Department of Mechanical Engineering

COURSE PLAN 2019-20

III Semester "A" division

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

Student Help Desk

S. N.	Additional Responsibility	Contact Person	
		Faculty	Staff
1.	Attestations, Dept. & Institute Work.	HOD	Sri. V G Badiger
2.	PG Coordinator/ Research Centre Head	Prof. S A Alur	Sri. R M Hunchyali
3.	I I I coordinator (INDUSTRY)	Prof. G A Naik	Sri. S C Jotawar
4.	I I I coordinator (INTERNSHIP)	Prof. R. V. Chitgopkar	Sri. R B Kumbar
5.	Class Teachers In-charges	Prof.K.M.Akkoli (III A)	Sri. M S Kurani
		Prof.Jagadeesh S A (III B)	Sri. R B Kumbar
		Prof.M. R. Ingalagi (V A)	Sri. R M Hunchyali
		Prof. R.K.Chitagopkar (V B)	Sri. S R Nakade
		Prof.S.A.Goudadi (VII A)	Sri. S C Jotawar
		Prof. M S Futane (VII B)	Sri. M B Badiger
6.	Record Room Coordinator	Prof. S. B. Awade	Sri. M S Kurani
7.	I A Test Coordinator	Prof. S. B. Awade/Prof. A M Biradar	Sri. M B Badiger
8.	Seminar/Project Coordinator	Prof. N.M.Ukkali/ Prof. B. M. Dodamani	Sri. M B Badiger/ Sri. S C Jotawar
9.	Faculty / AICTE/LIC/ Staff Activities	Prof. B. M. Dodamani	All Instructors
10.	Student Activities/Feedback Coordinator	Prof. Jagdeesh A	
11.	AIMSS Coordinator	Prof. M. M. Shivashimpi/Prof. M R Ingalagi	Sri. M B Badiger
12.	NBA Coordinator	Prof. S. A. Goudadi	
13.	Extra Curricular/ Induction Coordinator	Prof. T S Vandali	
14.	Dept. Meeting Proceedings Coordinator	Prof. K G Ambli	
15.	PhD.EMS/ News Letter Coordinator	Prof. M. M. Shivashimpi	
16.	Choice of Electives	Dr. S. N. Toppannavar Prof. D. N. Inamdar Prof. T. S. Vandali	
17.	EMS Coordinator	Prof. S. B. Awade/ Prof. N.M.Ukkali/ Prof. M R Ingalagi	
18.	T P Cell Coordinator	Prof. R V Nyamagoud	Sri S. R. Nakade
19.	Alumni Coordinator.	Prof. M A Hipparagi	
20.	Robo Vidya Coordinator	Prof. A M Biradar	Sri. V G Badiger
21.	Department Library Coordinator	Sri. Mahantesh Tanodi	Sri. R M Hunchyali
22.	Time Table/ISTE Coordinator	Prof. G. V. Chiniwalar	
23.	GATE Coordinator	H.O.D	
24	News Letter/ Tech. Magazine/ Coordinator,	Prof. S R Kulkarni/ Prof. M S Futane	
25	Central Counseling Coordinator (Dept.)	HOD & Class Teachers	
26	Dispensary	Dr. Arun G. Bullannavar - Cell No. 9449141549	
Institute Level			
01	NBA/NIRF Coordinator	Prof. D. N. Inamdar (9591208980)	
02	Student Welfare Convener	Prof. S. B. Akkoli (9480422508)	
03	Hostel warden KSCST Coordinator	Prof. M S Futane (7829611609)	
04	AICTE/ Hostel Asst. Warden Coordinator	Prof. K. M. Akkoli (9739114856)	
05	TP Cell Coordinator	Prof. N. M. Patel (9739619661)	
06	Anti Ragging Convener	Prof. M. S. Futane (9480849334)	
07	Anti Squad Convener	Prof. K. M. Akkoli (9739114856)	
08	Anti Sexual Harassment Convener	Prof.S.S.Kamate (9008696825)	
09	Grievance Redressal Convener	Prof. G. A. Naik (9480539283)	
10	Institute News & publicity	Prof. Mahesh Hipparagi (7411507405)	
11	First Year Coordinator	Dr. S. N. Toppannavar (9945082054)	

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	24	17
2	Technical staff	11	14
3	Helper / Peons	05	09

Major Laboratories

S.N.	Name of the laboratory	Area in Sq. Meters	Amount Invested (Rs.)
1	Basic Workshop Laboratory	170	427698
2	Fluid Mechanics Machinery Laboratory	172	775316.75
3	Energy Conversion Engg. Laboratory	173	1269190.2
4	Machine shop Laboratory	170	1361344.5
5	Foundry & Forging Laboratory	179	318787.11
6	Design Laboratory	73	364998
7	Heat & Mass Transfer Laboratory	148	524576
8	Metallography & Material Testing Laboratory	149	1095679.24
9	Mechanical Measurements & Metrology Laboratory	95	548011.75
10	CIM & Automation/CAMA Laboratory	66	3720223.1
11	Computer Aided Machine Drawing Laboratory	66	2013811.5
12	Computer Aided Engg Drawing Laboratory	66	1427271.3
13	Department/Other	--	1908664.2
	Total	**1527**	**1,57,55,571.65**

Teaching Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
1	Dr. S. C. Kamate	Principal	Ph. D	Thermal(Cogeneration)	LMISTE	03	26	9480849331
2	Dr. S. A. Alur	Professor	Ph. D	Thermal Power Engg.	LMISTE	--	24	9686856029
3	Dr. B M Shrigiri	HOD/Professor	Ph. D	Thermal Power Engg.	LMISTE	01	20	9741483339
4	Dr. S. N. Topannavar	Assoc. Professor	M Tech.(Ph. D)	Thermal Power Engg.	LMISTE	01	18	9482440235
5	Prof. D. N. Inamdar	Asso. Professor	M Tech.(Ph. D)	Tool Engg	LMISTE	08	14	9591208980
6	Prof. K. M. Akkoli	Asso. Professor	M Tech.(Ph. D)	Thermal Power Engg.	LMISTE	1.5	14	9739114856
7	Prof.R.K.Chitgopkar	Asst. Professor	M Tech.	Thermal Power Engg.	LMISTE	1.5	26	9886070475
8	Prof.G. A. Naik	Asst. Professor	M Tech.	Production Management	LMISTE	02	21	9480539283
9	Prof. G. V. Chiniwalar	Asst. Professor	M Tech.	Machine Design	LMISTE	04	14	8762336434
10	Prof.M.S.Futane	Asst. Professor	M Tech.	Computer Integrated Manufacturing	LMISTE	01	12	9164105035
11	Prof. T. S. Vandali	Asst. Professor	M Tech.	Machine Design	LMISTE	8.5	08	9686235904
12	Prof.S. A. Goudadi	Asst. Professor	M Tech.	Design Engineering	LMISTE	--	10	9448876682
13	Sri. S.R. Kulkarni	Asst. Professor	M Tech.	Design Engineering	LMISTE	--	10	8123661692
14	Prof.M.M.Shivashimpi	Asst. Professor	M Tech.(Ph.D)	Thermal Power Engg.	LMISTE	01	08	9742197173
15	Prof.M.A.Hipparagi	Asst. Professor	M Tech.(Ph.D)	Production Technology	LMISTE	02	07	7411507405
16	Prof. A. M. Biradar	Asst. Professor	M Tech.	Machine Design	LMISTE	02	07	9986127703
17	Prof. K. G. Ambli	Asst. Professor	M Tech.(Ph.D)	Product Design and Manufacturing	LMISTE	0.8	06	9164534514
18	Prof. S. B. Awade	Asst. Professor	M Tech.	Machine design	LMISTE		05	9632606108
19	Prof.Mahantesh Tanodi	Asst. Professor	M Tech.	Machine design	LMISTE	--	06	9611998812
20	Prof. N. M. Ukkali	Asst. Professor	M Tech.	Machine Design	LMISTE	--	05	9620152199
21	Prof. M. R. Inagalagi	Asst. Professor	M Tech.	Thermal Power Engg	LMISTE	--	04	9743868503
22	Prof. Jagadeesh A.	Asst. Professor	M Tech.	Thermal Power Engg	LMISTE	--	05	9902847774
23	Prof. R. V. Nyamagoud	Lecturer	M Tech.	Thermal Power Engg	LMISTE	--	04	9964822494
24	Prof. B. M. Dodamani	Asst. Professor	M Tech.	Energy System Engg	LMISTE	02	04	9535447575

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2019-20 (Odd)

Date	Events
29-07-2019	Commencement of III /V/VII Sem Classes
01-08-2019	Commencement of I Sem Classes
01-08-2019 to 11-08-2019	Induction Program for I Sem students
15-08-2019	Independence Day & Swachh Bharat Abhiyan
05-09-2019	Teachers Day, Mahadasoha
06-09-2019	Indoor Games & & Health Checkup Camp
12-09-2019 to 14-09-2019	First Internal Assessment of I/III/V/VII Sem
15-09-2019	Engineers Day
16-09-2019	Feed Back-1 on Teaching-Learning
18-09-2019	Display of First Internal Assessment Marks & Submission of Feedback-1 report to office
24-09-2019	EDP Activities/ Green Club activites
02-10-2019	Gandhi Jayanti & Swachh Bharat Abhiyan
11-10-2019	Blood donation camp
21-10-2019 to 23-10-2019	Second Internal Assessment of I/III/V/VII Sem
24-10-2019	Feed Back-2 on Teaching-Learning
28-10-2019	Display of Second Internal Assessment Marks & Submission of Feedback-2 Report to Office
01-11-2019	Kannada Rajyotsava
21-11-2019 to 23-11-2019	Third Internal Assessment of I/III/V/VII Sem
25-11-2019 to 27-11-2019	Lab Internal Assessment of I/III/V/VII Sem
28-11-2019	Display of Third & Final Internal Assessment Marks (I/III/V/VII Sem)
29-11-2019	Last Working Day of I Sem
30-11-2019	Last Working Day of III/V/VII Sem
03-12-2019 to 13-12-2019	Practical Exams of I/III/V/VII Sem
16-12-2019 to 07-02-2020	Theory Exams of I/III/V/VII Sem

