100 marks and marks scored will be proportionally scaled down to 50 marks
- 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 students have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecturer	% of Portion
1	1	Definition, transforms of elementary functions & Properties	
	2	Problems	

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	3	Periodic function	20
	4	Unit step function & Problems	
	5	Inverse Laplace Transforms	
	6	Convolution theorem	
	7	Solution of linear differential equations using Laplace Transforms	
	8	Problems	
2	9	Introduction to infinite series	20
	10	convergence and divergence	
	11	Introduction, Periodic functions, Dirichlet's conditions	
	12	Fourier series of periodic functions of period 2π & Problems	
	13	Fourier series of periodic functions of arbitrary period 2l & Problems	
	14	Fourier series of even & odd functions	
	15	Half range Fourier series & Problems	
	16	Practical harmonic analysis	
3	17	Introduction, Infinite Fourier transform	20
	18	Fourier sine transforms & Problems	
	19	Fourier cosine transforms & Problems	
	20	Inverse Fourier transforms & Problems	
	21	z-transform-definition & Standard z-transforms	
	22	Initial value and final value theorems (without proof) and problems	
	23	Inverse z-transform & Problems	
	24	Applications of z-transforms to solve difference equations	
4	25	Classifications of second-order partial differential equations	20
	26	Finite difference approximations to derivatives	
	27	Solution of Laplace's equation using standard five-point formula.	
	28	Problems.	
	29	Solution of heat equation by Schmidt explicit formula	
	30	Solution of heat equation by Crank- Nicholson method	
	31	Solution of the Wave equation	
	32	Problems.	
5	33	Numerical solution of second order ordinary differential equations	20
	34	Runge -Kutta method & Problems.	
	35	Milne's method & Problems.	
	36	Problems.	
	37	Calculus of Variations: Variation of function & Functional, variation problems	
	38	Euler's equation	
	39	Problems	
	40	Geodesics and problems	

13.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university	Module 1 of the syllabus	2	Individual Activity.	Book 1, of the reference list. Website of the

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		questions.				Reference list
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
3	Assignment 3: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
4	Assignment 4: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list
5	Assignment 5: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

Module-1: Laplace Transform

1. Find the Laplace Transform of $sin2t\ sin3t$. & $sin^3 2t$.
2. Find $L\ (e^3 tsin2t)$ & $L(e^{4t}\ sin2t\ cost)$.
3. Find $L\left(\frac{1-e^t}{t}\right)$ & $L[\frac{cosat-cosbt}{t}]$
4. Using unit step function find LT of $f(t) = \begin{cases} \sin t, & 0 < t < \pi \\ \sin 2t, & \pi < t < 2\pi \\ \sin 3t, & t > 2\pi \end{cases}$
5. Express $f(t) = \begin{cases} \cos t, & 0 < t < \pi \\ \cos 2t, & \pi < t < 2\pi \\ \cos 3t, & t > 2\pi \end{cases}$ in terms unit step function & hence find LT
6. Evaluate $L[t^2 u(t-3)]$.
7. Find the inverse transform $\frac{s+2}{s^2-4s+13}$.
8. Find $L^{-1}\left(\frac{4s+5}{(s-1)^2(x+2)}\right)$
9. Find $L^{-1}\left(\frac{s}{s^4+4a^4}\right)$.
10. Find $L^{-1}\left(\frac{s}{(s^2+a^2)^2}\right)$.
11. Find $L^{-1}\left[\ log\ \frac{(s+1)}{(s-1)}\right]$
12. Find $L^{-1}\left[\frac{s}{(2s-1)(3s-1)}\right]$
13. Using the Convolution THM obtain the $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$.
14. Solve the differential equation $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y\ =\ e^{3t}$ with $y(0) = 0 = y'(0)$, using LT
15. Solve the differential equation $y'' + 4y' + 3y = e^{-t}, y(0)\ = 1 =\ y'(0)$. Using LT

Module-2: Fourier series

1. Obtain a Fourier series to represent e^{-ax} from $(-\pi, x)$
2. Expand $f(x)\ =\ x\ sin\ x, 0\ <\ x\ <\ 2$, in a Fourier series.

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3. For a function $f(x)$ defined by $f(x) = |x|, -\pi < x < \pi,$ obtain a Fourier series. Deduce that
$\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}=\frac{\pi^2}{8}$
4. Find the Fourier series for the function $f(x)=\frac{\pi-x}{2}$ in $(0,2\pi)$.
Hence deduce that $\frac{\pi}{4}=1-\frac{1}{3}+\frac{1}{5}---$
5. Find the Fourier series to represent $f(x) = x + x^2$ from $x = -\pi$ to $x = \pi$ and deduce that
$\frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}-\frac{1}{4^2}=\frac{\pi^2}{12}$
6. Expand $f(x) = e^{-x}$ as a Fourier series in the interval $(-l, l)$
7. Obtain Fourier series for the function
$f(x)=\begin{cases}\pi x, & 0 \le x \le 1\\ \pi(2-x), & 1 \le x \le 2\end{cases}$ and deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}$-------
8. Develop f(x) in Fourier series in the interval (-2, 2) if $f(x)=\begin{cases}0, & -2 < x < 0\\ 1, & 0 < x < 2\end{cases}$
9. Find the half range cosine series for the function $f(x) = x^2$ in the range $0 \le x \le 1$
10. Find the complex form of the Fourier series of the periodic function$f(x) = cos\, ax$, in $-\pi < x < \pi$.
11. The following table gives the variation of periodic current over a period

t sec	0	T/6	T/3	T/2	2T/3	5T/6	T
A amp	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

Show that there is a direct current part of 0.75 amp in the variable current and obtain the amplitude of the first harmonic.

12. Obtain the Fourier expansion of $f(x) = 2x - x^2$ in $0 \le x \le 2$
13. Obtain the constant term and the coefficient of the first sine and cosine terms in the Fourier expansion of y as given below.

x	0	1	2	3	4	5
y	9	18	24	28	26	20

Module-3: Infinite Fourier Transforms and Z-Transforms

1. Find the Fourier transform of
$f(x)=\begin{cases}1, & |x|<1\\ 0, & |x|<1\end{cases}$. Hence evaluate $\int_0^\infty \frac{sinx}{x}dx$
2. Find the Fourier transform of the function
$f(x)=\begin{cases}x, & |x| \le \\ 0, & |x|>\alpha\end{cases}$. Where α is a positive constant?
3. Find the Fourier transform of $cosax^2$
4. Find the Fourier sine transform of e^{-ax}/x
5. Find the Fourier sine and cosine transform of $f(x)=\begin{cases}1, & 0 \le x < a\\ 0, & x \ge a\end{cases}$
6. Find the finite Fourier sine and cosine transform of $f(x) = 2x, \quad 0 < x < 4.$
7. Find the cosine transform of $f(x)=\frac{1}{1+x^2}$
8. Find the Fourier sine transform of $e^{-|x|}$
9. Find the Fourier transform of $f(x) = \begin{cases}a^2-x^2, & |x|<a\\ 0, & |x|>a\end{cases}$ and Evaluate $\int_0^\infty \frac{sinx-xcosx}{x^3}dx$.

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10. Find the Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}$, $a > 0$.
11. Find the Fourier cosine transform of $(x) = \begin{cases} x, & 0 < x < 1 \\ 2 - x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$.
12. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^\infty \frac{xsinmx}{1+x^2} dx$.
13. Find the Fourier transform of $f(x) = e^{-|x|}$ and Evaluate $\int_0^\infty \frac{xsinmx}{1+x^2} dx$.
14. P.T. $z_T(n^2) = \frac{z^2+z}{(z-1)^3}$
15. P.T. $z_T(n^3) = \frac{z^3+4z^2+2}{(z-1)^4}$
16. P.T. $z_T(cos\theta) = \frac{z(z-cos\theta)}{z^2-2zcos\theta+1}$
17. P.T. $z_T(sin\theta) = \frac{(zsin\theta)}{z^2-2zcos\theta+1}$
18. P.T. $z_T(a^n cosn\theta) = \frac{z(z-acos\theta)}{z^2-2azcos\theta+a^2}$
19. Find the Z-transform of $cos\, hn\theta$ & $sinhn\theta$.
20. Find the Z-transform of $(n+1)^2$
21. Using the inversion integral method find the inverse Z-transform of $\frac{3z}{(z-1)(z-2)}$
22. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_n = 0$ using Z-transform
23. Solve the difference equation $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_n = 0$ using Z-Transform.
24. Obtain the z-transform of $cos\, n\theta$ and $sin\, n\theta$
25. Find the Inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$.
26. If $\bar{u}(z) = \frac{2z^2+3z+12}{(z-1)^4}$, find the value of u_0, u_1, u_2, u_3.
27. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$, $u_0 = u_1 = 0$.

Module -4: Numerical Solution of Partial Differential Equations

1. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5$, $t \geq 0$ given that $u(x,0) = 20, u(0,t) = 0, u(5,t) = 100$.Compute u for thetime step with $h = 1$ by Crank Nicholson method.
2. Find the solution of the parabolic equation $u_{xx} = 2u_t$ when $u(0,t) = 0 = u(4,t) = 0$ and $u(x,0) = x(4-x)$, taking $h = 1$. Find the values up to $t = 5$.
3. Solve the equation $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$ with the conditions $u(0,t) = 0, u(x,0) = x(1-x)$ and $u(1,t) = 0$. Assume $h = 0.1$. Tabulate u for $t = k, 2k$ and $3k$ choosing an appropriate value of k.
4. Solve the boundary value problem $u_{tt} = u_{xx}$ with the conditions $u(0,t) = u(1,t) = 0$, $u(x,0) = \frac{1}{2}x(1-x)$ and $u_t(x,0) = 0$, taking $h = k = 0.1$ for $0 \leq t \leq 0.4$. Compare your solution with the exact solution at $x = 0.5$ and $t = 0.3$.
5. Solve $y_{tt} = y_{xx}$ upto $t = 0.5$ with a spacing of 0.1 subject to $y(0,t) = 0, y(1,t) = 0, y_t(x,0) = 0$ and $y(x,0) = 10 + x(1-x)$.Solve the equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in Fig. Iterate until the maximum difference between the successive values at any point is less than 0.001.

Module -5: Numerical Methods and Calculus of Variation

1. Use R- K method to solve $y = xy'^2 - y^2$ for x = 0.2 correct to 4 decimal places. $y(0) = 1$ & $y'(0) = 0$

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2. Evaluate $y(0.2)$ by RK method given that $y'' - x(y')^2 + y^2 = 0, y(0) = 1,\ y'(0) = 0$
3. Given $y'' - xy' - y = 0$ with the initial conditions y(0)=1, y'(0)=0. Compute y(0.2) and y'(0.2) by taking h=0.2 and using fourth order Runge Kutta method.
4. Obtain the solution of the equation $2\frac{d^2y}{dx^2} = 4x + \frac{dy}{dx}$ at the point $x = 1.4$ by applying Milne's method given that $y(1) = 2,\ y(1.1) = 2.2156,\ y(1.2) = 2.4649.\ y(1.3) = 2.7514, y'(1) = 2, y'(1.1) = 2.3178, y'(1.2) = 2.6725\ and\ y'(1.3) = 3.0657.$
5. Using R-K method of order four, solve $y'' = y + xy'$, y(0) = 1 , y'(0) to find $y(0.2)$ & $y'(0.2)$.
6. Show that the Geodesics on a plane are straight line.
7. Find the Geodesics on a right circular cylinder of radius a.
8. Find the extremals of the functional $\int_{x_0}^{x_1} \frac{(y'^2)}{x^3} dx$
9. Show that the shortest distance between any two points in a plane is a straight line.
10. Prove that Catenaries' is the curve which when rotated about a line generates a surface of minimum area.
11. Find the extremely of the functional $\int_0^{\pi}(y'^2 - y^2 + 4y\cos x)dx;\ y(0) = 0 = y(\pi)$
12. Solve the variation problem $\delta\int_1^2(x^2(y')^2 + 2y(x+y))dx = 0$, given $y(1) = y(2) = 0$
13. Find the path on which a particle in the absence of friction will slide from one point to another in a shortest time under the action of gravity.
14. Find the curve passing through the point (x_1, y_1) and (x_2, y_2) which when rotated about the x axis gives the minimum surface area.
15. Find the curve on which the functional $\int_0^1(y'^2 + 12xy)\,dx$ with $y(0) = 0$ and $y(1) = 1$ can be extremised.