August-2019

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

12-Bakrid, 15- Independance day, 26- Last Shravana Monday

September-2019

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					

02- Ganesh Chaturthi , 05- Mahadasoha, 10- Moharam, 28-Mahalaya Amavasye

October-2019

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		

02- Gandhi Jayanti, 07-Ayudha Pooja, 08- Vijayadashami, 13- Valmiki Jayanti, 27- Naraka Chaturdashi, 29- Balipadyami

November-2019

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 Rajyotsava, 10- Id-e-Milad, 15- Kanakadasa Jayanthi

Dr. Shilpa Shrigiri
IQAC Co-ordinator

Hirasugar Institute of Technology Nidasoshi Pin-591236 Dist. Belagavi

Dr. S C Kamate
PRINCIPAL
Hirasugar Institute of Technology
NIDASOSHI-591 236

DEPARTMENT CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2019-20 (Odd)

Date	Events
29-07-2019	**Commencement of III /V/VII Sem Classes**
17-08-2019	**Welcome Function for Fresher's and Inauguration of AIMSS Activities**
31-08-2019	Industrial Visit for III semester students
06-09-2019	Technical Talk by environmentalist
12-09-2019 to 14-09-2019	**First Internal Assessment**
16-09-2019	Feedback - 01 on Teaching and Learning
18-09-2019	Display of First I.A. Marks, Submission of Students Feedback-1 report and Central Counseling.
21-09-2019	Industrial Visit for V semester students
24-09-2019	ED Cell Activity
11-10-2019	Technical Talk by Academic Expert
21-10-2019 to 23-10-2019	**Second Internal Assessment**
24-10-2019	Feedback - 02 on Teaching and Learning
28-10-2019	Display of Second I.A. Marks, Submission of Feedback-2 Report to Office and Central Counseling.
08-11-2019	Technical Talk by Industry Expert
21-11-2019 to 23-11-2019	**Third Internal Assessment**
25-11-2019 to 27-11-2019	**Lab Internal Assessment**
28-11-2019	Display of Third & Final I.A. Marks
30-11-2019	**Last Working Day**
03-12-2019 to 13-12-2019	**Commencement of Practical Exams**
16-12-2019 to 07-02-2020	**Commencement of Theory Exams**

August-2019

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

12-Bakrid, 15- Independance day, 26- Last Shravana Monday

September-2019

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					

02- Ganesh Chaturthi , 05- Mahadasoha, 10- Moharam, 28-Mahalaya Amavasye

October-2019

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		

02- Gandhi Jayanti, 07-Ayudha Pooja, 08- Vijayadashami, 13- Valmiki Jayanti, 27- Naraka Chaturdashi, 29- Balipadyami

November-2019

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 Rajyotsava, 10- Id-e-Milad, 15- Kanakadasa Jayanthi

Prof. M. M. Shivashimpi
AIMSS Co-ordinator

Dr. B. M. Shrigiri
HOD

HOD
Mechanical Engg.
HIT, Nidasoshi

Scheme of Teaching and Examination

3rd Semester "A" division

III SEMESTER

Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P					
BSC	18MAT31	Mathematics	Mathematics	2	2	--	03	40	60	100	3
PCC	18ME32	Mechanics of Materials		3	2	--	03	40	60	100	4
PCC	18ME33	Basic Thermodynamics		3	0	--	03	40	60	100	3
PCC	18ME34	Material Science		3	0	--	03	40	60	100	3
PCC	18ME35A	Metal cutting and forming		3	0	--	03	40	60	100	3
PCC	18ME36A	Computer Aided Machine Drawing		1	4	--	03	40	60	100	3
PCC	18MEL37A	Material Testing lab		--	2	2	03	40	60	100	2
PCC	18MEL38A	Workshop and Machine Shop Practice (Consists of Fitting, and Machining)		--	2	2	03	40	60	100	2
	18CPH39	Constitution of India, Professional Ethics and Cyber Law		1	--	--	03	40	60		
				Examination is by objective type questions							

VTU Scheme

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Mathematics	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18ME32	Mechanics of Materials		3	2	--	03	40	60	100	4
3	PCC	18ME33	Basic Thermodynamics		3	0	--	03	40	60	100	3
4	PCC	18ME34	Material Science		3	0	--	03	40	60	100	3
5	PCC	18ME35A or	Metal cutting and forming		3	0	--	03	40	60	100	3
		18ME35B	Metal Casting and Welding									
6	PCC	18ME36A or	Computer Aided Machine Drawing/		1	4						
		18ME36B	Mechanical Measurements and Metallurgy		3	0	--	03	40	60	100	3
7	PCC	18MEL37A or	Material Testing lab		--	2	2	03	40	60	100	2
		18MEL37B	Mechanical Measurements and Metrology lab									
8	PCC	18MEL38A	Workshop and Machine Shop Practice (Consists of Fitting, and Machining)		--	2	2	03	40	60	100	2
		18MEL38B	Foundry, Forging and Welding lab									
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPH39	Constitution of India, Professional Ethics and Cyber Law		1	--	--	03	40	60		
					Examination is by objective type questions							
TOTAL					17 OR 19	10 OR 14	04	24 OR 27	420 OR 360	480 OR 540	900	24

Subject Title	**TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES**		
Subject Code	18MAT31	**IA Marks**	40
Number of Lecture Hrs /	04	**Exam Marks**	60
Total Number of Lecture Hrs	50	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: 1) Prof. S. A.Patil 2) Prof.S. I. Shivamoggimath	Designation: 1)Asst. Professor 2)Asst. Professor	Experience: 1) 09 2) 6.5
No. of times course taught: 1) 7 2) 4	**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 Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z- Transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

3.0 Course Outcomes

On completion of this course, students are able to:

	Course Outcome	POs
CO1	Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.	1,2,3
CO2	Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.	1,2,3
CO3	Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.	1,2,3
CO4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.	1,2,3
CO5	Determine the externals of functional using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.	1,2,3
Total Hours of instruction		50

4.0 Course Content

MODULES	RBT Levels	No. Of Hours
MODULE-1 **Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only). 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. Solution of linear differential equations using Laplace transforms.	**L1,L2**	**10**
MODULE-2 **Fourier Series**: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.	**L1, L2**	**10**
MODULE-3 **Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems. **Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.	**L1, L2**	**10**
MODULE-4 **Numerical Solutions of Ordinary Differential Equations(ODE's)**: Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.	**L1, L2**	**10**
MODULE-5 **Numerical Solution of Second Order ODE's:** Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae). **Calculus of Variations:** Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.	**L1,L2,L3**	**10**

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	Common to all	Common to all engineering Subjects	Signal and Analysis, Field Theory, Thermodynamics, Fluid Dynamics 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 variety of engineering problems, including heat transfer, vibrations, dynamics, fluid mechanics, etc.
02	Special functions are used to wave propagation and scattering, fiber optics, heat conduction in solids, and vibration phenomena.
03	In sampling is the reduction of a to a. A common example is the conversion of a (a continuous signal) to a sequence of samples (a discrete-time signal).

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 2017, 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 N P Bali and Manish Goyal, "A text book of Engineering mathematics" , Laxmi publications, 6th Edition, 2014.
2. B.V.Ramana "Higher Engineering M athematics" Tata McGraw-Hill, 11th Edition, 2010 .
3. H. K Dass and Er. RajnishVerma ,"Higher Engineerig Mathematics", S. Chand Publishing, 1st Edition, 2011.
4. C. Ray Wylie,Louis C. Barrett "Advanced Engineering Mathematics" ,McGraw-Hill Book Co, 6th Edition, 1995
5. Chandrika Prasadand Reena Garg, "Advanced Engineering Mathematics", Khanna Publishing,2018

Additional Study material & e-Books

1. N.P.Bali & Manish.Goyal, a Text book of Engineering Mathematics, 7th edition, Laxmi Publications.

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 - 20

10.0 Magazines/Journals Used and Recommended to Students

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

11.0 Examination Note

Internal Assessment: 40 Marks

Theoretical aspects as well as relevant sketches should be drawn neatly.

Scheme of Evaluation for Internal Assessment (40 Marks)

(a) Internal Assessment test in the same pattern as that of the main examination (All the three Internal Tests marks considered): **30**Marks.

(b) Assignments: **10** Marks

SCHEME OF EXAMINATION:

Question paper pattern:

Note: -The SEE question paper will be set for 100 marks and the marks will be proportionately reduced to 60.

i) The question paper will have **ten** full questions carrying equal marks.
ii) Each full question consisting of **20** marks.
iii) There will be **two** full questions (with a **maximum** of **four** sub questions) from each module.
iv) Each full question will have sub question covering all the topics under a module.
v) The students will have to answer **five** full questions, selecting **one** full question from each module.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
MODULE-1	1	Definition, transforms of elementary functions	20
	2	Properties	
	3	Problems	
	4	Periodic function	
	5	Unit step function	
	6	Problems	
	7	Inverse Laplace Transforms	
	8	Convolution theorem	
	9	Solution of linear differential equations using Laplace Transforms	
	10	Problems	
MODULE-2	11	Introduction, Periodic functions, Dirichlet's conditions	20
	12	Fourier series of periodic functions of period 2π	
	13	Fourier series of periodic functions of arbitrary period 2c	
	14	Problems	
	15	Fourier series of even functions	
	16	Fourier series of odd functions	
	17	Problems	
	18	Half range Fourier series	
	19	Practical harmonic analysis	
	20	Problems	
MODULE-3	21	Introduction, Infinite Fourier transform	20
	22	Fourier sine transforms	
	23	Fourier cosine transforms	
	24	Inverse transforms	
	25	z-transform-definition	
	26	Standard z-transforms	
	27	Damping rule, Shifting rule	
	28	Initial value and final value theorems (without proof) and problems	

	29	Inverse z-transform	
	30	Applications of z-transforms to solve difference equations	
MODULE-4	31	Numerical solution of ordinary differential equations of first order & first degree	**20**
	32	Taylor's series method & Problems.	
	33	Modified Euler's method	
	34	Problems	
	35	Runge -Kutta method of fourth order	
	36	Problems	
	37	Milne's predictor and corrector method	
	38	Problems	
	39	Adams-Bashforth predictor and corrector method	
	40	Problems.	
MODULE-5	41	Numerical solution of second order ordinary differential equations	**20**
	42	Runge -Kutta method	
	43	Problems.	
	44	Milne's method	
	45	Problems.	
	46	Calculus of Variations: Variation of function and Functional, variation problems	
	47	Euler's equation	
	48	Problems	
	49	Geodesics	
	50	Hanging chain, problems	

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	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity.	Book 1, of the reference list. Website of the 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 & Inverse Laplace Transform;

1. Find the Laplace Transform of sin2t sin3t. & $\sin^3 2t$.
2. Find L (e^{3t}sin2t) & L (e^{4t} sin2tcost).
3. Find L[1-e^t]/t & L[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^2u(t-3)].
7. Find the inverse transform s+2/s^2-4s+13.
8. Find L^{-1}[4s+5/$(s-1)^2(x+2)$]
9. Find L^{-1}[s/s^4+4a^4].
10. Find L^{-1}[s/$(s^2+a^2)^2$].
11. Find L^{-1}[log(s+1/s-1)]
12. Find L^{-1}[(s/(2s-1)(3s-1)].
13. Using the Convolution THM obtain the L^{-1}[s/$(s^2+a^2)2$] .
14. Solve the differential equation d^2y/dx^2-3dy/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**.**
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, 2π). 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=- π to x= π 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 ≤ x ≤ 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 series for the function f(x) = Hence deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5}+$

_____

13. Obtain the Fourier expansion of $f(x) = 2x - x^2$ *in* $0 \le x \le 2$

14. 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: Fourier 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, $0 < x < 4$.
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 $\int_0^\infty \frac{sinx - xcosx}{x^3} dx$.
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 $\int_0^\infty \frac{xsinmx}{1+x^2} dx$.