16.0 University Result

Examination	FCD (S+, S, A)	FC (B)	SC (C, D, E)	% Passing
2020-21				
2019-20				

Prepared by	Checked by		
Prof.S.S.Thabaj	Dr. S. L. Patil	HOD	Principal

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Subject Title	Metal Casting Forming and Joining Process		
Subject Code	21ME32	IA Marks	50
No of Lecture Hrs + Practical Hrs / Week	03+2	Exam Marks	50
Total No of Lecture + Practical Hrs	40+12	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Mr. : G.M.Zulapi	**Designation:** Asst. Professor	**Experience:** 14 Years
No. of times course taught: 00 Time	**Specialization:** Product Design and Manufacturing	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
1	Mechanical Engineering	I / II	Elements of Mechanical Engineering

2.0 Course Objectives

- To acquaint with the basic knowledge on fundamentals of metal forming processes
- To study various metal forming processes.
- To provide adequate knowledge of quality test methods conducted on welded and cast components.
- To provide knowledge of various casting process in manufacturing.
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys.
- To provide detailed information about the moulding processes.
- To impart knowledge of various joining process used in manufacturing.

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	Cognitive Level	POs
C202.1	Classify manufacturing process and elaborate the parts of casting process.	U	1,6,12
C202.2	Summarize the different casting process and select the melting furnace based on ferrous and non-ferrous alloys.	U	1,6,12
C202.3	Understand the solidification, gasification, casting defects and different methods of directional solidification.	U	1,2,5,6,12
C202.4	List and explain different types of conventional welding processes.	U	1,2,3,6,12
C202.5	Explain different special types of welding, soldering, brazing and NDT.	U	1,2,3,5,6,12
Total Hours of instruction		**40**	

4.0 Course Content

MODULE -1

INTRODUCTION & BASIC MATERIALS USED IN FOUNDRY

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

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

Sand molding: Types of base sand, requirement of base sand. Binder, Additives definition, need and types

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Preparation of sand molds: Molding machines- Jolt type, squeeze type and Sand slinger.

Study of important molding process: Green sand, core sand, dry sand, sweep mold, CO2 mould, 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 risering (open, blind) Functions and types.

08 Hours

MODULE -2

MELTING & METAL MOLD CASTING METHODS

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 molds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes. Casting defects, their causes and remedies. **08 Hours**

MODULE -3

METAL FORMING PROCESSES

Introduction of metal forming process: Mechanical behaviour of metals in elastic and plastic deformation,stress-strain relationships, Yield criteria, Application to tensile testing, train 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. **08Hours**

MODULE -4

JOINING PROCESSES

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding. **08 Hours**

MODULE -5

Weldability and thermal aspects: Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkageand residual stresses in welded structures); Welding defects and remedies.

Allied processes: Soldering, Brazing and adhesive bonding

Advance welding processes: Resistance welding processes, friction stir welding (FSW). **08 Hours**

PRACTICAL COMPONENT OF IPCC

Course objectives:

- Impart fundamental understanding of various casting, welding and forming processes
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys
- Discuss design methodology and process parameters involve in obtaining defect free component

Sl.NO	Experiments
1	Studying the effect of the clay and moisture content on sand mould properties
2	Preparation of sand specimens and conduction of the following tests: 1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
3	To determine permeability number of green sand, core sand and raw sand.
4	To determine AFS fineness no. and distribution coefficient of given sand sample.
5	Use of 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

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6	To study the effect of heat affected zone on the microstructure of steel weldment using MMAW.
7	Preparing minimum three forged models involving upsetting, drawing and bending operations
8	Sheet metal punch/die design and layout optimization
	Demo experiments for CIE
9	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
10	Mould preparation of varieties of patterns, including demonstration
11	To generate plastic curve of a given metal strip at room temperature and at recrystallization temperature during rolling. Observe the changes in metal characteristic after rolling.
12	Demonstration of material flow and solidification simulation using Auto-Cast software

5.0 Relevance to future subjects/Area

SL. No	Semester	Subject	Topics / Relevance
01	IV	Machining Science And Jigs & Fixtures (IPCC)	Industry

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Casting Processes and testing
02	Melting Furnaces
03	Metal joining Techniques and Testing
04	Production of different metallic components by forming the metal in different shape and size with the application of different methods.

7.0 Books Used and Recommended to Students

Books

1. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press.
2. Parmar R. S., (2007), Welding Processes and Technology, Khanna Publishers.
3. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1989
4. Grong O. – 'Metallurgical Modelling of Welding' – The Institute of Materials – 1997 – 2nd Edition
5. Kou S. – 'Welding Metallurgy' – John Wiley Publications, New York – 2003 – 2nd Edition.
6. Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7thEdition
7. Principles of foundry technology, 4th edition, P L Jain, Tata McGraw Hill, 2006.
8. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing, 2006.

Additional Study Material and e-Books

- Nptel.ac.in
- VTU, E- learning
- MOOCS

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- Open courseware

8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
1. (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112105127/)
2. (Link:http://www.springer.com/us/book/9781447151784http://nptel.ac.in/courses/112
3. http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
4. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm
5. MOOCs: http://nptel.ac.in/courses/112105126/.

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Global Casting Magazines	http://www.globalcastingmagazine.com/
2	Science Direct	http://www.sciencedirect.com
3	Metal Forming Magazine	http://www.metalformingmagazine.com/home
4	International Journal of Material Forming	https://link.springer.com/journal/12289

10.0 Examination Note

1. The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 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 students have to answer 5 full questions, selecting one full question from each module.**Assessment Details (both CIE and SEE)**
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 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of 20 Marks (duration 01 hour)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for 30 marks.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.

The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-

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ups are added and scaled down to 15 marks.

- The laboratory test (duration 03 hours) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 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 students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE.

Marks secured will be scaled down to 50.

11.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
1	1	Definition, Classification of manufacturing processes. Metals cast in the foundry-classification	20%
	2	Factors that determine the selection of a casting alloy.Introduction to casting process & steps involved– (Brief Introduction)-Not for SEE.	
	3	Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.	
	4	Sand molding: Types of base sand, requirement of base sand. Binder, Additives definition, need and types.	
	5	Preparation of sand molds: Molding machines- Jolt type, squeeze type and Sand slinger.	
	6	Study of important molding process: Green sand, core sand,	
	7	Dry sand, sweep mold, CO2 mold, shell mold, investment mold, plaster mold, cement bonded mold..	
	8	Cores: Definition, need, types. Method of making cores,	
	9	concept of gating (top, bottom, parting line, horn gate)	
	10	Risering (open, blind) Functions and types	
2	11	Melting furnaces: Classification of furnaces,	40%
	12	Gas fired pit furnace, Resistance furnace,	
	13	Coreless induction furnace, electric arc furnace,	
	14	Constructional features & working principle of cupola furnace.	
	15	Casting using metal molds: Gravity die casting,	

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	16	Pressure die casting,	
	17	Centrifugal casting,	
	18	Squeeze casting,	
	19	Slush casting,	
	20	Thixocasting and continuous casting processes	
	21	Casting defects, their causes and remedies	
3	22	Introduction of metal forming process: Mechanical behaviour of metals in elastic and plastic	60%
	23	deformation,stress-strain relationships, Yield criteria	
	24	Application to tensile testing, train rate and temperature in metal working	
	25	Hot deformation, Cold working and annealing.	
	26	Metal Working Processes: Fundamentals of metal working, Analysis of bulk forming processes like forging,	
	27	Rolling, extrusion, wire drawing by slab method,	
	28	Other sheet metal processes: Sheet metal forming processes (Die and punch assembly,	
	29	Blanking, piercing, bending etc.,	
	30	Compound and Progressive die), High Energy rate forming processes	
4	31	Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types	80%
	32	Flame characteristics; Manual metal arc welding	
	33	Gas Tungsten arc welding	
	34	Gas metal arc welding	
	35	Submerged Arc Welding (SAW)	
5	36	Weldability and thermal aspects: Concept of weldability of materials	100%
	37	Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures);	
	38	Welding defects and remedies.	
	39	Allied processes: Soldering, Brazing and adhesive bonding	
	40	Advance welding processes: Resistance welding processes	
	41	friction stir welding (FSW).	

12.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 syllabus	3	Individual Activity and submission of hard copy.	Book 1 and all the reference book
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 syllabus	6	Individual Activity and submission of hard copy.	Book 1 and all the reference book
3	Assignment 3: University Questions	Students study the Topics and write the Answers. Get	Module 3 syllabus	9	Individual Activity and submission of hard copy.	Book 1 and all the reference

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		practice to solve university questions.				book
4	Assignment 3: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 syllabus	12	Individual Activity and submission of hard copy.	Book 1 and all the reference book
5	Assignment 3: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 syllabus	15	Individual Activity and submission of hard copy.	Book 1 and all the reference book

13.0 QUESTION BANK

Sample Questions	Questions
I	**MODULE 1** 1. Define manufacturing and explain the classification of manufacturing processes. 2. Define casting. Enumerate different steps involved in producing a component by casting process. 3. Define Pattern and explain the various pattern allowances. 4. What are the common materials used for pattern making? Discuss their relative merits and demerits. 5. Explain match plate pattern with sketch. 6. Explain with neat sketch sand slinger machine. 7. Explain with neat sketch Jolt machine. 8. Explain with neat sketch Squeeze machine. 9. Draw gating system and show all the elements. 10. Explain cement bonded mould. 11. Explain with neat sketch shell moulding process. 12. Explain with neat sketch CO_2 moulding process. 13. Explain with neat sketch sweep moulding process. 14. Explain method of core making. 15. Discuss functions and types of gating system. 16. Explain with neat sketches Open Riser and Blind Riser.
II	**MODULE 2** 1. Mention the factors to be considered in the selection of a suitable melting furnace. 2. What are the different types of crucible furnaces? With a sketch explain the principle of operation of a gas fired pit furnace. 3. Explain with neat sketch the operation of a high frequency induction furnace. 4. What are the differences between core type and coreless type induction furnaces? 5. Explain with neat sketch the operation of an indirect arc furnace. How does it differ from a direct arc furnace? 6. Explain with neat sketch Cupola furnace.. Mark the different zones clearly and discuss the importance of each zone. 7. Explain with neat sketch Hot chamber pressure die casting process. 8. Explain with neat sketch Casting defects.
III	**MODULE 3** 1. Explain the following Yield Criteria a) Tresca's Yield Criterion b) von Mises Criterion 2. Explain temperature in metal forming and write the comparison between hot working and cold

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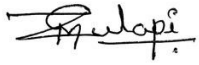
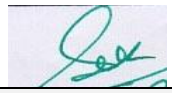
	working. 3. Derive the expression for forging by slab method. 4. Derive the expression for rolling load by slab method. 5. Derive the expression for extrusion by slab method. 6. Derive the expression for wire drawing load by slab method. 7. Explain the various dies and punches. 8. Explain with neat sketch sheet metal forming process like blanking, Piercing and bending. 9. Explain with neat sketch compound and progressive die. 10. Explain with neat sketches the following High Energy rate forming processes a) Explosive Forming b) Electro-hydraulic forming c) Electro-magnetic forming
IV	**MODULE 4** 1. Explain with a neat sketch oxy-acetylene welding. 2. Explain types of flame characteristics in oxy-acetylene welding. 3. What is the working principle of arc welding? 4. Explain with a neat sketch the MMAW welding process. Mention its advantages and limitations. 5. Explain with a neat sketch the MIG welding process. Mention its advantages and limitations. 6. Explain with a neat sketch the TIG welding process. Mention its advantages and limitations. 7. Explain with a neat sketch the SAG welding process. Mention its advantages and limitations.
V	**MODULE 5** 1. Define weldability and briefly explain the factors that affect the weldability of materials. 2. Explain Distortion, shrinkageand residual stresses in welded structures. 3. Explain with neat sketches welding defects and remedies. 4. Differentiate between soldering and brazing. 5. Explain with neat sketch Resistance spot welding process. 6. Explain with neat sketch Resistance seam welding process. 7. Explain with neat sketch Resistance butt welding process. 8. Explain with neat sketch Resistance projection welding process. 9. Explain with neat sketch friction stir welding (FSW).

14.0 University Result

Examination	S+	S	A	B	C	D	E	% Passing
--	--	--	--	--	--	--	--	New subject

Prepared by	Checked by		
			
Prof. G.M.Zulapi	**Prof. M A Hipparagi**	**HOD**	**Principal**
Faculty	**Module coordinator**		

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Subject Title	MATERIAL SCIENCE & ENGINEERING		
Course Code	21ME33	CIE Marks	50
Number of Lecture Hrs / Week(L:T:P: S)	3:0:2*:0	SEE Marks	50
Total Number of Lecture Hrs	40 hours Theory + 12 Lab slots	Exam Hours	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof. D.N. INAMDAR.	Designation: Asst .Professor	Experience:21Years
No. of times course taught:02	Specialization: Tool Design	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	High School	8, 9,10th Std.	Physics, Chemistry
02	PU Science	I and II year	Atomic Physics, Physical Chemistry. Periodic Tables

2.0 Course Objectives

CLO1: Provide basic background to systematically approach for selection of materials for a wide range of products in engineering applications
CLO2: Introduce the concept of crystal structure, atomic planes and directions.
CLO3: Introduce the concept of atomic packing, coordination, and symmetry elements.
CLO4: Introduce imperfections in solids.
CLO5: Introduce phase stabilities and phase diagrams.
CLO6: Teach mechanism of phase transformations.
CLO7: Introduce various heat treatment methods.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to draw and use modeling software's to generate

	Course Outcome	Cognitive Level	Pos
CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.	U	PO1, PO2, ,PO7, PO5,
CO2	Understand the importance of phase diagrams and the phase transformations.	U	PO1, PO2, ,PO7, PO5, PO12
CO3	Know various heat treatment methods for controlling the microstructure..	U	PO1, PO2, ,PO7, PO5,
CO4	Correlate between material properties with component design and identify various kinds of defects.	U	PO1, PO2, ,PO7, PO5, PO12

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CO5	Apply the method of materials selection, material data and knowledge sources for computer-aided selection of materials.	U	PO1, PO2, ,PO7, PO5, PO12
Total Hours of instruction		**40**	

4.0 Course Content

MODULE-1 **8 HOURS**

Structure of Materials

Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding

Geometrical Crystallography: Symmetry elements: the operation of rotation, Proper and Improper rotation axes, Screw axes, Glide planes

Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density, packing of atoms and packing fraction, Classification and Coordination of voids, Bragg's Law

Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Concept of free volume in amorphous solids.

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MODULE-2 **8 HOURS**

Physical Metallurgy

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

Phase Diagrams: Gibbs Phase Rule, Solubility limit, phase equilibria and Phase Diagrams: Isomorphous systems, Invariant Binary Reactions, Lever Rule; important phase- diagrams , Iron-Carbon Diagram.

Diffusion: Diffusion-Fick's Laws, Role of imperfections in diffusion.

MODULE-3 **8 HOURS**

Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation. Plastic Deformation: Slip, Twinning; Recovery- Recrystallization-Grain Growth, Introduction to Strengthening mechanisms. Lever rule and phase diagram.

Heat treatment: Annealing, Normalizing, hardening, Tempering, Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. TTT diagram, microstructural effects brought about by these processes and their influence on mechanical properties.

MODULE-4 **8 HOURS**

Surface coating technologies: Introduction, coating materials, coating technologies, types of coating, advantages and disadvantages of surface coating.

Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical and Chemical methods, Characterization of powders (Particle Size & Shape Distribution), Powder Shaping: Particle Packing Modifications, Lubricants & Binders, Powder Compaction & Process, Sintering and Application of Powder Metallurgy.

MODULE 5 **000008 HOURS**

Materials Selection

The need for material selection in design, the evolution of Engineering materials.

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The Design Process and Materials Data: Types of design, design tools and materials data, processes of obtaining materials data, materials databases
Engineering Materials and Their Properties: The classes of engineering materials and their structure, material properties: mechanical properties, functional properties.
Material Selection Charts: Selection criteria for materials, material property Charts, deriving property limits and material
indices, materials indices which include shape.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	V/VI	Design of Machine Elements I/II	Material Selection for Design of Joints, Threaded Fastners and Automotive drive Mechanisms
02	VIII	Project work	Knowledge of metallurgy of engineering materils to be used in fabrication projects under taken

6.0 Relevance to Real World

SL.No	Real World Mapping
01	**Engineering materials used in Aerospace Industries, Automotive Industries, Manufacturing industries of machine tools and SPMs etc.**
02	Study of surface characterization of materials to improve mechanical properties as research and development projects.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Online videos/animated videos,PPTs on the topics as and when required to students
02	NPTEL	Videos of Material Science and Metallurgy and Recent advancement in materials such as smart materials and biomedical application materials

8.0 Books Used and Recommended to Students

Text Books

1. Ashby, M.F. (2010), Materials Selection in Mechanical Design, 4th Edition, Butterworth-Heinemann.
2. Azaroff, L.V., (2001) Introduction to solids, 1st Edition, McGraw Hill Book Company.
3. Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.
4. Powder Metallurgy Technology, Cambridge International Science Publishing,2002.

Reference Books

1. Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials 1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.
2. Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials 2: An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
3. Callister Jr, W.D., Rethwisch, D.G., (2018), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley.
4. Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4th Edition, Cengate Learning.

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5. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi,2008.

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
3. Science and Engineering, Indian Institute of Technology Delhi, http://nptel.ac.in/courses/113102080/
4. Subramaniam, A., Structure of Materials, NPTEL Course Material, Department of Material Science and Engineering, Indian Institute of Technology Kanpur,https://nptel.ac.in/courses/113104014/
5. Schuh, C., 3.40J Physical Metallurgy. Fall 2009. Massachusetts Institute of Technology: MIT Open Course Ware, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.
6. Ghosh, R.N., Principles of Physical Metallurgy, IIT Kharagpur, http://nptel.ac.in/syllabus/113105024/

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	Materials Science and Metallurgy Engineering	http://www.sciepub.com/journal/MSME
2	Journal Of Materials Science & Technology	https://www.elsevier.com/journals/journal-of-materials-science-and-technology/1005-0302?generatepdf=true
3	International Journal of Minerals, Metallurgy and Materials	http://www.sciencedirect.com/journal/international-journal-of-minerals-metallurgy-and-materials
4	International Journal of Minerals, Metallurgy, and Materials	http://www.springer.com/materials/journal/12613

11.0 Examination Note

Assessment Details (both CIE and SEE)

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 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of 20 Marks (duration 01 hour)

- First test at the end of 5th week of the semester

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- Second test at the end of the 10th week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for 30 marks.

CIE for the practical component of IPCC

On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.

- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write- ups are added and scaled down to 15 marks.
- The laboratory test (duration 03 hours) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for
20 marks.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be proportionally reduced to 50 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 students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE.

  Marks secured will be scaled down to 50.

12.0 Course Delivery Plan

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Module No.	Lecture No.	Content of Lecture	Teaching Method	% of Portion
I	1	Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
		Geometrical Crystallography: Symmetry elements: the operation of rotation,	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	2	Proper and Improper rotation axes, Screw axes, Glide planes	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	3	Crystal Structure: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Planar Atomic Density,	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	4	packing of atoms and packing fraction	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	5	Classification and Coordination of voids, Bragg's Law	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	6	Imperfections in Solids: Types of imperfections, Point defects: vacancies, interstitials	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	7	line defects, 2-D and 3D-defects,	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
	8	Concept of free volume in amorphous solids.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5
II	1	Alloy Systems: Classification of Solid solutions, Hume- Rothery Rules	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	2.5

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	2	Phase Diagrams: Gibbs Phase Rule, Solubility limit, phase equilibria	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	3	Binary Reactions, Lever Rule;	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	4	Important phase- diagrams	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	5	Important phase- diagrams continued…	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	6	Iron-Carbon Diagram.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	7	Iron-Carbon Diagram continued..	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	8	Diffusion: Diffusion-Fick's Laws, Role of imperfections in diffusion.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk	**2.5**
III	1	Nucleation and growth: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and	**2.5**
	2	Plastic Deformation: Slip, Twinning; Recovery-Recrystallization-Grain Growth	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	3	Introduction to Strengthening mechanisms. Lever rule and phase diagram.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	4	Heat treatment: Annealing, Normalizing, hardening, Tempering	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	5	Nitrating, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**

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	6	TTT diagram	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	7	TTT diagram continued..	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	8	Microstructural effects brought about by these processes and their influence on mechanical properties	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
IV	1	Surface coating technologies: Introduction, coating materials, coating technologies	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	2	Types of coating, advantages and disadvantages of surface coating.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	3	Powder metallurgy: Introduction, Powder Production Techniques: Different Mechanical Methods	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	4	Powder Production Techniques: Different Chemical Methods	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	5	Characterization of powders (Particle Size & Shape Distribution),	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	6	Powder Shaping: Particle Packing Modifications	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	7	Lubricants & Binders, Powder Compaction & Process	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**

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	8	Sintering and Application of Powder Metallurgy	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
V	1	The need for material selection in design, the evolution of Engineering materials.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	2	The Design Process and Materials Data: Types of design, design tools and materials data, processes of obtaining materials data, materials databases	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	3	Engineering Materials and Their Properties: The classes of engineering materials and their structure,	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	4	Material properties: mechanical properties, functional properties.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	5	Mechanical properties, functional properties.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	6	Material Selection Charts: Selection criteria for materials, material property Charts.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	7	Material Selection Charts: Deriving property limits and material indices.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**
	8	Materials indices which include shape.	Power-point Presentation, Video demonstration or Simulations, Chalk and Talk. Laboratory Demonstrations and Practical Experiments -	**2.5**

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper

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1	Assignment 1	Students should able study the Topicsand write appropriate answers. Have practice to solve university questions.	Module 1, 2 & First half of 3rd Module	4 th week of the semester	Individual Activity.	Book 1, 2 of the text book list and 1,2,3 of the Reference list
2	Assignment 2	Students should able study the Topicsand write appropriate answers. Have practice to solve university questions.	Second half of of 3rd Module and Modules 4 & 5	9th week of the semester	Individual Activity.	Book 1, 2 of the text book list and 1,2,3 of the Reference list

14.0 QUESTION BANK

Module-I

1. Define unit cell, space lattice, and lattice parameter and coordination number.
2. List the fourteen Bravais space lattices.
3. Explain with neat sketch the following crystal structure I) BCC II)FCC and III)HCP.
4. Define atomic packing factor. Calculate Atomic Packing Factor for BCC structure.
5. Write the sketch of HCP unit cell and determine its APF.
6. If the atomic radius of lead (FCC) is 0.175 nm, calculate its unit cell, volume in meters also calculates APF.
7. Tantalum at 20 deg Celsius is BCC and has Atomic Radius 0.143 nm. Calculate its lattice parameter.
8. Classify crystal imperfections in the order of their geometry.
9. Explain with neat sketch I) Frenkel defect ii) interstitialacy
10. Draw a crystal lattice containing an edge dislocation and show the burgers vector.
11. With the help of neat sketch draw conventional stress-strain diagram for mild steel under uni-axial static tensionand explain the behavior of the material till fracture.
12. What is plastic deformation & with neat sketches plastic deformation by slip
13. With neat sketches plastic deformation by twinning.
14. Differentiate between slip and twinning deformations in materials.

Module – II

1. Define an alloy & what the different types of alloys are.
2. What is a solid solution & explain substitutional & interstitial solid solution with neat sketches.
3. State the Hume-Rothery rules.

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4. State & explain Gibb's phase rule.
5. What is solid solution and explain the mechanism of solidification.
6. Explain Homogeneous nucleation & Heterogeneous nucleation.
7. Explain with neat sketches cast metal structures.
8. What are the different types of solid solutions, explain it.
9. List the Hume-Rothery rules for the formation of substitutional solid solutions.
10. State and explain Gibb's phase rule and its applicability to metallic systems.
11. Draw a binary eutectic phase diagram between two components, which are partially soluble in each other in thesolid state. Label all the phase fields.
12. Considering the example of an isomorphism system and describe the construction of phase diagrams.
13. State and discuss lever rule with an example.
14. Give typical examples for eutectic and eutectoid reactions mentioning for each the temperature and composition at which it occurs. What is an invariant reaction? Write down the following invariant reactions
    a) Eutectic, b) Peritectic , c) Eutectoid.
15. A binary alloy of composition 40 percent B, 60 percent A contains two phases namely liquid and solid at particular temperature. The composition of solid phase is 23 percent and that of liquid phase is 68 percent B. estimate the amount of solid and liquid phases in alloy.
16. Describe the construction of phase diagrams by thermal analysis.
17. Draw Fe-C equilibrium diagram and label all the fields, also explain all the invariant reactions in the system.
18. Define austenite, ferrite, cementite, martensite and pearlite.
19. Explain effect of non-equilibrium cooling.
20. Explain the term coring & homogenization.
21. Explain the effect of common alloying elements in steel.
22. Explain the composition, properties & applications of stainless steel, common alloy steels & tool steels.
23. Write a specification of steel.