Z- Transformation:

1. P.T. $z_T(n^2) = \frac{z^2+z}{(z-1)^3}$
2. P.T. $z_T(n^3) = \frac{z^3+4z^2+2}{(z-1)^4}$
3. P.T. $z_T(cos\theta) = \frac{z(z-cos\theta)}{z^2-2zcos\theta+1}$
4. P.T. $z_T(sin\theta) = \frac{(zsin\theta)}{z^2-2zcos\theta+1}$
5. P.T. $z_T(a^n cosn\theta) = \frac{z(z-acos\theta)}{z^2-2azcos\theta+a^2}$
6. Find the Z-transform of $cos\, hn\theta$ & $sinhn\theta$.
7. Find the Z-transform of $(n+1)^2$
8. Using the inversion integral method find the inverse Z-transform of $\frac{3z}{(z-1)(z-2)}$
9. 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
10. Solve the difference equation $y_{n+2} + 2y_{n+1} + y_n = n$ with $y_0 = y_n = 0$ using Z-Transform.
11. Obtain the z-transform of $cos\, n\theta$ and $sin\, n\theta$
12. Find the Inverse z-transform of $\frac{2z^2+3z}{(z+2)(z-4)}$.

13. If $\bar{u}(z) = \frac{2z^2+3z+12}{(z-1)^4}$, find the value of $u_0,\ u_1,\ u_2,\ u_3$.
14. Solve the difference equation $u_{n+2} + 6u_{n+1} + 9u_n = 2^n$, $u_0 = u_1 = 0$.

MODULE-4: Numerical Methods

1. Solve $\frac{dy}{dx} = x^2y - 1$with y(0)=1 using Taylor's series method and find y(0.1) consider upto 4th degree terms.
2. Use Runge Kutta fourth order method to solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ with y(0)=1 and find y for x= 0.2 and 0.4 take h=0.2
3. Given $\frac{dy}{dx} = xy + y^2$, y(0)=1, y(0.1) =1.1169 ,y(0.2)=1.2773, y(0.3)=1.5049 find y(0.4) accurate upto three decimal places using Milne's predictour corrector method.
4. Applying R-K method to find an approximate value of y for x=0.2 in steps of 0.1 of $\frac{dy}{dx} = x + y^2$ given that y=1 when x=0.
5. Given $\frac{dy}{dx} = x^2(1 + y)$ & y(1)=1,y(1.1)=1.233, y(1.2) = 1.548,y(1.3) = 1.979. Evaluate y(1.4) by Adams Bash Fourth method
6. Employ Taylor's series method to find an approximate solution correct to fourth decimal places for the following initial value problem at x=0.1 & 0.2 $\frac{dy}{dx} = 2y + 3e^x$, y(0) = 0.
7. Using Milne's predictour corrector method find y where x=0.8 given $\frac{dy}{dx} = x - y^2$, y(0)=0, y(0.2)=0.02, y(0.4)=0.0795, y(0.6)=0.1762.Applying corrector formula twice.
8. Employ R-K method of 4rth order to solve the equation $\frac{dy}{dx} = 3x + y/2$, y(0)=1 at x=0.2 taking step length h=0.1
9. Solve the differential equation $\frac{dy}{dx} = x^2 + y^2$ given y(0)=1 to find the value of y(0.1) by using Taylor's series method of order.
10. Using modified Euler's method ,solve the equation $\frac{dy}{dx} = \frac{1}{x+y}$, y(0)=1 in steps of 0.5 at x = 1
11. Using Adams Bash fourth predictor correct method find y when x=0.8 given $\frac{dy}{dx} = x - y^2$, y(0)=0, y(0.2)=0.02, y(0.4)=0.0795, y(0.6)=0.1762. Apply correct formula twice.
12. Using Taylor's series method to find y at the point x=0.1& x=0.2 given that $\frac{dy}{dx} = x^2 + y^2$,y(0)=1
13. From the data given below find y at x=1.4 using Milne's predictour corrector method y'= x^2+y/2

x	1	1.1	1.2	1.3
y	2	2.2156	2.4649	2.7514

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. $y(0) = 1$ & $y'(0) = 0$
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 Catenary is the curve which when rotated about a line generates a surface of minimum area.

11. Find the extremal of the functional $\int_0^{\pi}(y'^2 - y^2 + 4ycosx)dx;\ y(0) = 0 = y(\pi)$
12. Solve the variational 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
Jan 2019				
Jan 2018	18	09	18	86.54

Prepared by	Checked by		
1) Prof. S. A.Patil 2) Prof. S. I. Shivamoggimath	Prof. S. L. Patil	**HOD**	**Principal**

Subject Title	**MECHANICS OF MATERIALS**		
Subject Code	18ME32	**CIE Marks**	40
Number of Lecture Hrs / Week	03(L)+02(T) hrs	**SEE Marks**	60
Total Number of Lecture Hrs	50 (10 Hours per Module)	**Exam Hours**	03
			CREDITS – 04

FACULTY DETAILS:		
Name: Prof. D.N.Inamdar / Prof. G. V. Chiniwalar.	**Designation:** Asst. Professor	**Experience:** 17/16
No. of times course taught: 08/08	**Specialization:** Tool Design / Machine Design	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Students should have the knowledge of basic subjects	I/II Sem & PUC	Engineering Mechanics, Trigonometry

2.0 Course Objectives

1. To know the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.
2. To know behaviour & properties of engineering materials.
3. To understand the stresses developed in bars, compounds bars, beams, shafts, and cylinders.
4. To understand the concepts of calculation of shear force and bending moment for beams with different supports.
5. To expose the students to concepts of Buckling of columns and strain energy.

3.0 Course Outcomes

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

CO	Course Outcome	Cognitive Level	POs
C302.1	Understand simple, compound, thermal stresses and strains their relations and strain energy.	L1,L2	PO1, PO2,PO3,PO4
C302.2	Analyze structural members for stresses, strains and deformations.	L1,L2 & L3	PO1, PO2,PO3,PO4
C302.3	Analyze the structural members subjected to bending and shear loads.	L1,L2 & L3	PO1, PO2,PO3,PO4
C302.4	Analyze shafts subjected to twisting loads.	L1,L2 & L3	PO1, PO2,PO3,PO4
C302.5	Analyze the short columns for stability.	L1,L2 & L3	PO1, PO2,PO3,PO4
Total Hours of instruction		**50**	

4.0 Course Content

Module - 1

Stresses and Strains: Introduction, Properties of materials, Stress, Strain and Hooke's law, Stress strain diagram for brittle and ductile materials, True stress and strain, Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Elastic constants and relations between them. 10 hours

Module- 2

Analysis of Stress and Strain: Introduction to three dimensional state of stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions.

Cylinders: Thin cylinder: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, Thick cylinders: Lames equations. 10 hours

Module- 3

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

Stress in Beams: Bending and shear stress distribution in rectangular, I and T section beams. 10 hours

Module- 4

Theories of Failure: Maximum Principal stress theory, Maximum shear stress theory.

Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections 10 hours

Module- 5

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

Strain Energy: Strain energy due to axial, shear, bending, torsion and impact load. Castigliano's theorem I & II and their applications. 10 hours

5.0 Relevance to future subjects

Sl. No	Semester	Subject	Topics
01	VII/VIII	Project work	Fundamental concepts
02	VII	Dynamics of Machines	Fundamental concepts of vibrations and mechanical systems
03	V/VI	Design of Machine Elements I/II	Design of Keys, Shafts, couplings, Fasteners, Keys and Joints, Rivets, curved beams, springs cylinders.

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Checking for solid body stability & Analysis of Stresses and Strains in machine elements.
02	Design of Boiler, column, Gear, Keys, Beams and Shaft.
03	Determination of Mechanical properties of engineering materials.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	NPTEL Tutorial	Topic: concepts of stress and strain, plane stress system, shear force and bending moment diagram, torsion, columns and theories of failures.

8.0 Books Used and Recommended to Students

Sl.No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Text Books				
01	Mechanics of Materials	J M Gere, B J Goodno	Cengage	Eighth edition 2013
02	Fundamentals of Strength of Materials	P N Chandramouli	PHI Learning Pvt. Ltd	2013
03	Strength of Materials	R K Rajput	S.Chand and Company Pvt. Ltd	2014
Reference Books				
01	Strength of Materials	R. Subramanian	Oxford	2005
02	Strength of Materials	S. S. Ratan	Tata McGraw Hill	2nd Edition, 2008
03	Mechanics of Materials	S.C.Pilli and N Balasubramanya	Cengage	2019
04	Mechanics of Materials	Ferdinand Beer, Russell Johston, John Dewolf, David Mazurek	McGraw Hill Education (India) Pvt. Ltd	Latest Edition
05	Mechanics of Materials	R C Hibbeler	Pearson	Latest Edition
Additional Study material & e-Books				

1. Strength of Materials by R.K.Bansal_pdf drive
2. Strength of Materials by R.K.Rajaput_pdf drive

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

Website and Internet Contents References

1) Introduction to Strength of materials: https://www.youtube.com/watch?v=GkFgysZC4Vc
2) Solid Mechanics: https://www.youtube.com/watch?v=A1SWKe6ZwVc
3) Advanced strength of Materials: https://www.youtube.com/watch?v=_2d8YsXwm7M
4) Video on Torsion of circular shaft: https://www.youtube.com/watch?v=ICDZ5uLGrI4
5) Video on Bending of beam: https://www.youtube.com/watch?v=asBW0Ojc0bY
6) Video on deriving bending equation: https://www.youtube.com/watch?v=AvCkrU3KaZw
7) GATE: https://www.btechguru.com/GATE--mechanical-engineering--strength-of-materials-video-lecture--23--133.html
8) Theories of Failures: https://nptel.ac.in/courses/105102090/20
9) Columns:
   - https://www.youtube.com/watch?v=hwpGAxa8UoI&list=PL4K9r9dYCOoqADwI0zQXTJ6wy_Dr37Fy2
   - https://www.youtube.com/watch?v=F692spiIyHU&list=PL4K9r9dYCOoqADwI0zQXTJ6wy_Dr37Fy2&index=2
   - https://www.youtube.com/watch?v=DYeRXKa8mKA&list=PL4K9r9dYCOoqADwI0zQXTJ6wy_Dr37Fy2&index=3
   - https://www.youtube.com/watch?v=szApiRoy_wY&list=PL4K9r9dYCOoqADwI0zQXTJ6wy_Dr37Fy2&index=6
10) Strain Energy Theory
   - https://www.youtube.com/watch?v=szApiRoy_wY&list=PL4K9r9dYCOoqADwI0zQXTJ6wy_Dr37Fy2&index=6
   - https://www.youtube.com/watch?v=99_UsxPgDqs
   - https://www.youtube.com/watch?v=sur6mZ_66ak
   - https://www.youtube.com/watch?v=dX8hvaFczY4
   - https://www.youtube.com/watch?v=xf2UoWkIa5w
11) Gate solution with Key answers
   - www.iesacademy.com
   - https://www.iesacademy.com/uploaded_files/download/small-1465029586.pdf
   - https://www.youtube.com/watch?v=LF5GQNDVd7s&list=PLgzsL8klq6DI7pZwzHuLgpeQMLoTIGVgO
12) Stress Strain Theory at a Glance for IES & Gate
   https://www.iesacademy.com/uploaded_files/download/small-1463734449.pdf
13) Previous Question Papers:
   https://drive.google.com/file/d/1zdKzCsXBJWToiys54kv6pyXpWY6XMHYA/view

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	Elsevier	https://www.journals.elsevier.com
2	Journal of Gears	http://journals.sagepub.com
3	Journal of Manufacturing Science and Engineering	http://manufacturingscience.asmedigitalcollection.asme.org
4	International Journal of Renewable Energy Research (IJRER)	http://www.ijrer.org
5	Magazines	https://www.asminternational.org/news/magazines

11.0 Examination Note

CONTINUOS INTERNAL EVALUATION: 40 Marks
Scheme of Evaluation for Internal Assessment (30 Marks): Internal Assessment test in the same pattern as that of the main examination (Average of all three tests). Questions shall be answered in internal assessment books (blue book).Internal assessment book shall be submitted.
Scheme of Evaluation for Assignments (10 Marks): Assignment on each module is to be submitted and each module carries 10 marks (Average of all five assignments).Assignment book shall be submitted.

SCHEME OF END SEMESTER EXAMINATION:
Two full questions (with a maximum of four sub questions) of twenty mark each to be set from each module. Each question should cover all the contents of the respective module. Students have to answer five full questions choosing one full question from each module. From each module out of two full questions one full question to be answered and each carries 20 Marks. Five full question to be answered 5x20 = 100 Marks. Later final marks are reduced to 60 marks.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
Module-1	1	Introduction to **Mechanics of Materials**	20 %
	2	Concepts of stress and strain, Hooke's law and Mechanical Properties of Materials	
	3	Calculation of stresses and deformations in straight bar	
	4	Calculation of stresses and deformations in stepped bar	
	5	Calculation of stresses and deformations in Tapered and composite Sections.	
	6	Stresses due to temperature changes	
	7	Shear stress, shear strain, Poisson's ratio and lateral strain	
	8	Generalized hooks law, Elastic constants	
	9	Relationship between elastic constants	
	10	Problems on elastic constants	
Module-2	11	**Analysis of Stress and Strain**	40 %
	12	Plane stress system	
	13	Components of stresses acting on inclined plane	
	14	Principal stresses and their planes	
	15	Maximum shear stresses, planes and principal angles.	
	16	Problems on stress components calculations	
	17	Mohr's circle method for plane stress analysis	
	18	**Cylinders:** Thin cylinders, Hoop's stress, maximum shear stress	
	19	Circumferential stress and longitudinal stresses	
	20	Thick cylinders and Lami's equation	
Module-3	21	**Shear force and Bending moment diagrams**	60 %
	22	Definition of beam, Types of Beam, Loads and End Conditions.	
	23	Relationship between distributed load, Shear force and Bending moment	
	24	Determination of shear force and Bending moment for Cantilever, Simply supported and	
	25	Single and double overhanging beam subjected to point,UDL, UVL, COUPLE & Bracket load	
	26	**Bending stresses in Beam:** Theory of pure bending	

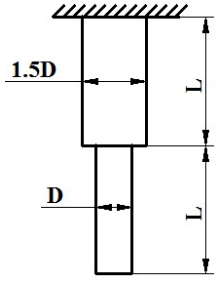
	27	Curvature of beam, longitudinal strains in the beams	
	28	Flexural Formula for beams	
	29	Bending and Shear stress distributions in beams with rectangular, I, T, C cross-sections.	
	30	Problems on Bending and Shear stress distributions in beams	
Module-4	31	**Theories of Failures**	**80 %**
	32	Maximum principal stress theory	
	33	Maximum shear stress theory	
	34	Problems on Theories of Failures	
	35	**TORSION:** Torsion of solid circular and hallow shafts	
	36	Torsional Moment of Resistance	
	37	Power transmission of straight and stepped shafts	
	38	Twisting in shaft sections	
	39	Thin tubular and thin walled sections	
	40	Problems on Torsions	
Module-5	41	**Columns :**Buckling and Stability of columns, critical load	100%
	42	Analysis of columns with pinned ends and other support conditions	
	43	Effective length of columns	
	44	Secant formula	
	45	Problems on columns	
	46	**Strain Energy Theory**	
	47	Strain energy due to axial, shear, bending, torsion and impact load	
	48	Castigliano's theorem I &II	
	49	Load deformation diagram	
	50	Applications on Castigliano's theorem I &II	

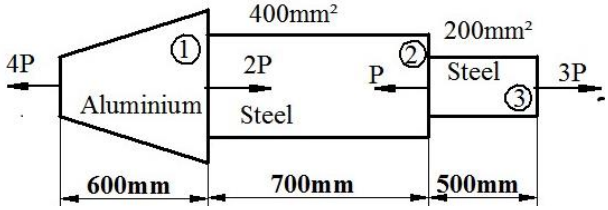
13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on stress and strain concepts.	Students study the Topics and prepare the multiple choice questioner with answer.	Module-1 of the syllabus	2	Group Activity. Each group should prepare minimum 05 questions expected.	Book 1, 2 of the reference list. Website of the Reference list
2	Assignment 2: University Questions on Analysis of Stress and Strain	Students study the Topics and identify components of stresses &construct Mohr's circle for the given plane stress system.	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 on Shear Forces and Bending Moments	Students study the Topics and draw the SFD &BMD for the beam subjected to external load system	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 on Torsion and Columns	Students study the Topics and derive the torsion equation.	Module-4of the syllabus	8	Individual Activity	Book 1, 2 of the reference list. Website of the Reference list
5	Assignment 4: University Questions on Theories of Failure:	Students study the Topics and explain different theories of failures.	Module-5 of the syllabus	10	Individual Activity	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

Module1: Stress and Strain:

1. Define the stress and Strain.
2. State Hooke's law and define Poisson's ratio.
3. Draw Stress-Strain diagram for a ductile material.
4. Define the following: i) Limit of Proportionality ii) Elastic limit iii) Yield point iv) Ultimate stress v) Breaking stress.
5. Define i) stress ii) Hook's law iii) Elasticity iv) lateral strain.
6. Draw Stress-Strain diagram for mild steel with salient features.
7. Draw Stress-Strain diagram for Aluminum.
8. Define Nominal stress and True stress
9. Derive an expression for the elongation of a bar subjected to tensile load
10. Show that the extension produced due to self weight of a bar of uniform cross section fixed at one end suspended vertically is equal to half the extension produced by a load equal to self weight applied at the free end.
11. Derive an expression for the extension of a rectangular bar which is having continuously varying cross-section
12. Derive an expression for the extension of a circular bar which is having continuously varying cross section.
13. Derive an expression for the elongation of a bar of uniform cross section due to its self weight
14. The observations were made in a tension test of a mild steel i) rod of diameter 10mm ii) length 200mm iii) Extension under a load of 10kN=0.12mm iv) The Maximum load =26kN v) Load beyond which stress-strain curve was not proportional=11KN vi) Final length at failure =261.5mm, Diameter at failure =5.7mm Find the limit of proportionality, Young's modulus, percentage elongation of length and percentage reduction of area at failure.
15. A stepped bar having circular sections of diameter 1.5D and D are as shown in ***Figure 1*** 1if ρ and E are the density and Young's modulus of elasticity respectively, find the extension of the bar due toown weight.    ***Figure*** 1
16. A steel wire of 6mm diameter is used for lifting a load 1.5KN at its lower end , the length of the wire being 160 m. Calculate the total elongation of the wire taking E=2x10^5 N/mm^2 and unit weight of steel=78kN/m^3

17. A round bar with stepped portion is subjected to the forces as shown in ***Figure 2***. Determine magnitude of force P such that the net deformation in the bar does not exceed 1mm.Young's modulus for steel is 200GPa and that for aluminum is 70GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively. 

18. A member ABCD is subjected to a pointloads P_1,P_2,P_3 & P_4 as shown in ***Figure 3***. calculate the force P_2 necessary for equibrilium . if P_1 =45KN, P_3 =450KN & P_4= 130KN. Determine stresses in each member also determine the total elongation of the member assuming the E to be 2.1x 0^5N/mm^2.