Module – III

1. Explain the steps to construct TTT diagram. Draw a labeled sketch of TTT diagram for an eutectoid steel.
2. What are TTT curves? Explain with neat sketch for eutectoid steels.
3. What are CCT curves and mention its uses.
4. Distinguish between TTT and CCT diagrams. Which is its practical use? Justify.
5. Define the process of heat treatment and classify various heat treatment processes.
6. What is meant by heat treatment? What are its objectives?
7. Explain recrystallization during annealing of metals.
8. Explain annealing and normalizing.
9. Differentiate between annealing and normalizing.
10. Write short notes on cyaniding and high frequency induction surface hardening.
11. Explain the concept of hardenability.
12. Describe Jominy hardenability test and its practical applications.
13. Both pearlite and tempered martensite contain ferrite and cementite, but tempered martensite is stronger andtougher. Explain?
14. What is the purpose of case hardening? Classify the methods of case hardening and describe briefly any two ofthem.
15. Explain recovery, recrystalization & grain growth in case of annealing.
16. Explain types of annealing.
17. What are the factors affecting the hardenability.
18. Explain austempering & martempering.
19. Explain age hardening & explain it for aluminium-copper alloys & PH steels.
20. Explain the composition, properties & uses for Grey cast iron, malleable cast iron & S.G. iron.

Module – IV

1. What is mean by powder metallurgy?
2. What are advantages and limitations of powder metallurgy.
3. What are the steps in powder metallurgy?

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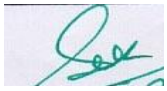
4. What is blending ? How it is achived?
5. Explain in brief liquid penetrant test

Module –V

1. Write an engineering brief about the creep test?
2. Explain the mechanism of plastic deformation of metals by slip and twinning?
3. Describe the characteristics of ductile fracture and brittle fracture.
4. Explain the testing procedure for Vickers hardness testing?
5. Explain the two modes of plastic deformation in metals with neat sketches?
6. What is brittle fracture? Explain the Griffith theory on brittle fracture and deduce an expression for the critical stress required to propagate a crack simultaneously in a brittle materials?
7. Critically compares the deformation by slip and twinning?
8. Explain the types of impact tests and how ductile to brittle transition is occur with diagram.
9. Draw the engineering stress – strain curve for mild steel, aluminium and cast iron. Discuss the tensile test and different mechanical properties obtained in tensile testing. Write a short note on compression test.
10. Discuss fatigue test for a metallic material. What is S-N diagram?
11.
12. What are the different types of fractures in metallic materials? Give the important features of these fractured surfaces. What is the use of this study?
13. What are the properties measured from tensile testing and write their engineering significance? Draw the stress and strain curve for aluminium, cast iron and low carbon steel.
14. Describe fatigue testing and methods for improving fatigue strength of the components. Draw the S-N curve for aluminium and titanium.
15. Draw creep curve and explain the different stages of creep damage.
16. Draw S-N curve for ferrous and non-ferrous metals and explain how endurance strength can be determined. Also discuss the factors that affect the fatigue life.

16.0 University Result

Examination	S+	S	A	B	C	D	E	F	% Passing
July 2020-21									

Prepared by	Checked by		
-sd-	-sd-		
Prof.D.N.Inamdar	Prof.D.N.Inamdar	HOD	Principal

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Subject Title	**THERMODYNAMICS**		
Subject Code	21ME34	**IA Marks(20)+Assignments(10)+ Activity (20)**	50
Number of Lecture Hrs / Week	2+2 hrs	**Exam Marks(appearing for)**	50 (100)
Total Number of Lecture Hrs	40	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Dr. K. M. Akkoli	**Designation:** Associate Professor	**Experience:** 20Years
No. of times course taught: 10	**Specialization:** Thermal Power Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Students should have the knowledge of basic subjects	PUC	**Mathematics, Physics and chemistry**

2.0 Course Objectives

- State the governing laws of Thermodynamics.
- Explain the concepts and principles of pure substances and entropy.
- Describe air standard, gas and vapour power cycles used in prime movers.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to understand construction and working mechanical systems.

CO'S	Course Outcome	Cognitive Level	POs
C204.1	Describe the fundamental concepts and principles of engineering thermodynamics.	L1,L2&L3	PO1, PO2,PO3
C204.2	Apply the governing laws of thermodynamics for different engineering applications.	L1,L2&L3	PO1, PO2,PO3
C204.3	Analyse the various thermodynamic processes, cycles and results.	L1,L2&L3	PO1, PO2,PO3
C204.4	Interpret the behavior of pure substances and its application in practical	L1,L2&L3	PO2, PO3
C204.5	Interpret and relate the impact of thermal engineering practices to real life problems.	L1,L2&L3	PO1, PO2,PO3
Total Hours of instruction		**40**	

4.0 Course Content

Module - 1

Introduction and Review of fundamental concepts: Thermodynamic definition and scope, Microscopic and Macroscopic approaches, Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, (Only for Self study)

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Zeroth law of thermodynamics. Temperature; scales, thermometry, Importance of temperature measuring instruments. Design of Thermometers.

Work and Heat: Thermodynamic definition of work; examples, sign convention, Displacement work, Heat; definition, units and sign convention, Expressions for displacement work and heat in various processes through p-v diagrams. Shaft work, Electrical work.

First Law of Thermodynamics: Statement of the first law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, Steady Flow Energy Equation (SFEE) and engineering applications. **8 Hour**

Module- 2

Second Law of Thermodynamics and Entropy: Limitations of first law of thermodynamics. Devices converting heat to work; (a) In a thermodynamic cycle, (b) In a mechanical cycle. Thermal reservoir, direct heat engine; schematic representation and efficiency. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Carnot cycle, Clausius inequality, Statement-proof, Entropy-definition, a property, change of entropy, entropy as a quantitative test for irreversibility, entropy as a coordinate.

Available energy and Exergy: Available energy, Maximum work in a reversible process; useful work; Dead state; availability; Second law efficiency. **8 Hours**

Module- 3

Introduction and Review of Ideal and Real gases: Ideal gas mixtures, Daltons law of partial pressures, Amagats law of additive volumes, Evaluation of properties of ideal gases. Real gases: introduction, Van-Der Waal's equation,Van-Der aal's constants in terms of critical properties. (Only for self study)

Compressibility factor, compressibility chart and applications.

Thermodynamic relations: Maxwell's equations, TdS equation. Ratio of Heat capacities and Energy equation, Joule-Kelvin effect, Clausius-Clapeyron equation.

Combustion thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels, excess air, actual combustion. Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, adiabatic flame temperature, combustion efficiency. **8 Hours**

Module- 4

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

Vapour Power Cycles: Carnot vapour power cycle, simple Rankine cycle, actual vapour power cycles, ideal and practical regenerative Rankine cycles, open and closed feed water heaters, Reheat Rankine cycle and characteristics of an Ideal working fluid in vapour power cycles. **8 Hours**

Module- 5

Gas power cycles: Ericson Cycle, Stirling Cycle, Air standard cycles-Otto cycle, Diesel cycle and Dual cycle, computation of thermal efficiency and mean effective pressure, comparison of Otto, Diesel & Dual cycles.

Gas turbine Cycles: Introduction and classification of gas turbine, gas turbine (Brayton) cycle; description and thermal analysis and methods to improve thermal efficiency of gas turbines, Jet Propulsion.

8 Hours

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	IV	Applied Thermodynamics	Industry
02	V	Turbo Machines	Power Sector
03	VI	Heat Transfer	Industry

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Automotive Industry
02	Power Sector

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03	Aerospace Industray

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	NPTEL Tutorial	Topic: Energy resources, internal combustion engines, Turbines, Automation and Robotics.

8.0 Books Used and Recommended to Students

Text Books

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Basic and Applied Thermodynamics	P.K.Nag,	Tata McGraw Hill	2nd Ed., 2017
2	A textbook of Engineering Thermodynamics	R K Rajput	Laxmi Publications,	5th Edition 2019
3	Fundamentals of Thermodynamics	Claus Borgnakke and Richard E Sonntag	Wiley India Edition	8th Edition 2020
4	Thermodynamics, An Engineering Approach,	Yunus A Cenegal, Michael A Boles, and Mehmet Kanoglu	Tata McGraw Hill publications	9th Edition 2019
Reference Books				
3	Engineering Thermodynamics	J B Jones and G A Hawkins,	John Wiley and Sons.	1986
4	An Introduction to Thermodynamcis	Y.V.C.Rao	Wiley Eastern	2003,
5	Applications of Thermodynamics	Dr V Kadambi and Dr T R Seetharam	Wilay Publications	2018

Additional Study material & e-Books

- Nptel.ac.in
- VTU, E- learning
- MOOCS
- Open courseware

9.0 Relevant Websites (Reputed Universities and Others) for Notes /Animation / Videos Recommended

Website and Internet Contents References

https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
- https://www.youtube.com/watch?v=jkdMtmXo664&list=PL3zvA_WajfGAwLuULH-L0AG9fKDgplYne
- https://www.youtube.com/watch?v=1lk7XLOxtzs&list=PLkn3QISf55zy2Nlqr5F09oO2qcIwNNfrZ&index=3
- https://www.youtube.com/watch?v=Dy2UeVCSRYs&list=PL2_EyjPqHc10CTN7cHiM5xB2qD7BHUry7

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website

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1	International Journal of Heat transfer	https://www.journals.elsevier.com/international-journal-of-fluid flow and fluid dynamics/
2	**International Journal of Thermodynamics**	http://dergipark.ulakbim.gov.tr/eoguijt/

11.0 Examination Note

Assessment Details (both CIE and SEE)

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 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of 20 Marks (duration 01 hour)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the 15th week of the semester

Two assignments each of 10 Marks

1. First assignment at the end of 4th week of the semester
2. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)

1. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

9. The question paper will have ten questions. Each question is set for 20 marks.
10. 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 students have to answer 5 full questions, selecting one full question from each module.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	Teaching Method	% of Portion
1	42	Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches.	Chalk and Talk, Power-point Presentation	20%
	43	Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples.	Power-point Presentation	
	44	Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume,	Chalk and Talk	
	45	Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes;	Chalk and Talk	

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	46	Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics,	Power-point Presentation	
	47	Temperature; scales, thermometry, Importance of temperature measuring instruments. Design of Thermometers.	Chalk and Talk	
	48	**Work and Heat:** Thermodynamic definition of work; examples, sign convention, Displacement work, Heat; definition, units and sign convention, Expressions for displacement work and heat in various processes through p-v diagrams. Shaft work, Electrical work.	Video demonstration or Simulations,	
	49	**First Law of Thermodynamics:** Statement of the first law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, Steady Flow Energy Equation (SFEE) and engineering applications.	Video demonstration or Simulations,	
2	50	Second Law of Thermodynamics and Entropy: Limitations of first law of thermodynamics.	Chalk and Talk, Power-point Presentation	40%
	51	Devices converting heat to work; (a) In a thermodynamic cycle, (b) In a mechanical cycle.	Chalk and Talk, Power-point Presentation	
	52	Thermal reservoir, direct heat engine; schematic representation and efficiency. Kelvin - Planck statement of the Second law of Thermodynamics;	P Chalk and Talk, ower-point Presentation	
	53	PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Carnot cycle,	Chalk and Talk, Power-point Presentation	
	54	Clausius inequality, Statement-proof, Entropy- definition, a property, change of entropy,	Power-point Presentation	
	55	entropy as a quantitative test for irreversibility, entropy as a coordinate.	Power-point Presentation	
	56	Available energy and Exergy: Available energy, Maximum work in a reversible process;	Power-point Presentation	
	57	useful work; Dead state; availability; Second law efficiency.	Video demonstration or Simulations,	
3	58	**Introduction and Review of Ideal and Real gases:** Ideal gas mixtures, Daltons law of partial pressures, Amagats law of additive volumes, (Only for self study)	Chalk and Tal	60%
	59	Evaluation of properties of ideal gases. Real gases: introduction,	Chalk and Talk, Power-point Presentation	
	60	Van-Der Waal's equation,Van-Der aal's constants in terms of critical properties.	Power-point Presentation	
	61	Compressibility factor, compressibility chart and applications.	Power-point Presentation	
	62	**Thermodynamic relations:** Maxwell's equations, TdS equation. Ratio of Heat capacities and Energy equation, Joule-Kelvin effect, Clausius-Clapeyron equation.	Chalk and Talk, Power-point Presentation	
	63	**Combustion thermodynamics:** Theoretical (Stoichiometric) air for combustion of fuels, excess air, actual combustion.	Chalk and Talk	
	64	Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction,	Chalk and Talk, Power-point Presentation	
	65	enthalpy of formation, enthalpy and internal energy of combustion, adiabatic flame temperature, combustion efficiency.	Chalk and Talk	

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4	66	**Pure Substances:** P-T and P-V diagrams, triple point and critical points,	Power-point Presentation	80%
	67	sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapour,	Power-point Presentation	
	68	saturated vapour and superheated vapour states of pure substance with water as example.	Power-point Presentation	
	69	Enthalpy of change of phase (Latent heat), Dryness fraction (quality) representation of various processes on T-S & H-S diagrams.	Chalk and Talk	
	70	**Vapour Power Cycles:** Carnot vapour power cycle,	Power-point Presentation	
	71	simple Rankine cycle, actual vapour power cycles, ideal and practical regenerative	Power-point Presentation	
	72	Rankine cycles, open and closed feed water heaters,	Chalk and Talk	
	73	Reheat Rankine cycle and characteristics of an Ideal working fluid in vapour power cycles.	Power-point Presentation	
5	74	**Gas power cycles:** Ericson Cycle, Stirling Cycle,	Chalk and Talk	100%
	75	Air standard cycles-Otto cycle, Diesel cycle and Dual cycle,	Power-point Presentation	
	76	computation of thermal efficiency and mean effective pressure,	Power-point Presentation	
	77	comparison of Otto, Diesel & Dual cycles.	Power-point Presentation	
	78	**Gas turbine Cycles:** Introduction and classification of gas turbine,	Chalk and Talk, Power-point Presentation	
	79	gas turbine (Brayton) cycle;	Power-point Presentation	
	80	description and thermal analysis and methods to improve thermal efficiency of gas turbines,	Chalk and Talk	
	81	Jet Propulsion.	Chalk and Talk	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Introduction and Review of fundamental concepts, Work and Heat, First Law of Thermodynamics Second Law of Thermodynamics and Entropy, Introduction and Review of Ideal and Real gases	Students study the Topics and prepare the multiple choice questioner with answer.	1,2 and ½ of 3rd Module of the syllabus	3	Group Activity. Each group should prepare minimum 05 questions expected.	Book 1, 2 of the reference list. Website of the Text Book list.

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2	Assignment 2: University Questions on Thermodynamic relations, Combustion thermodynamics Pure Substances, Vapour Power Cycles, Gas power cycles, Gas turbine Cycles	Students study the Topics and prepare the multiple choice questioner with answer.	4,5 and ½ of 3rd Module of the syllabus	6	Individual Activity.	Book 1, 2 of the reference list. Website of the Text Book list.

15.0 QUESTION BANK

Sample Questions	Questions
VI	**Module 1** 1. Define the word' Thermodynamics', and differentiate microscopic and macroscopic approaches. 2. Illustrate open and closed systems with examples. 3. Differentiate the intensive and extensive properties. 4. Describe thermodynamic equilibrium. 5. Explain Zeroth law of thermodynamics. 6. Explain the definition of temperature, its scale and measurement. 7. Describe the various thermodynamic temperature scale. 8. Explain International Temperature Scales, Standards 9. Solve numericals on temperature scales 10. Explain System, Boundary and Control volume 11. Define, differentiate and illustrate the heat and work and its sign conventions. 12. Explain the displacement work. 13. Analyze the various thermodynamic processes through PV diagram. 14. Formulate different types of works and describe the conversion to heat and vice versa. 15. Explanation about shaft work and also various work conversion factors 16. Explain the similarities and dissimilarities between work and heat Describe the Joule's experiment and analyze the formulation. 17. Define and explain the first law of thermodynamics. 18. Apply the first law of thermodymics to non-cyclic processes and control volume. 19. Explain the specific heat and enthalpy and their relations. 20. Derive the SFEE and formulate the different applications of SFEE. 21. Explain what are the significance of SFEE 22. Explain PMM I 23. Solve numericals on first law of thermodynamics
VII	**Module 2** 1. Define and explain the different definitions of Second Law of Thermodynamics. 2. Explain thermal energy reservoir, sink 3. Explain the two statements on second law and draw similarity between them 4. Explain PMM II and differentiate between PMM-I and PMM-II. 5. Explain and differentiate reversible and irreversible processes and their factors to make different principles. 6. Define heat engine and heat pump. Explain their schematic diagram.Define the "Entropy" and explain the Classius inequality. 7. Derive the proof of inequality statement and explain its applications. 8. Derive to show that the entropy of universe is always increasing. 9. Solve the examples by using TDS relation.

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	10. Explain different available and unavailable energy
VIII	**Module 3** 1. Derive and explain Vander Waal's Equation and also define compressibility factor. 2. Describe and use of compressibility chart. 3. Derive and Explain Dalton Law of partial pressure 4. Define Amagat's law of additive volumes, evaluation of properties, Analysis of various processes. 5. Concept of Maxwell Relation 6. Concept of Clausius Clayperson's Equations 7. Derive and explain Ideal gas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. 8. Evaluate heat and work for different qausi-static process. 9. What is Theoretical (Stoichiometric) air for combustion of fuels, excess air, actual combustion. 10. Explain enthalpy of formation, enthalpy and internal energy of combustion, adiabatic flame temperature, 11. Explain combustion efficiency.
IX	**Module 4** 1. Explain PT and PV diagram of pure substances. 2. Define the dryness fraction and the change of phase. 3. Represent the various processes on T-S and H-S diagram. 4. Use the steam tables. 5. Explain the throttling and separating calorimeter. 6. Explain the various operation of a Carnot cycle. Also represent it on a T-s and p-V diagrams. 7. Describe the different operations of Rankine cycle. Derive also the expression for its efficiency. 8. State the methods of increasing the thermal efficiency of a Rankine cycle. 9. . Explain with the help of neat diagram a 'Regenerative Cycle'. Derive also an expression for its thermal efficiency. 10. State the advantages of regenerative cycle/simple Rankine cycle. 6. Explain with a neat diagram the working of a Binary vapour cycle
X	**Module 5** 1. Draw the P-V and T-S diagram for otto cycle. 2. What are the assumption s made for air standard cycle analysis? 3. Define mean effective pr essure as applied to gas power cycles. 4. What is the effect of compression ratio on efficiency of otto cycle? 5. Draw the actual and theoretical P-V diagram for four stroke cycle SI engine. 6. Mention the various processes of dual cycle. 7. For the same compressi on ratio and heat supplied, state the order o f decreasing air standard efficiency of Ot to, diesel and dual cycle. 8. Drive and expression for the air standard efficiency of Otto cycle in terms of volume ratio. 9. Drive an expression for the air standard efficiency of Diesel cycle. 10. Drive an expression for the air standard efficiency of Dual cycle. 11. Explain the working of 4 stroke cycle Diesel engine. Draw the theoretical and actual PV diagram. 12. Drive the expression for air standard efficiency of Brayton cycle in terms of pressure ratio.

16.0 University Result

Examination	S+	S	A	B	C	D	E	F	% Passing

Prepared by	Checked by		
-sd-	-sd-		
Dr. K. M.Akkoli	Dr. M. M. Shivashimpi	HOD	Principal

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Subject Title	MACHINE DRAWING AND GD & T		
Subject Code	21MEL35	**IA Marks**	50
Teaching Hours/Week (L:T:P:	01:0:02	**Exam Marks**	50
Total No of Lecture + Practical Hrs	50	**Exam Hours**	03
			CREDITS – 03

FACULTY DETAILS:		
Name: Prof. S. A. Goudadi	**Designation:** Asst. Professor	**Experience:** 15 Years
No. of times course taught: 01	**Specialization:** Design Engg.	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engineering	I/II	CAED
02	Mechanical Engineering	III	Mechanical Measurements

2.0 Course Objectives

- To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.
- To make drawings using orthographic projections and sectional views
- To impart knowledge of thread forms, fasteners, keys, joints, couplings and clutches.
- To understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to draw and use modeling software's to generate

CO	Description
C206A.1	Interpret the Machining and surface finish symbols on the component drawings..
C206A.2	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
C206A.3	Illustrate various machine components through drawings
C206A.4	Create assembly drawings as per the conventions

4.0 Course Content

Module 1 (only for CIE), 01 Sessions

Review of basic concepts of Engineering Visualization

Geometrical Dimensioning and Tolerances (GD&T): Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.

Module 2 (only for CIE), 02 Sessions

Sections of Simple and hollow solids: True shape of sections.

Module 3 (only for CIE), 03 Sessions

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External)

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square and Acme. Sellers thread, American Standard thread, Helicoil thread inserts

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, countersunk head screw, grub screw, Allen screw

Rivets

Keys: Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.

Module 4, 03 Sessions

Assembly of Joints, couplings and clutches (with GD&T)using 2D environment

Joints: Like Cotter joint (socket and spigot), knuckle joint (pin joint).

Couplings: Like flanged coupling, universal coupling

Clutches: Like Single Plate clutch, cone clutch

Module 5, 05 Sessions

Assembly of Machine Components (with GD&T) using 3D environment

(Part drawings shall be given)

1. Bearings
2. Valves
3. Safety Valves
4. I.C. Engine components
5. Lifting devices
6. Machine tool components
7. Pumps

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Drawings, Part Modeling
02	V/VI	Design of Machine Elements I/II	Fasteners, Keys and Joints, Rivets and Assembly drawings

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Industrial drawings and design of various components
02	Model creation for analysis
03	Development of a software applications

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Lettering, Line, Methods of dimensioning
02	NPTEL	Assembly Application

8.0 Books Used and Recommended to Students

Text Books
1. K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN-13:978-81-224-2518-5, 2006 2. 'Machine Drawing', N.D.Bhat&V.M.Panchal, Published by Charotar Publishing House, 1999.
Reference Books
1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007. 2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.
Additional Study material & e-Books

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1. Sadhu Singh, P. L. Sah, "Fundamentals of Machine Drawing", PHI Learning Pvt. Ltd, 2nd Edition, ISBN:9788120346796, 2012
2. Ajeet Singh, "MACHINE DRAWING", Tata McGraw-Hill Education, , ISBN: 9781259084607, 2012

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
1) https://hareeshang.wordpress.com/tutorials/camd/
2) http://m.noteboy.in/vtuflies/machine%20drawing.pdf
3) https://www.edx.org/school/iitbombayx?utm_source=bing&utm_medium=cpc&utm_term=iit-bombay&utm_campaign=partner-iit-bombay
4) http://www.vlab.co.in/

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Journal of Aircraft	http://arc.aiaa.org/loi/ja
2	International Journal of Solids and Structures	http://www.sciencedirect.com/science/journal/00207683
3	Journal of Manufacturing Science and Engineering	http://manufacturingscience.asmedigitalcollection.asme.org/issue.aspx?journalid=125&issueid=27340
4	American Fastener Journal	http://www.fastenerjournal.com/

11.0 Examination Note

Assessment Details (both CIE and SEE)

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 40% of the maximum marks (20 marks) and that for SEE minimum passing mark is 35% of the maximum marks (18 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is 50 Marks.

● CIE shall be evaluated for max marks 100. Marks obtained shall be accounted for CIE final marks, reducing itby 50%.

●CIE component should comprise of

- Continuous evaluation of Drawing work of students as and when the Modules are covered.
- At least one closed book Test covering all the modules on the basis of below detailed weightage.
- Weightage for Test and Continuous evaluation shall be suitably decided by respective course coordinators.