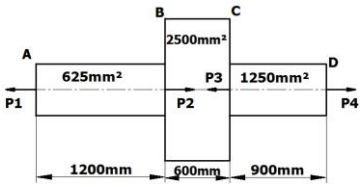


Figure 3

19. For the laboratory tested specimen the following data were obtained,
    i) Diameter of the specimen =25mm
    ii) Length of the specimen =300mm
    iii) Extension under the load of 15KN=0.045mm
    iv) Load at yield point =127.65KN
    v) Maximum load =208.60KN
    vi) Length of the specimen after failure=375mm
    Determine i) Young's modulus ii) Yield point stress iii) Ultimate stress iv) Percentage Elongation v) percentage reduction in area.

20. A stepped bar subjected to an external loading as shown in ***Figure 4***, Calculate the change in the length of the bar. Take E=200Gpa for Steel E=70 GPa for Aluminum and E=100 GPa for Copper (Dec 07/Jan 08)

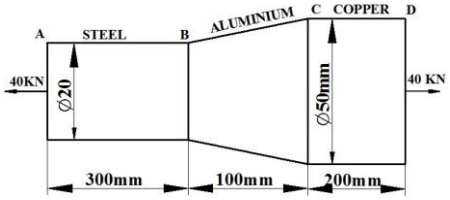


Figure 4

21. A 500 mm long bar has rectangular cross section 20mm x 40mm. This bar is subjected to
    i) 40KN tensile force on 20mm x 40mm faces
    ii) 200KN Compressive forces on20mm x 500 mm faces and
    iii) 300KN tensile force on 40mm x 500mm faces
    Find the change in the volume if E=2x10^5 N/mm^2 and μ=0.3.

22. Two copper rods and one steel rod together support a load of 200KN as shown in ***Figure 5***. Find the stress in the rod Take E_s=2 x 105 N/mm^2 and E_c=1 x 105N/mm^2.

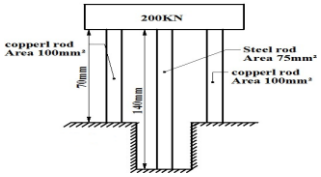


Figure 5

23. A steel bolt of 16mm diameter passes centrally through a copper tube of internal diameter 20mm and external diameter 30mm. The length of the whole assembly is 500mm. after tight fitting of the assembly; the nut is over tightened by quarter of a turn. What are the stresses introduced in bolt and tube, if pitch of the nut is 2mm.Take E=200kN/mm^2.

24. Define the following i) Volumetric strain, ii) Bulk modulus, iii) Poisson's ratio
    iv) Modulus of rigidity v) Modulus of Elasticity iv) Factor of safety.

25. Establish the relationship between Modulus of elasticity and Modulus of rigidity

26. Establish the relationship between Modulus of elasticity and Bulk modulus

27. state the concept of shear stress and shear strain

28. Define volumetric strain. A bar of uniform rectangular section of area A is subjected to an axial load P. show that the volumetric strain is given by $\epsilon_v = \frac{P}{AE}\left(1 - \frac{2}{m}\right)$,where E is the young's modulus &1/m is the poisson's ratio.

29. The modulus of rigidity of a material is 0.8 x 10^5N/mm^2. When a 6mmx6mm rod of this material was subjected to an axial pull of 3600N,it was found that the lateral dimensions of the rod changed to 5.9991mmx5.9991mm. Find the poisson's ratio and the modulus of Elasticity.

30. A horizontal rigid bar AB weighing 200KN is hung by three vertical rods, each of 1m length and 500mm^2 cross

section as shown in ***Figure 6***. the central rod is of steel and outerrods are copper. If the temperature rise is 40°C, estimate the load carried by each rod and by how much the load will descend.Take E_s=200GN/m^2, E_c=100GN/m^2, α_s=1.2x10^{-5}/˚C ,α_c=1.8x10^{-5}/˚C.

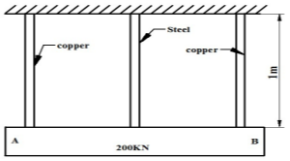


Figure 6

31. A compound bar is made of a central steel plate 60mm wide and 10mm thick to which copper plates 40mm wide and 5mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 meter. If the temperature is raised by 80˚C, determine the stresses in each metal and change in length. Take E_s=200GN/m^2,E_c=100GN/m^2 α_s=12x10^{-6}/˚C α_c=17x10^{-6}/˚C
32. A 12 mm diameter steel rod passes centrally through a copper tube 48 mm external diameter and 36mm internal diameter and 32.50 mm long. The tube is closed at each end by 24mm thick steel plates which are secured by nuts .The nuts are tightened until the copper tube is reduced in length by 0.508mm .The assembly is then raised in temperature by 60˚C. Calculate the stresses in the copper and steel before and after raising the temperature, assuming the thickness of the plate remain to be unchanged. Take α_s=1.2x10^{-5}/˚C, αc=1.75x10^{-5}/˚C, E_s=2.1x10^5 N/mm^2,E_c=1.05x10^5 N/mm^2
33. A steel tube of 25mm external diameter and 18mm internal diameter encloses a copper rod of 15mm diameter. The ends are rigidly fastened to each other. Calculate the stresses in the the rod and the tube when the temperature is raised from 15˚ to 200˚C Take α_{st}=11x10^{-6}/˚C, α_{cu}=18x10^{-6}/˚C, E_{st}=200 GPa and E_{cu}=100 GPa
34. A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15˚C. At this stage they are rigidly connected together at both ends. When the temperature is raised to 315˚C, the length of the bars increased by 1.50mm. Determine the original length and the final stresses in the bars. Take E_s=2.1x10^5 N/mm^2, E_c=1x10^5 N/mm^2, α_s=0.000012/˚C, α_c=0.0000175/˚C
35. A 25 mm diameter steel rod passes concentrically through a bronze tube 400mm long,50mm external diameter and 40mm internal diameter. The end of the steel rod are threaded and provided with nuts andwashers which are adjusted initially so that there is no end play at 20°C.assuming that there is no change in the thickness of the washers, find the stress produced in the steel and bronze when one of the nuts is tightened by giving it one-tength of a turn, the pitch of the rhread being 2.5mm. take E for steel=200KN/mm^2 and E for bronze=100KN/mm^2.
36. A compound bar consist of steel, copper and aluminum bars connected in series is held between two supports as shown in ***Figure 7*** .When the temperature of the compound bar is increased by 50˚C, determine stresses induced in each bar. Consider the two cases i) Rigid supports ii) support yield by 0.5mm. Take α_s=12x10^{-6}/˚C α_B=19x10^{-6}/˚C α_{AL}=22x10^{-6}/˚C Es=200 GPa E_B=83 GPa E_{Al}=70 GPa

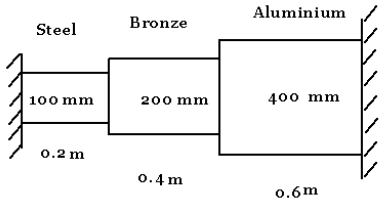


Figure 7

37. A stepped bar shown in ***Figure 8*** is fixed at its two ends rigidly .The bar is free from stresses when its temperature is 30˚C .When the temperature of the bar is increased to 90˚C determine i) Stresses induced in steel and the copper portions and ii) Displacement in the junction at point C .Take α_c=1.8x10^{-5}/˚C, α_s=1.2x10^{-5}/˚C, Ec=100Gpa E_s=200Gpa.

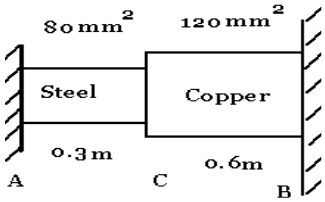


Figure 8

38. A bar of Brass 25mm diameter is enclosed in a steel tube 50mm external diameter. The bar and the tube are both initially 1.5mlong and are rigidly fastened at both ends using 20mm diameter pins .Find the stresses in the two materials when the temperature rises from 30˚C to 100˚C. Take E for Steel =200 kN/mm^2, E for Brass =100KN/mm^2, α for steel =11.6x10^{-6}/˚C, α for brass=18.7x10^{-6}/˚C.

Module 2: Analysis of Stress and Strain and Cylinders:

1. What do you mean by Compound stresses?
2. Define Principal plane and Principal Stress
3. State the sign conventions used in the analysis of stresses
4. What do you understand by maximum shear stress?
5. A rectangular bar is subjected to two direct stresses σ_x and σ_y in two mutually perpendicular directions. Prove that the normal stress(σ_n) & shear stress(τ) on oblique plane which is,

$$\sigma_n = \left(\frac{\sigma_x+\sigma_y}{2}\right) + \left(\frac{\sigma_x-\sigma_y}{2}\right) cos2\theta \;\&\; \tau = \left(\frac{\sigma_x-\sigma_y}{2}\right)\sin2\theta.$$

6. Explain procedure for constructing of Mohr's circle, for an element acted upon by two tensile stresses and shear stresses.
7. A point in a strained material is subjected to stresses shown in ***Figure 9***. Using Mohr's circle, determine the normal and tangential stresses across oblique plane.check the answer analytically.

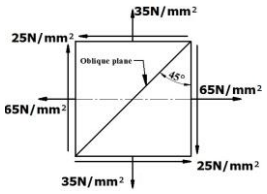


Figure 9

8. The plane element is subjected to stresses as shown in the ***Figure 10***. Determine principal stresses .Maximum shear stresses and their planes. Sketch the plane determined

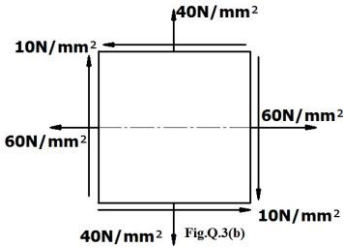


Figure 10

9. The state of the stress in two dimensionally stressed body is shown in ***Figure 11*** .Determine the principal planes, principle stresses ,maximum shear stresses and their planes(June/ July 08)

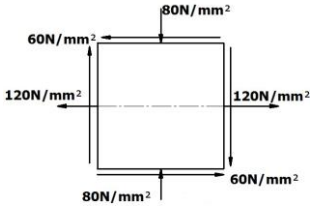


Figure 11

10. Use Mohr's circle, Determine the principal stresses and the planes ,Maximum shear stress and the planes .show the same elements separately

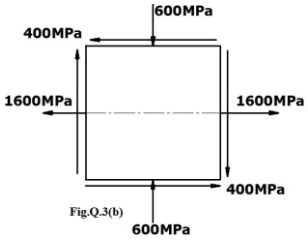


Figure 12

11. A point is strained material is subjected to the stresses as shown in ***Figure 13***. Locate the principal planes and evaluate the principal stresses.