Module	Max. Marks weightage	Evaluation Weightage in marks	
		Computer display &printout	Preparatory sketching
Module 1	10	05	05
Module 2	15	10	05
Module 3	25	20	05
Module 4	25	20	05
Module 5	25	25	00
Total	**100**	**80**	**20**

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

- The duration of SEE is 03 hours**. Questions shall be set worth of 3 hours**
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

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- SEE shall be conducted and evaluated for maximum marks 100. Marks obtained shall be accounted for SEEfinal marks, reducing it to 50 marks.
- Question paper shall be set jointly by both examiners and made available for each batch as per schedule. **Questions are to be set preferably from Text Books.**
- Evaluation shall be carried jointly by both the examiners.
- Scheme of Evaluation: *To be defined by the examiners jointly and the same shall be submitted to the universityalong with question paper.*

One full question shall be set from Modules 3 and 4 as per the below tabled weightage details. *However, thestudent may be awarded full marks, if he/she completes solution on computer display without sketch.*

Module	Max. Marks Weightage	Evaluation Weightage in marks	
		Computer display &printout	Preparatory sketching
Module 4	40	30	10
Module 5	60	50	10
Total	**100**	**80**	**20**

2.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
		PART - A	
MODULE 1	01	Review of basic concepts of Engineering Visualization **Geometrical Dimensioning and Tolerances (GD&T)**: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.	7.14
MODULE 2	02	**Sections of Simple and hollow solids**: True shape of sections.	14.28
		PART – B	
MODULE 3	04	**Thread Forms**: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread, Helicoil thread inserts	21.42
	05	**Fasteners**: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, countersunk head screw, grub screw, Allen screw	
	06	**Rivets** **Keys:** Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.	
MODULE 4	07	**Assembly of Joints, couplings and clutches (with GD&T)using 2D environmentJoints**: Like Cotter joint (socket and spigot), knuckle joint (pin joint).	21.42
	08	**Couplings**: Like flanged coupling, universal coupling	
	09	**Clutches**: Like Single Plate clutch, cone clutch	
		PART-C	
MODULE 5	11	**Assembly of Machine Components (with GD&T) using 3D environment** *(Part drawings shall be given)* **1. Bearings** **2. Valves** **3. Safety Valves** **4. I.C. Engine components** **5. Lifting devices** **6. Machine tool components** **7. Pumps**	35.74

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Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: **Geometrical Dimensioning and Tolerances (GD&T)**	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
2	Assignment 2: Questions on Section of solids and Orthographic views University Questions on	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 2 of the syllabus	4	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
3	Assignment 3: Questions on Thread forms and fasteners Keys, Joints and Riveted joints,	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3 of the syllabus	6	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
4	Assignment 4: Questions **Assembly of Joints, couplings and clutches**	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4 of the syllabus	8	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
5	Assignment 5: Questions on **Assembly of Machine Components**	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 5 of the syllabus	10	Individual Activity. Printed solution expected.	Book 1, 2 of the reference list. Website of the Reference list
6	Mini Project Rivets based for the students groups	Students study the Rivets applications from Real World Example view. Gain Knowledge of Rivets Applications.	Syllabus with Real World Mapping	12	Group Activity. Student Group need to perform Project and do a brief Report	All Books / paper Resources / Study Material. All Internet / Web resources.

14.0 QUESTION BANK

MODULE 1: LIMITS, FITS AND TOLERANCES

1. Define Limits, Fits and Tolerances
2. Explain with neat sketch Types of fits with symbols and applications

MODULE 2:
SECTIONS OF SOLIDS

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Section of pyramids

1. An equilateral triangular pyramid of base side, 40 mm and height 70 mm rests with its base on the HP such that one of its slant edges parallel to VP. A section plane perpendicular to VP and inclined at 63° to HP cuts the pyramid by passing through one of its lateral faces at a height of 9mm above the HP. Draw the FV, sectional top view and sectional side view along with the cut solid.
2. An equilateral triangular pyramid of 30mm side of base and axis 60mm long rests with its base on HP such that one of the base edges is inclined at 45° to the VP and nearer to it. It is cut by a section plane inclined at 60° to the HP and perpendicular to the VP, intersecting the axis at 40mm from the vertex. Draw the FV, sectional views from the top and right side along with the cut solid. Also project the true shape of section.
3. Fig p2.3 shows the sectional side view of an equilateral triangular truncated pyramid. Determine the true shape of section. Also find the inclination of the section plane with reference plane and size of the pyramid.
4. A triangular pyramid of base sides 50mm and axis 80mm long stands vertically with its base on the HP, such that one of the base edges is perpendicular to VP. A sectional plane perpendicular to VP and parallel to one of the slant edges of the pyramid passes at distances of 25mm from it. Draw the sectional top view and true shape of section. Also determine the inclination of the section plane with the reference plane.
5. A triangular pyramid of50mm side of base and axis length 80mm rests on its base on the HP with one of its base edges perpendicular to the VP.A section plane perpendicular to the VP and parallel to one of the lateral faces of the pyramid passes through at a distance of 25mm from the apex. Draw the front view, sectional top view and true shape of section. Determine the inclination of the section plane with the reference plane.
6. A triangular pyramid base 50mm sides and axis 80mm long, resting on its base on the ground with one of its base edges perpendicular to VP, is cut by two section planes, both perpendicular to the VP and are inclined at 45° to the HP, meet the axis at its mid-height. Both the section planes lie on either side of the axis and lean towards the base of the pyramid. Draw the front view, sectional top view and the combined true shape of section.
7. A triangular pyramid of base sides 50mm and 80mm long, resting on its base on the ground with one of its base edges perpendicular to the VP, is cut by two section planes, both perpendicular to the VP and are inclined at 45° to the HP, meet the axis at its mid-height. Both the section planes lie on either side of the axis and lean upwards. Draw the front view, sectional top view and the combined true shape of section.
8. A triangular pyramid, base 40mm sides and axis 60mm long, resting on its base on the HP with one of its base edges parallel to the VP. A section plane passing through one of the base corners of the pyramid and the two slant edges at 20mm and 30mm above the HP cuts the pyramid. Draw the front view, sectional top view and true shape of section. Determine the inclination of the section plane with the reference plane.
9. A triangular pyramid of base sides40mm and axis length 60mm is resting on its base on the ground with one of its base edges parallel to the VP and nearer to it. It is cut by two section planes both perpendicular to the VP and inclined to HP and meet at one of the base corners of the of the pyramid which is at equidistant from the other two base corners. One of the section planes is inclined at 45° to the HP and cuts the left slant edge while the other section plane is inclined at 60° to the HP and cuts the right end slant edge. Draw the front view, sectional top view and true shape of section.
10. A triangular pyramid of base sides 50mm and axis 65mm long rest vertically on its base with one of the base edges inclined at 30° to the VP and from it is such a way that the apex will be at 35mm in front of the VP. A HT inclined at 45° to XY line cuts the pyramid at 10mm in front of the axis. Both the section plane and the reference base edge of the pyramid lean towards right side. Draw the resulting sectional view the true shape section.
11. A square pyramid of base side 45mm and axis length 70mm rests on its base on the HP in such way that all of its base edges are equally inclined to the VP. It is cut by a section plane perpendicular to the VP, inclined at 45° to the HP and bisecting the axis. Draw the sectional top view sectional side view and true shape of section.
12. A square pyramid side of base 40mm and altitude 60mm has its base on the HP with an edge of base inclined at 30° to the VP. It is cut by a VT, passing through one of the extreme base corners and the center of gravity of the pyramid. Draw the sectional top view and true shape of section.
13. A square pyramid of base side 35mm and axis length 65mm is resting on the HP on its base with a side of base inclined at 30° to the VP. It is cut by a plane perpendicular to both the HP and VP and is 10mm away from the axis. Draw its top view, front view and true shape of section.
14. A hexagonal pyramid side of base 30mm and altitude 70mm is rests with its base on the HP and with a side of base parallel to the VP. It is cut by a cutting plane inclined at 35° to the HP and perpendicular to the VP and is bisecting the axis. Draw the front view, the sectional view looking from the top and true shape 0f section.
15. A pentagonal pyramid side of base 40mm and altitude 70mm is rests with its base on the HP and with a side of base parallel to the VP and 25mm from it. It is cut by a horizontal cutting plane and is bisecting the axis. Draw the front view and the sectional view looking from the top.

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Sections of tetrahedrons

1. A tetrahedron of sides 60mm is resting on the HP on one of its faces, with an edge perpendicular to the VP and the nearest base corner is 25mm in front of it. A VT, whose angle of inclination 55° with the reference line XY cuts solid by passing through the axis at a height of 40mm above the base. Draw the resulting sectional view and true shape of section.
2. Fig p.16 shows two concentric equilateral triangles. It is the resulting sectional view of a tetrahedron resting on its base on the HP which is cut by a VT. Complete the projections of the cut solids. Determine the height of the full solid and the position of the section plane.

Sections of cones

1. A cone of base diameter 50mm and axis length 65mm rests with its base on the HP. Draw the true shape of section made by a section plane perpendicular to the VP and inclined to the HP at 50° and passing through an end point on the circumference of the base circle of the cone.
2. A cone of base diameter 50mm is resting on its base on the HP. It is cut by section plane perpendicular to the VP, so that the true shape of cut section is a triangle of base 40mm and altitude 63mm. locate the section plane and determine the angle of inclination of the VT with the reference line XY. Draw the front view. Determine the height of the cone. Also draw the apparent section and true shape of section.
3. A cone of base diameter 50mm and height 60mm stands with its base on the HP. It is cut by a VT inclined at 70° to the reference line XY and is passing through the apex of the cone. Draw its front view, sectional top view and true shape of section.
4. A cone of diameter of base 60mm and axis length 70mm is resting on its base on the ground. It is cut by two section planes. One is parallel to contour generator and 10mm away from it, while the other is parallel to the opposite contour generator. Both the cutting planes lean towards the base, intersecting each other on the axis of the cone. Draw the sectional plan, elevation and the left side view. Also draw the true shape of section with respect to any one of the section planes. Name the curve thus obtained.
5. A cone of diameter of base 50mm and axis length 70mm is standing with its base on the HP. It is cut by a section plane inclined at 40° to the VP and perpendicular to the HP cut s the cone at a distance 10mm in front of its axis. Draw the top view, sectional front view and true shape of section.

Sections of cubes

1. A cube of 45mm edge rests on one of its faces on the ground with its base edges equally inclined to the VP. A VT perpendicular to one of the solid diagonals cuts the solids through one of its base corners. Draw the sectional top view, true shape of section and determine the inclination of the section plane with the reference plane.
2. A hexahedron of 50mm side rests with a face on the HP such that one of its vertical faces is inclined is 30° to the VP. A section plane parallel to the VP and perpendicular to the HP cuts the cube at a distance of 20mm from the farthest vertical edge from the observer. Draw its top view, sectional front view and true shape of section.
3. The true shape of section of a hexahedron is an equilateral triangle of side 50mm. Position the cube of suitable size on the HP and locates the VT. Determine the inclination of section plane with HP and size of the cube. Also draw the sectional top view and true shape of section.
4. A cube of 40mm side is cut by a VT, so that the true shape of section is an equilateral triangle of sides of maximum length. Draw the sectional top view and true shape of section. Determine the inclination plane to HP and measure the length of the sides of the equilateral triangle.
5. The true shape of the section of a cube is a rhombus having diagonals of 60mm and 50mm. Draw the projections of the cube keeping it on base using a suitable position. Determine the size of the cube and the inclination of AIP with the HP. Also check the true shape of section.
6. A hexahedron of 40mm sides is cut by a section plane, so that the true shape of section is a rhombus of sides of maximum length. Draw the sectional top view and the true shape of section. Also find the inclination of the section lane with the reference plane and the size of the rhombus.

Sections of prisms

1. A Rectangular prism of height 75mm and cross section 60X37.5mm is resting on its base on the HP with one of its shorter base edges parallel to VP.A VT whose width between its ends is equal to the longer base edge cuts the prism through one of the extreme base edges and pass through the lateral face opposite to that base edge. Draw the front view and true shape of the section. Measure the inclination of the section plane and sides of the true shape.

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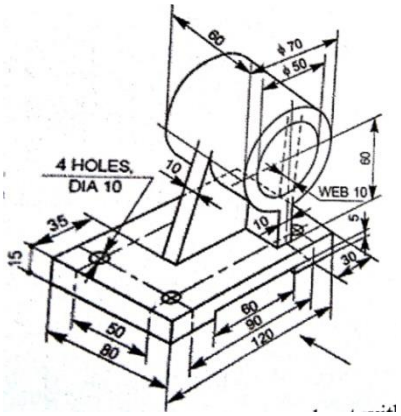
2. A rectangular prism of height 80mm and cross section 48X32mm is resting on the HP with its base. It is cut by a section plane in such a way that the true shape of section is a square of sides of maximum dimension. Draw the front view and determine the inclination of section plane to the reference plane. Also draw the sectional top view and true shape of section.
3. A square prism, sides of square faces 40mm and height 80mm rests with its base on the HP with a vertical face inclined at 30° to the VP. It is cut by a plane inclined at 50° to the VP and perpendicular to the HP and is 15mm from axis nearer to the observer. Both that inclined faces and the section plane lean towards the same direction. Draw its top view, sectional front view and true shape of section.
4. An equilateral triangular prism of 60mm base side and axis length 100mm is resting on the HP with its axis vertical and one of its base edges parallel to the VP and nearer to it. It is cut by an inclined section plane perpendicular to the HP and 60° to the VP and 10mm in front of the axis. Draw the sectional front view and true shape of section.

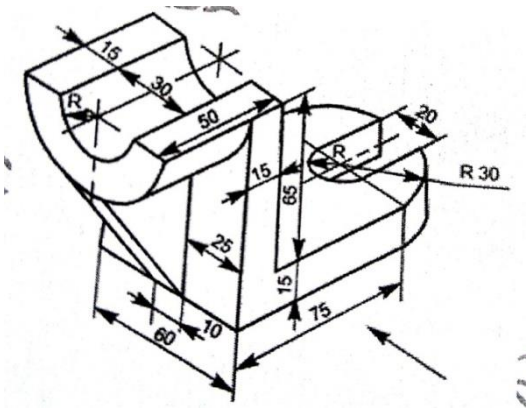
Sections of cylinders

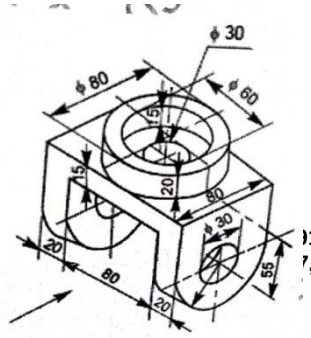
1. A cylinder of base diameter 50mm and 70mm is resting with its base on the HP. A section plane inclined at 50° to the VP and perpendicular to the HP cuts the solid at 10mm in front of it. Draw its top view, sectional front view and true shape of section.
2. A cylinder of base diameter 50mm and axis 70mm is resting on the HP with its axis vertical. A section plane perpendicular to both the HP and the VP cuts the cylinder at 15mm right of the axis. Draw the projections of the cylinder showing the true shape of section.
3. A cylinder of diameter of base 45mm and height 70mm long rests on its base on the HP. It is cut by a plane perpendicular to the VP and inclined at 30° to the HP and meets the axis at a height of 30mm above the base. Draw the front view, sectional top view and true shape of section.
4. A cylinder, 60mm diameter of base and axis 80mm long rests with its base on the HP. A section plane passing through one of its extreme end points on the circumference of its base circle and a point on the axis at 49mm from the base cuts the cylinder. Determine the inclination of the section plane with reference plane. Also draw the sectional top view and the sectional side view.
5. A cylinder of dbase diameter 50mm and axis 100mm long rests on its base on the HP. A VT cuts the cylinder to the HP through the mid point of the axis. Draw the front view, sectional plan and true shape of section.
6. A triangle of base 60mm and height 75mm is the front view3 of a cut cylinder of base diameter 60mm and height 75mm sectioned by two cutting planes. Draw the sectional views looking from the top and right sides. Also project one of the true shapes of section and determine the inclinations of the section planes.

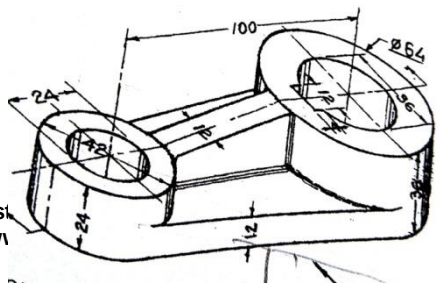
ORTHOGRAPHIC VIEWS

1. Draw the following views of machine components Sectional FV, TV, Left side view.









MODULE 3: THREAD FORMS:

1. Draw neat sketches to indicate conventional represe3ntaion of the following:
   i) BSW thread having pitch 50mm.ii) Acme thread pitches 60mm. Show at least 3 threads in section.
2. i) Draw proportionate sketch of the locking device for a nut, use 20mm diameter Bolt using split pin.
   ii) Sketch any one type of Grub screw.
3. Draw neat and proportionate sketches of the following.
   i) ISO screw thread profile of pitch 50mm indicate all proportions and dimensions.
   ii)Two views of hexagonal headed bolt with nut for a 30mm diameter bolt. Take length of bolt equal to 125mm.
   iii) Castle nut.
4. Make neat and proportionate sketches of the following.
   i) Acme thread,
   ii)Two view of M20 hexagonal bolt with flanged nut. Consider length of the Shank as 150mm,
   iii) Counter sunk head screw.
5. Draw a proportional neat sketch of a Knuckle joint to connect two rods of 20mm dia. Indicate all the proportions with dimensions.
6. Sketch a proportionate sectional front view of a knuckle joint to connect two rods of diameter 20mm. Indicate a few important dimensions in terms of diameter 'd'.

FASTNERS:

1. Draw two views of
   a. Hexagonal bolt and
   b. Square headed bolt of size 25mm dia and 100mm long. Indicate all the dimensions.
2. Draw the three views of an ISO-threaded hexagonal bolt 140mm long, 24mm diameter and a threaded length of 60mm, with a hexagonal nut. Indicate all the proportions and actual dimensions.

KEYS :

1. Draw the tow views of a sunk key fastening a boss to a shaft of 40mm diameter. The noncircular views of the assembly should be shown in half section. Indicate the actual dimensions and empirical proportions of the key.
2. Sketch to 1:1 scale, inserting all the dimensions, tow views of a wheel boss fixed to a shaft by means of a sunkgib-head key using the following dimensions. Diameter of the shaft=50mm, diameter of boss=100mm, length of boss=75mm.
   Using empirical proportions for the gib-head key, the view showing the length of the key should be drawn in section. Indicate the actual dimensions of the key.
3. Draw in assembly the flat and hollow saddle keys for 40mm diameter shaft. Use empirical proportions. The drawing should be completely dimension.Draw the feather key locked to a shaft of 40mm diameter fastened to a boss. Show the non circular view of the assembly in half section. Fully dimension the drawing.
4. Sketch to 1:1 scale, inserting dimensions, two views of a boss fixed to a shaft by means of woodruff key. Diameter of the shaft is 50mm. diameter of the boss is 100mm. the length of the boss is 75mm.

MODULE 4: COUPLINGS:

1. Draw i) half sectional front view with top half section and ii) Side view of a protected type flange coupling to connect two shafts of diameter 25mm each.
2. Prepare free hand sketches of a protected type flange coupling as per instruction given below: i) Sectional elevation with top half in section. Ii) Right view. Take diameter of shaft D=30mm and a scale of 1:1. Indicate important dimensions on the sketches.
3. Prepare free hand sketches (half sectional front view-top half) of a protected type flange coupling for a shaft of 30mm dia adopt. Standard proportions add side view. Mark important dimensions/proportions on the views.
4. Draw to 1:1 scale, the following views of a protected type flange coupling (diameter of shaft=20mm):
   i) Front view with top half section.
   ii) Left view looking form the nut end. Indicate important dimensions, add parts list.
5. Draw the following views of a UNIVERSAL COUPLING used to connect two rods of diameter 20mm:
   i. Sectional front view.

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ii) Profile view.

6. Draw a free hand sketch of a flanged nut assuming the nominal diameter to be 20mm.
7. Draw a neat and proportionate sketch of a protected type of flanged coupling to connect two shafts of 25mm showing the following views.
   i) Front view with top half in section.
   ii) Simple top view.
   iii) Right side view.
8. draw i) Half sectional front view, with top half in section ii) side view of a bushed pin type flange coupling to connect two shafts, each of diameter 30mm.

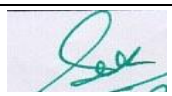
i) Prepare a neat and proportionate free hand sketch of a bushed-pin type of flexible coupling to connect two shafts of 20mm diameter for the following views: i)Front view with top half in section. ii) Side view form pin-head end.

2. Sketch neat proportional half sectional front view of protected type flanged coupling to connect two shafts of 20mm diameter. Indicate all proportions with dimensions. Prepare parts list.
3. Sketch the following view of a Flanged coupling (protected type) to connect two shafts of 20mm diameter.
   i) Front view with top half in section.
   ii) Left side view.
4. Sketch half sectional front view of a flange coupling unprotected type to connect two shafts 20mm diameter. Indicate all proportions. Add parts list.
5. Sketch sectional front view of a **Universal** coupling to connect two rods of diameter 30mm. indicates all dimensions, add parts lists.
6. Draw the following, views of pin type flexible coupling, to connect to shafts of 30mm diameter.
   i) Front view with top half in section,
   ii) Side view from the pin end.
7. Sketch the sectional front view of a flexible coupling to connect two shafts of 25mm dia with all dimensions.

MODULE 5 : LIMITS, FITS AND TOLERANCES

ASSEMBLY DRAWINGS: (Part drawings should be given)

1. Details of a "PLUMMER BLOCK" is shown in fig. Assemble the parts and draw the following views with all important dimensions.i) Left half sectional view.ii) Top view.
2. Fig. shows the details of "SCREW JACK". Assemble the parts and draw the following views i) Front view showing right half in section and ii) top view.
3. Fig. Shows the details of "SCREW JACK". Assemble the parts and draw the following views i) Sectional Front view and ii) Top view.
4. Fig. shows the details of a "Ramsbottom safety valve". Assemble the parts and draw the following views. Dimension the drawings.i) Front view in section.ii) Top view.
5. Details of a "PLUMMER BLOCK" are shown in fig.1.2. Assemble the parts and draw the following views of the assembly.i) Front view showing right half in section.ii) Top view.
6. Fig. shows the details of an I.C Engine Connecting Rod. Assemble the parts and draw the following views. Dimension the drawings.i) Front view with top half in section.ii) Top view.
7. Fig. shows the details of a Tail-Stock of a Lathe. Assemble the parts and draw.i) Sectional Front view.ii) Top view.
8. Fig. shows the details of a "CONNECTING ROD". Assemble the parts and draw the following views. Dimension the drawings .i) Front view and ii) Top view.

Prepared by	Checked by		
sd	sd		
Prof. S. A. Goudadi	Prof. D. N. Inamdar	HOD	Principal

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Subject Title	Course Title: **CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)**		
Subject Code	**18CPC39/49**	**SEE Marks**	60
Number of Lecture Hrs / Week	01	**CIEMarks**	40
Total Number of Lecture Hrs	25	**Exam Hours**	02
CREDITS – 01			

FACULTY DETAILS:		
Name: Prof.M. S. Futane	**Designation:** Asst. Prof.	**Experience:**17Years
No. of times course taught: 3	**Specialization:** CIM	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engg.		

2.0 Course Objectives

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

- Know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

3.0 Course Outcomes

After study of the course, the students are able to

	Course Outcome	Cognitive Level	POs
C102.1	Have general knowledge and legal literacy and thereby to take up competitive examinations	U	1, 5
C102.2	Understand state and central policies, fundamental duties	U	1, 5
C102.3	Understand Electoral Process, special provisions	U	1, 5
C102.4	Understand powers and functions of Municipalities, Panchayats and Co-operative Societies.	U	1, 5
C102.5	Understand Engineering ethics and responsibilities of Engineers. Have an awareness about cyber law.	U	1, 5
Total Hours of instruction		**50**	

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4.0 Course Content

Course syllabus

Module-1

Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.

Module-2

Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.

Module-3

Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences.

Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Module-4

Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

Module-5

Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.