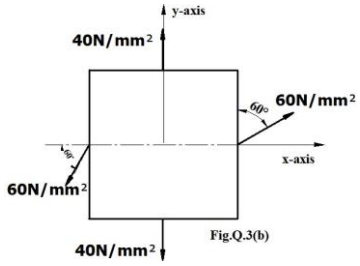


Figure 13

12. The state of stress at a point in strained material is as shown in ***Figure 14***. Determine:
    i) Direction of principle planes
    ii) Magnitude of principle stresses
    iii) Magnitude of the Maximum shear stress and its direction .Indicate all the above by a sketch

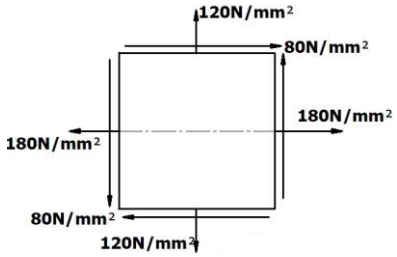


Figure 14

13. The state of stress in two dimensional stressed body is shown in ***Figure*** *15.* Determine principle stresses, principle planes and maximum shear stress .Determine also the normal and tangential stresses on Plane AC .Verify the results by drawing Mohr's circle.

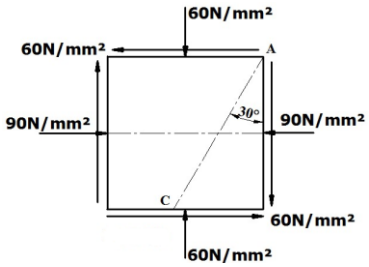


Figure15

14. A point of machine member is subjected to pure shear stress 45Mpa. Determine:
    i) Maximum and minimum stresses induced and orientation of their planes
    ii) ii) stresses on plane whose normal is at an angle of 110˚ with respect to X-axis

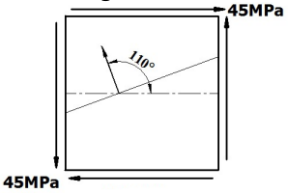
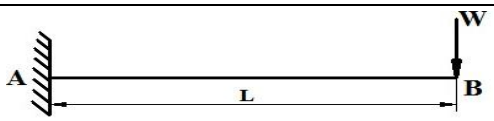


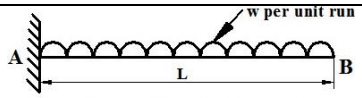
Figure 16

15. What is a thin cylinder and thick cylinder?
16. What do you understand by circumferential and longitudinal stresses?
17. Derive the expressions for the change in the dimensions of a cylinder subjected to internal pressure
18. Derive an expression for strain energy, when member subjected to impact loads.
19. Derive an expression for circumferential stress of a thin cylinder.
20. Define i) strain energy ii) work.
21. Prove that volumetric strain in thin cylinder is given by $\frac{Pd}{4tE}(5-4\mu)$, with usual notations.
22. Calculate the i) change in diameter; ii) change in length and iii) change in volume of a thin cylinder shell 1000mm diameter, 10mm thick and 5m long when subjected to internal pressure of 3N/mm^2. Take the value of **E = 2 x 10^5 N/mm^2** and **1/m= 0.3.**

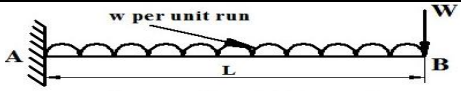
23. A pressure vessel with outer and inner diameters of 400mm and 320mm respectively is subjected to an external pressure of 80MPa. Determine the circumferential stress induced at the inner and outer surfaces. Prove that the longitudinal strain is constant throughout the cylinder.
24. A thick cylinder with internal diameter 80mm and external diameter 120mm is subjected to an external pressure of 40N/mm^2; when the internal pressure is 120N/mm^2, calculate circumferential stress at external and internal surfaces of the cylinder. Plot the variation of circumferential stress and radial pressure on the thickness of the cylinder.
25. A C.I pipe has200mm internal diameter and 50mm metal thickness and carries water under a pressure of 5 N/mm^2. Calculate the maximumnand minmum intensities of circumferential stress and sketch the disribution of circumferentialstress intensities and intensity of radial pressure across the section.
26. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 80N/mm^2.Find the maximum and minimum hoop stresses across the section. Also sketch radial and hoop stresses distribution across the section
27. A thin cylindrical shell 1.2m in diameter and 3m long has a metal wall thickness of 10mm .it is subjected to an internal fluid pressure of 3.2Mpa .Find the circumferential and longitudinal stress in the wall .determine the change in length .diameter the volume of the cylinder .Assume E=210Gpa and μ=0.3
28. A thick cylinder with internal diameter 80mm and External diameter 120mm is subjected to an external pressure of 40Kn/m^2, when the internal pressure is 120KN/m^2 .Calculate the circumferential stress at external and internal surface of the cylinder. Plot the variation of circumferential stress and radial pressure on the thickness of the cylinder
29. A cylindrical tube with closed ends has an internal diameter of 50mmand a wall thickness of 2.50mm.Yhe tube is axially loaded in tension with a load of 10KN and is subjected to an axial torque of 500NM under an internal pressure of 6N/mm^2 .Determine the principle stresses on outer surface of the tube and maximum shear stress.
30. A cylindrical shell 1 meter long ,180mm internal diameter ,thickness of the metal is 8mm is filled with a atmospheric pressure .If an additional 20000mm^3 of the fluid is pumped into the cylinder find the pressure exerted by the fluid on the wall of the cylinder .find also the hoop stress induced .Take E=2x10^{5}N/mm^{2}and 1/m.=0.3.
31. A pipe of 200mm internal diameter and 100mm thickness contains a fluid at a pressure of 6N/mm^2.Find the maximum and minimum hoop stresses across the section.
32. Find the thickness of the metal necessary for a steel cylindrical shell of internal diameter 150mm ton with stand an internal pressure of 50N/mm^2.The maximum hoop stress in the section is not to exceed 150N/mm^2.
33. A 1.2 meter long thin cylindrical pressure vessel of 500 mm inner diameter and 14 mm wall thickness undergoes a volume change of 5x10^4 mm^3, when it is subjected to an internal pressure 'p'. Taking E=210GPa and v=0.3 determine the magnitude of P.
Module 3: Shear Forces and Bending Moments: Stress in Beams: Deflection of beams:
1. What are different types of beams? Explain briefly
2. What are different types of loads
3. Briefly explain different types of beam supports
4. Establish relationship between distriuted load, shear force and bending moment at a cross section of a beam
5. Define i)Shear force ii) Bending moment and iii)Point of contraflecture 6.
7. Draw the SFD &BMD for following for members carrying different loads.



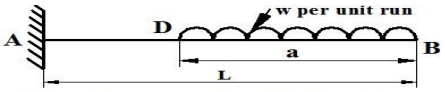
A cantilever of length L carrying a concentraed load w at free end



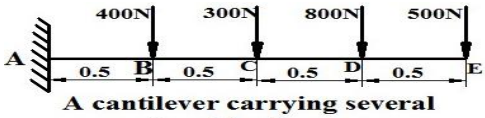
A cantilever of length L carrying a uniformly distributed load w per unit length over the whole length.



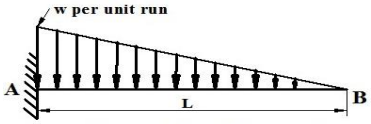
A cantilever of length L carrying a uniformly distributed load w per unit length over the whole length and acomcentrated load W at free end.



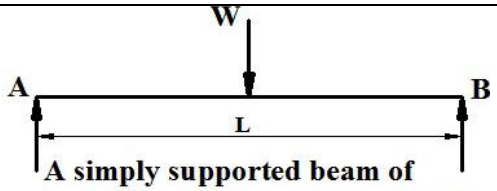
A cantilever of length L carrying a uniformly distributed load w per unit length for a distance 'a' from the free end.



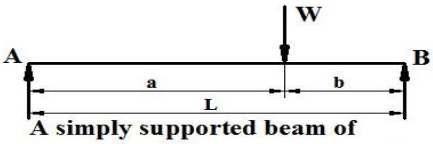
A cantilever carrying several concentraed loads.



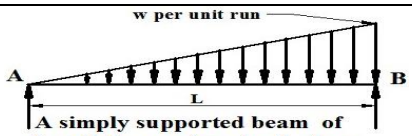
A cantilever of length L carrying a load whose intensity varies uniformly from zero at free end to w per unit run at fixed end.



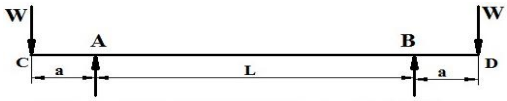
A simply supported beam of length L carrying a concentraed load w at mid span.



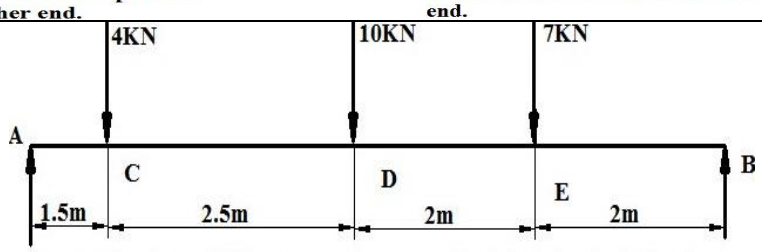
A simply supported beam of length L carrying a concentraed load w placed eccentrically on the span.



A simply supported beam of length L carryinga load whose intensity varies uniformly from zero at one end to w per unit run at other end.