5.0 Books Used and Recommended to Students

Text Books
1 Constitution of India,Professional Ethics and HumanRights Shubham Singles,Charles E. Haries,and et al Cengage Learning India2018 2 Cyber Security and Cyber Laws Alfred Basta and et al Cengage Learning India 2018
Reference Books
1Introduction to the Constitution of India Durga Das Basu Prentice –Hall, 2008. 2 Engineering Ethics M. Govindarajan,S. Natarajan,V. S. Senthilkumar Prentice –Hall, 2004

6.0 Examination Note

Internal Assessment: 50 Marks

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7.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
1	1	The Necessity of the Constitution, The Societies before and after the Constitution adoption.	20
	2	Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly	
	3	Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations.	
	4	Directive Principles of State Policy (DPSP) and its present relevance in our society with examples.	
	5	Fundamental Duties and its Scope and significance in Nation building.	
2	6	Parliamentary System, Federal System, Centre-State Relations.	20
	7	Union Executive – President, Prime Minister, Union Cabinet, Parliament	
	8	LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism	
	9	State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts,	
	10	Special Provisions (Articles 370.371,371J) for some States.	
3	11	Elections, Electoral Process, and Election Commission of India, Election Laws.	20
	12	Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments.	
	13	Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies.	
	14	Emergency Provisions, types of Emergencies and its consequences.	
	15	**Constitutional special provisions:** Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.	
4	16	Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics.	20
	17	Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India):	
	18	Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest.	
	19	Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility.	
	20	Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering	
5	21	Internet and Need for Cyber Laws, Modes of Regulation of Internet	20
	22	Types of cyber terror capability,	
	23	Net neutrality, Types of Cyber Crimes,	
	24	India and cyber law, Cyber Crimes and the information Technology Act 2000,	
	25	Internet Censorship. Cybercrimes and enforcement agencies.	

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8.0 QUESTION BANK

Module– I:

1. The _____ Act transferred the power of the Crown to the Secretary of state of India .
   a. Indian Councils Act 1858 c. Indian Council Act 1861
   b. Morley Minto reforms 1909 d. Montague –Chelmsford reforms 1919.
2. The first meeting of the Constituent Assembly was held on _____.
   a. 9th January 1947 b. 9th December 1946 c. 9th August 1945 d. 9th September 1944
3. The governor General at the time of the India Independence Act 1947 was
   a. Lord Curzon b. Lord Wavell c. Lord Mount batten d. Sir Cripps
4. The President of the Constituent Assembly was
   a. Dr. B.R.Ambedkar b. Dr. Rajendra Prasad c. Jawaharlal Nehru d. Mahatma Gandhiji.
5. The Chairman of the Drafting Committee was
   a. Dr. Rajendra Prasad b. Dr.B.R.Ambedkar c. Dr. K.N.Rao d. Dr. K.Krinshna murthy
6. The Final draft of the Constitution was signed on
   a. 26th Jan 1947 b. 26th Dec 1948 c. 26th Nov 1949 d. 26th jan 1950.
7. The whole of the Constitution came into force on
   a. 26th Jan 1950 b. 15th Aug 1947 c. 26th Dec 1950 d. 15th Aug 1950.
8. Every Citizen of India is eligible to vote in an Election after Attaining ____ years .
   a. 21 b. 16 c. 25 d. 18 .
9. The Mountbatten plan was executed in the year
   a. 1946 b. 1949 c. 1950 d. 1947.
10. The Constitution is divided into ___ Parts \
    a. 21 b. 22 c. 23 d. 24.

Module – II:

1. The Words" We the People of India " in the preamble of the Indian Constitution refer to all
   a. The members of the Drafting committee c. People of India
   b. The Members of the Drafting committee &Constituent Assembly d. None of these.
2. The Preamble of Indian Constitution indicates
   a. The Date of Commencement of the Indian Constitution
   b. The Rights given to socially and economically backward class
   c. The role to be played by the Judiciary in securing Social ,Political and economic justice to the Citizen of India .
   d. None of these.
3. The Secular Nature of the Preamble recognizes
   a. All religion b. Only one religion c. attitude of neutrality towards all religions d. None of these.
4. The nature of our Constitution is
   a. Federal b. Unitary c. Federal with unitary features d. Unitary with feral features .
5. The Preamble tells us the
   a. Source of the Constitution c. The importance of the Constitution
   b. Number of religions d. None of these.

Module – III:

1. The Fundamental rights are contained in _____ part of the Constitution
   a. I b. II c. III d. IV
2. The Fundamental rights are classified into ____
   a. 5 groups b. 6 groups c. 7 groups d. 8 groups
3. The provisions of Article 14 does not apply to
   a. President & Governor c. Chief-minister & Governor
   b. Prime-minister & Chief-ministers d. President & Prime-minister.
4. Article 15 applies to
   a. Citizens only b. Aliens only c. both a & b d. None of these .

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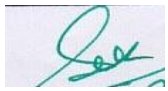
5. Article 19 gives us __ freedoms
   a. 4 b. 5 c. 6 d.7
6. Article 32 refers to
   a. Right against exploitation c. Cultural & Educational rights
   b. Right to Equality d. Right to Constitutional remedies
7. Which of the following has been dropped from the List of fundamental rights?
   a. Right to liberty b. Right to Property c. Right to Religion d. Right against Exploitation.
8. Which Article of the constitution guarantees the Right to life and personal liberty?
   a. 20 b. 21 c. 22 d. 23
9. Which Article of the Constitution has been described as the very soul of the Constitution and the very heart of it?
   a. 32 b. 19 c. 21 d. 21A
10. Cultural and Educational rights are contained in Articles?
    a. 25-26 b. 27-28 c. 29-30 d. 73-74

Module – IV:

1. The Directive Principles of state policy aim at
   a. Establishing a free society b. Establishing a genuine political democracy.
   c. Establishing social, economic base for democracy d. All of the above.
2. The Constitution makers have taken the idea of Directive Principles from the Constitution of
   a. Ireland b. America c. Britain d. Canada.
3. The Enforcement of the Directive Principles depends upon
   a. People b. Judiaciary c. Opposition Party d. Ruling Party.
4. Who has aptly described the Directive Principles of State policy as a "Novel Feature" of the Constitution of India
   a. L.M.Singhvi b. Motilal Nehru c. N.Madhava Rao d. Dr.B.R.Ambedkar
5. Which directive Principle has not been enforced till now?
   a. Belief in Peace c. Protection of Animals
   b. Free Education upto certain classes d. Enforcement of prohibition.
6. Which is not a Directive Principle of State Policy?
   a. Participation of workers in the management of industries
   b. Organization of agriculture and Animal Husbandry
   c. Uniform Civil Code for all the citizens
   d. Abolition of tittles.

Module – V:

1. Which of the following is not a type of cyber crime?
   a) Data theft b) Forgery c) Damage to data and systems **d)** Installing antivirus for protection
2. Cyber-laws are incorporated for punishing all criminals only.
   a) True **b)** False
3. Cyber-crime can be categorized into _____ types.
   a) 4 b) 3 **c)** 2 d) 6
4. Which of the following is not a type of peer-to-peer cyber-crime?
   a) Phishing b) Injecting Trojans to a target victim c) MiTM **d)** Credit card details leak in deep web
5. Which of the following is not an example of a computer as weapon cyber-crime?
   a) Credit card fraudulent **b)** Spying someone using key logger
   c) IPR Violation d) Pornography

-Sd-		
M. S Futane	**HOD**	**Principal**

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Subject Title	**INTRODUCTION TO PYTHON Lab**		
Subject Code	21ME381	**IA Marks**	50
Practical Hrs / Week	02	**Exam Marks**	50
Total No of Lecture + Practical Hrs	16	**Exam Hours**	02
			CREDITS – 01

FACULTY DETAILS:		
Name: Dr. K. M. Akkoli	**Designation:** Associate Professor	**Experience: 20** Years
No. of times course taught: 01 Times	**Specialization:** Thermal Power Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engineering	PUC	Mathematics
02	Mechanical Engineering	I/II	Mathematics

2.0 Course Objectives

1. Demonstrate the use of Anaconda or PyCharm IDE to create Python Applications
2. Develop Python programming language to develop programs for solving real-world problems
3. Utilize Object-Oriented Programming concepts in Python.
4. Analyse the working of various documents like PDF, Word file

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	Cognitive Level	POs
C209.1	Demonstrate the use of Anaconda or PyCharm IDE to create Python Applications.	U	1,2,7,12
C209.2	Develop Python programming language to develop programs for solving real-world problems.	A	1,2,7,12
C209.3	Utilize Object-Oriented Programming concepts in Python.	A	1,2,7,12
C209.4	Analyse the working of various documents like PDF, Word file	U	1,2,7,12
Total Hours of instruction			**52**

4.0 Course Content

1. Develop a python program to find the better of two test average marks out of three test's marks accepted from the user.
2. Develop a python program to find the smallest and largest number in a list
3. Develop a python program to arrange the numbers in ascending and descending order
4. Develop a binary search program in python
5. Develop a bubble sort program in python
6. Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.
7. Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.
8. Write a Python program for pattern recognition with and without using regular expressions

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Demonstration Experiments (For CIE)

9. Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet
10. Demonstration of reading, writing and organizing files.
11. Demonstration of the concepts of classes, methods, objects and inheritance
12. Demonstration of working with PDF and word files

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	VIII	Project work & Application	AI & ML, CNC Programming

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Awareness of writing program.
02	Logic development.
03	Knowledge AI and ML.

7.0 Books Used and Recommended to Students

Reference Books

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3" 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf)
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015.(http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Download pdf files from the above links)
3. Al Sweigart, "Automate the Boring Stuff with Python",1stEdition, No Starch Press, 2015. (Available under CC-BYNC-SA license at https://automatetheboringstuff.com/)
4. Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.

8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

1.http://www.nptel.ac.in

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Cambridge Journals	*https://www.cambridge.org/core/journals/journal-of-fluid-mechanics*
2	Springer	*www.springer.com › Home › Engineering › Mechanics*
3	Iop-Science	*iopscience.iop.org/journal/1873-7005*

10.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimumpassing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied theacademic requirements and earned the credits allotted to each course. The student has to secure not less than 35%(18 Marks out of 50) in the semester-end examination (SEE).

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Continuous Internal Evaluation (CIE):

CIE marks for the practical course is 50 Marks.

The split-up of CIE marks for record/ journal and test are in the ratio 60:40.

 Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for theevaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling thelaboratory session and is made known to students at the beginning of the practical session.

 Record should contain all the specified experiments in the syllabus and each experiment write-up will be

evaluated for 10 marks.

 Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).

 Weightage to be given for neatness and submission of record/write-up on time.

 Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the Semester and the second test shall be conducted after the 14th week of the semester.

 In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry aweightage of 60% and the rest 40% for viva-voce.

 The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics

suggested in Annexure-II of Regulation book

 The average of 02 tests is scaled down to 20 marks (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adheredto by the examiners. OR based on the course requirement evaluation rubrics shall be decided jointly by examiners. Students can pick one question (experiment) 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 are mentioned here, writeup-20%, Conduction procedure and result in -60%, Vivavoce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners) Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

11.0 Course Delivery Plan

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Expt No	Lecture / Practical No	Name of the Experiment	% Of Portion
1	1	Develop a python program to find the better of two test average marks out of three test's marks accepted from the user.	100
2	2	Develop a python program to find the smallest and largest number in a list	
3	3	Develop a python program to arrange the numbers in ascending and descending order	
4	4	Develop a binary search program in python	
5	5	Develop a bubble sort program in python	
6	6	Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.	
7	7	Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.	
8	8	Write a Python program for pattern recognition with and without using regular expressions	
Demonstration Experiments (For CIE)			
9	9	Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet	
10	10	Demonstration of reading, writing and organizing files.	
11	11	Demonstration of the concepts of classes, methods, objects and inheritance	
12	12	Demonstration of working with PDF and word files	

12.0 QUESTION BANK

Q1.What is Python?
Q2. Python is an interpreted language. Explain
Q3. What is the difference between lists and tuples?
Q4. What is pep 8?
Q5. What are the Key features of Python?
Q6. How is Memory managed in Python?
Q7. What is PYTHONPATH?
Q8. What are Python Modules?
Q9. What are python namespaces?
Q10. Explain Inheritance in Python with an example?

13.0 University Result

Examination	S+	S	A	B	C	D	E	% Passing

Prepared by	Checked by		
Dr. K. M. Akkoli		HOD	Principle

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