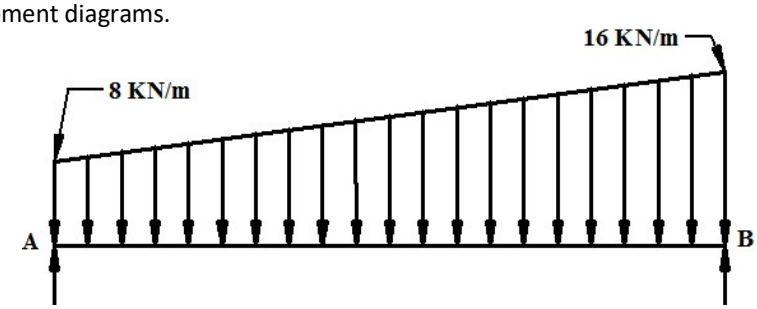


A beam of length (L+2a) has supports 'L' aparts with an overhang 'a' on each side. the beam carries a concentraed load w at each end.



A simply supported beam carrying a number of concentrated loads

8. The intensity of loading on a simply supported beam of length 5m increases uniformly from 8KN/m at one end to 16KN/m at the other end. Find the position and magnitude of the maximum bending moment. Also draw shear and bending moment diagrams.



9. Draw the SFD &BMD for the cantilever beam shown in ***Figure18***

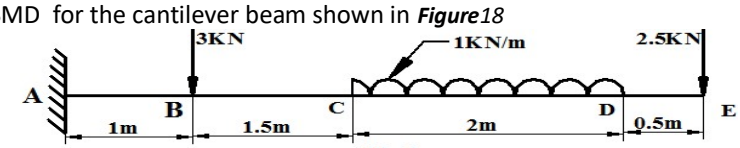


Figure18

10. Draw the beam shown in ***Figure 19***, draw SFD &BMD and mark the values at the salient points.

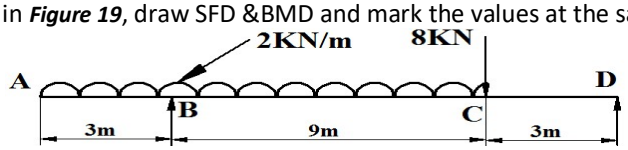


Figure 19

11. Draw the SFD & BMD for the overhanging beam shown in ***Figure 20***. Indicate all significant values including point of contra-flexure.

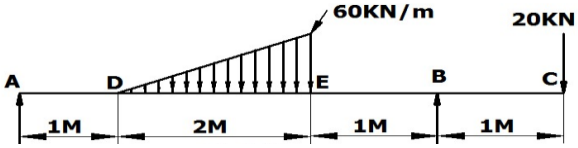


***Figure** 20*

12. Draw the SFD & BMD for the overhanging beam shown in ***Figure 21***. Indicate all significant values including point of contra-flexure.

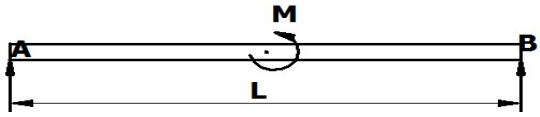


Figure 21

13. A cantilever beam is loaded as shown in ***Figure 22***. Draw the shear force and bending moment diagrams, for the beam.

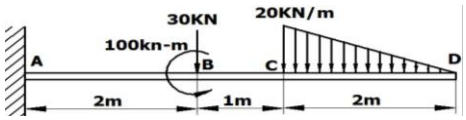


Figure 22

14. Draw shear force and bending moment diagram for overhanging beam as show in ***Figure 23*** and locate the point of contra flexure.

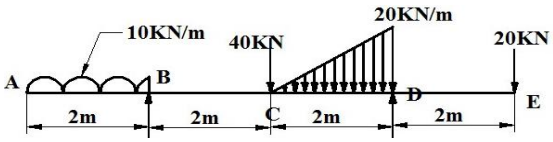


***Figure** 23*

15. Draw shear force and bending moment diagram for the beam loaded as shown in the ***Figure*** 24.

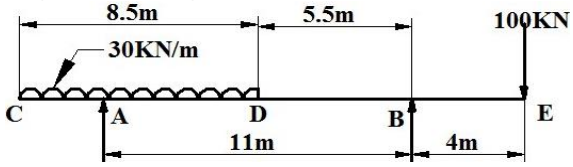


***Figure** 24*

16. For the beams shown in ***Figure 25***, draw shear force and bending moment diagram. Locate point of contra flexure if any

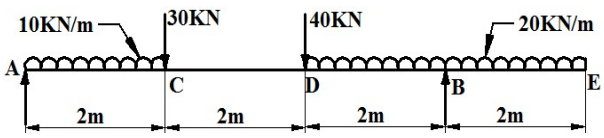


***Figure** 25*

17. For the beam shown in ***Figure 26***. Draw shear force and bending moment diagram and indicating the principle values (June/July 08)

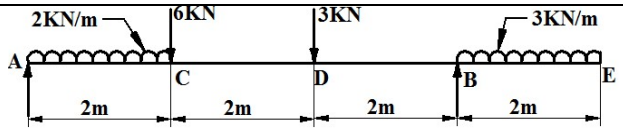


***Figure** 26*

18. Draw shear force and bending moment diagram for the loading factor on the beam as shown in ***Figure 27***. Indicate where the inflection and contra flexure points are located. Also locate maximum bending moment with its magnitude

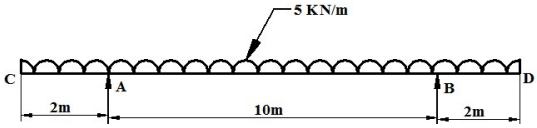


***Figure** 27*

19. For the beam shown in ***Figure 28***. Draw shear force and bending moment diagram

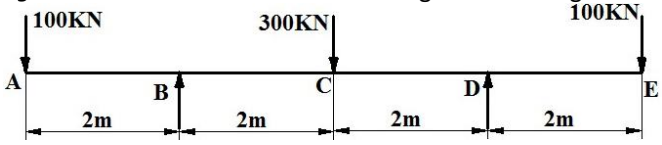


***Figure** 28*

20. For the beam shown in ***Figure 29***. Draw shear force and bending moment diagram

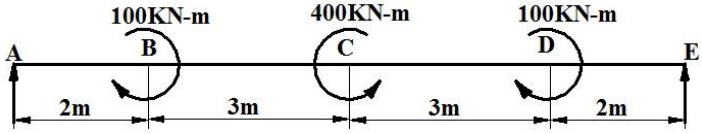


Figure *29*

BENDING STRESS & SHEAR STRESS:

1. What are the assumptions made in simple theory of bending?
2. Prove that $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$ with usual notations.
3. Derive an expression for relationship between bending stress and radius of curvature.
4. A beam of an I-section consists of 180mmx15mm flanges and a web of 280mmx 15 mm thicknesses. It is subjected to a shear force of 60KN. Sketch the shear stress distribution along the depth of the section.
5. An I section has the following dimensions, Flanges 200mm x 10mm; web 380mm x 8mm. The maximum shear stress developed in the beam is 20M/mm^2. Find the shear force to which the beam is subjected.
6. A simply supported beam of span 5m has a cross section 150mm x 250mm. if the permissible stress is 10N/mm^2,find i) Maximum intensity of uniformly distributed load it can carry, ii) The maximum concentrated load P applied at 2m from one end it can carry.
7. Prove that the maximum shear stress in a circular section of a beam is 4/3 times the average shear stress.
8. Derive an equation for moment carrying capacity of rectangular and circular sections
9. Explain plain neutral axis and modulus of section as applied to beam.
10. Prove that maximum shear stress in a rectangular section of width b and depth d is equal to 1.5 times of its average shear stress
11. At a given position in a beam of uniform I-section is subjected to a bending moment of 100KN-m. Plot the variation of bending stress across the section (refer ***Figure 30***).

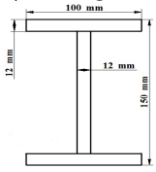


Figure 30

12. A T shaped cross section of a beam as shown in ***Figure 31*** is subjected to a vertical shear force of 100KN. Calculate the shear stress at the neutral axis and at the junction of the web and flange. M I about horizontal neutral axis is 0.000113m^4.

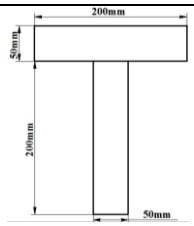


***Figure** 31*

13. Determine the maximum allowable span length "L" for a simple beam as shown in ***Figure 32***. The beam is of rectangular cross section (140mmx240mm) subjected to a uniformly distributed load q=6.5KN/m and allowable bending stress is 8.2Mpa

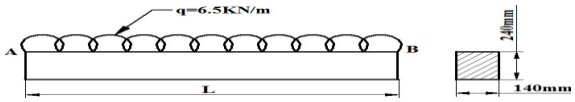


***Figure** 32*

14. Determine the deflection under the loads in the beam as shown in ***Figure 33***. Take flexural rigidity as IE through out

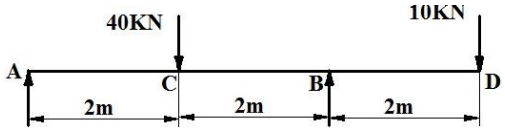


***Figure** 33*

15. An unequal angle section shown in ***Figure 34*** is used as simply supported beam over a span of 2 m and uniformly distributed load of 10 KN/m, inclusive of its own weight. Determine the maximum tensile and compressive stresses in the section

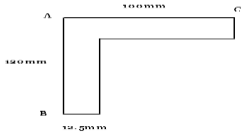


Figure 34

16. A beam of T section has a length of 2.5m and is subjected to a point load as shown in the ***Figure 35***. Calculate compressive bending stress and plot the stress distribution across the cross section of the beam .The maximum tensile stress is limited to 300MPa .Calculate the value of W.

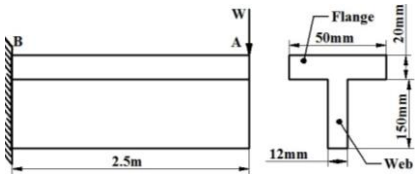


***Figure** 35*

17. A 1 m long cantilever with T section is subjected to a point load 10KN at its free end. The size of the flange is (140 mm x 10mm) and overall depth of the section is 150mm.thickness of web is 10mm.Determine the maximum tensile stress and maximum compressive stress induced in the section and draw the bending stress distribution.

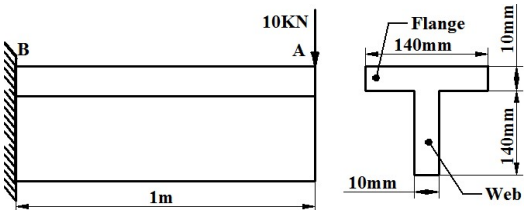


***Figure** 36*

18. A cantilever has an I section with unequal flanges .The upper and lower flanges are (200mmx14mm) and (100mmx14mm) respectively .The web is (14mmx250mm).The cantilever is subjected to UDL of magnitude 4KN/m over its entire length and a point load W at the free end as shown in the Figure 37 Yield stress for the material of cantilever is 330MPa .Taking the factor of safety as 2. Determine the magnitude of maximum load W that can be applied.

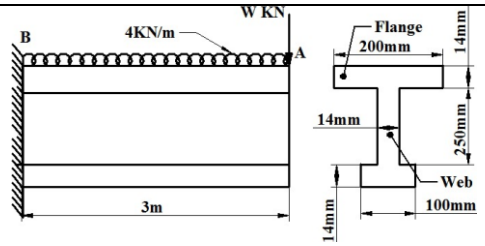


Figure 37

19. When a simply supported beam is subjected to the loads as shown in the ***Figure 38***. The longitudinal strain induced at a point P is found to be $500x10^{-6}$. Determine the magnitude of W. Take E=200GPa.

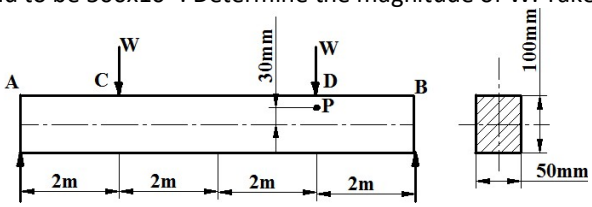


Figure 38

MODULE 4: Theories of Failure &TORSION

1. 1.Define the theories of failures and explain Maximum principal stress theory
2. 2. A rod of circular section is to sustain torsion of 300KN-m & bending moment of 200KN-m. selecting C40 steel(σ_y=353MPa) & FOS = 3. Determine the diameter of rod as per (i) Maximum principal stress theory. (ii) Maximum shear stress theory.
3. A plate of C45 steel (σ_y=353MPa) is subjected to the following stresses. σ_x= 150 N/mm^2 τ_{xy}= 50 N/mm^2. Find FOS by (i) Maximum principal stress theory. (ii) Maximum shear stress theory
4. State the assumptions made in the theory of pure torsion
5. Define Polar Modulus and Torsional rigidity
6. Derive the torsion equation with usual notations. State the assumptions made in the derivation.
7. Define a Column. What are different types of columns?
8. What are the assumptions made in the theory of column?
9. A hallow steel shaft 3m long must transmit a torque of 25 KN-m .The total angle of twist in this is not to exceed 2.5degree an allowable shearing stress is 90Mpa .Determine inside and outside diameter of the shaft if G=85Gpa
10. A solid shaft rotating at 500rpm transmits 30KW.Maximum torque is 20% more than mean torque .Allowable shear stress 65MPa and modulus of rigidity 81Gpa ,angle of twist in the shaft should not exceed 1˚ in 1m length .Determine suitable diameter
11. A hollow circular steel shaft has to transmit 60KW at 210rpm such that the maximum shear stress does not exceeds 60MPa.if the ratio of internal to external diameters is equal to ¾ and the value of rigidity is 84GPa, find the dimensions of the shaft and angle of twist in a length of 3m.
12. Find the diameter of the shaft required to transmit 60KW at 150rpm if the maximum torque is 25% of the mean torque for a maximum permissible shear stress of 60MN/m^2. Find also the angle of twist for a length of 4m.Take G=80GPa
13. A 2 meters long hollow cylinder shaft has 80mm outer diameter and 10mm wall thickness. When the tortional load on the shaft is 6KN-m.determine i)Maximum shear stress induced ii) angle of twist .Also draw the distribution of shear stress in the wall of the shaft. Take G as 80GPa (ρ =344)
14. A solid shaft rotating at 500rpm transmits 30KW .The maximum torque is 20% more than the mean torque .Material of shaft has the allowable shear stress 65MPa and modulus of rigidity 81GPa.Angle of twist in the shaft should not exceed 1˚ in 1m length .Determine the diameter of the shaft(ρ=346)

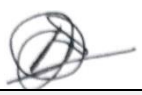
Module 5: COLUMNS & Strain Energy

1. Derive an expression for the critical load in a column subjected to compressive load
2. Derive an expression for Euler's buckling load for a long column having one end fixed and other end hinged. State the assumption made in the derivation.
3. Define slenderness ratio and derive Euler's expression for bucking load for column with both ends hinged
4. A hollow shaft of diameter ratio 3/8 is required to transmit 588KWatt 110 rpm, the maximum torque being 120%of the mean. Shear stress is not to exceed 63 N/mm^2 and twist in length of 3 m not to exceed 1.4 degrees. Calculate external iameter of shaft which would satishfy theseconditions. Take modulys of rigidity = 84GPa.
5. A hollow shaft having an inside diameter 60% of its outer diameter, is to replace a solid shaft transmitting the

same power at the same speed. Calculate the percentage saving in material, if the material to be used is also the same.
6. A hollow C.I. column whose outside diameter is 200mm has a thickness of 20mm. it is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate the slenderness ratio and the ratio of Euler's and Rankine's critical loads. Take f_c = 550N/mm^2, a = 1/1600 in Rankin's formula and E = 9.4 x 10^2.
7. Find the Euler's clipping load a hallow cylindrical steel column of 38mm external diameter and 2.5mm thick .Take length of column as 2.3m and hinged at its both ends. Take E=2.05x105N/mm2.Also determine the crippling loads by Rankin's formula using constants as 335N/mm2 and 1/7500
8. A 1.5m long column has a circular cross section of 50mm diameter .One of ends of a column fixed in direction and position and other end is free .Taker factor of safety as 3,calculate safe loading using i)Rankin's formula , take yield stress=560N/mm2 and a=1/1600 for pinned end ii) Euler's formula ,Young's modulus for C.I=1.2x105 N/mm2
9. Derive an expression for the critical load in a column subjected to compression load, when one end is fixed and the other end free.
10. Derive an expression for the critical load in a column subjected to compression load, when one end is fixed and the other end free.
11. Derive an expression for strain energy due to shear stresses
12. Write a note on: (i) Maximum principal stress theory. (ii) Maximum shear stress theory
13. A hollow circular shaft 2 m long is required to transmit 1000 KW power, when running at a speed of 300 rpm. If the outer diameter of the shaft is 150 mm and inner diameter is 120 mm. find the maximum shear stress and strain energy stored in the shaft.
14. A solid circular shaft is subjected to a bending moment of 40 KN-m and a torque of 10KN-m.design the diameter of the shaft according to, (i) Maximum principal stress theory. (ii) Maximum shear stress theory. Take μ=0.25, stress at elastic limit=200 N/mm^{2}and FOS=2.
15. Derive one expression for strain energy stored in an elastic bar when subjected to axial load, torque and bending moment.
16. The maximum stress produced by a pull in a bar of length 1100 mm is 100 N/mm^2. The area of cross-section and length are shown in fig. calculate the total strain energy stored in the bar if E= 200GPa.
17. Define strain energy, Resilience, proof resilience and Modulus of resilience.
18. A cantilever beam of length 'L' carries UDL 'W' per unit length over its entire length. Determine (i) strain energy stored in beam (ii) If 'W'= 10KN/m; L=2m &EI =2X 10^5 KN -mm^2 determine strain energy.

16.0 University Result

Examination	S$^+$	S	A	B	C	D	E	F	% Passing
Dec-18/Jan-19(A)	--	--	--	01	04	14	05	06	**80.00%**
Dec-18/Jan-19 (B)	--	--	01	02	06	06	16	12	**63.63%**

Prepared by	Checked by		
			
Prof. G. V. Chiniwalar	**Prof. D.N.Inamdar**	**HOD**	**Principal**

Subject Title	BASIC THERMODYNAMICS		
Subject Code	18ME33	**CIA Marks**	40
No of Lecture Hrs + Practical Hrs / Week	03	**SEE Marks**	60
Total No of Lecture + Practical Hrs	50	**Exam Hours**	03
			CREDITS – 03

FACULTY DETAILS:		
Name: Prof. K M Akkoli	**Designation:** Assistant. Professor	**Experience: 16** Years
No. of times course taught: 03	**Specialization:** Thermal Power Engg	
Name: Prof. Jagadeesh A	**Designation:** Assistant. Professor	**Experience: 06** Years
No. of times course taught: 06	**Specialization:** Thermal Power Engg	

1.0 Prerequisite Subjects:

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

2.0 Course Objectives

- Learn about thermodynamic systems and boundaries.
- Learn about thermodynamic system and its equilibrium
- Understand various forms of energy - heat transfer and work
- Study the basic laws of thermodynamics including, zeroth law, first law and second law.
- Interpret the behavior of pure substances and its application in practical problems.
- Study of Ideal and real gases and evaluation of thermodynamic properties

3.0 Course Outcomes

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

CO	Course Outcome	Cognitive Level	Pos
CO1	Explain the fundamental concepts of thermodynamics and energy interactions between the system and surroundings.	A	1,2,6,12
CO2	Interpret and apply first and second law of thermodynamics to flow and non-flow processes	A	1,2,4,6,12
CO3	Estimate the entropy for reversible and irreversible processes and measure Quality, Quantity and Thermodynamic properties of pure substance.	A	1,2,4,6,12
CO4	Analyze the reversible and irreversible processes and derive the thermodynamic relations to evaluate the energy and thermodynamic	A	1,2,4,12
CO5	Evaluate the properties of mixture of ideal and real gases	A	1,2,12
Total Hours of instruction		**50**	

4.0 Course Content

MODULE 1

Fundamental Concepts & Definitions: 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, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer

Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and signconvention.Problems. **10Hours**

MODULE 2

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

Second Law of Thermodynamics: 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. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles.Problems. **10Hours**

MODULE 3

Reversibility: Definitions of a reversible process, reversible heat engine, importance and superiority of a reversible heat engine and irreversible processes; factors that make a process irreversible, reversible heat engines. Unresisted expansion, remarks on Carnot's engine, internal and external reversibility, Definition of the thermodynamic temperature scale.Problems

Entropy: Clasius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, , calculation of entropy using Tds relations, entropy asacoordinate. **10Hours**

MODULE 4

Availability, Irreversibility and General Thermodynamic relations.Introduction, Availability (Exergy), Unavailable energy (anergy), Relation between increase in unavailable energy and increase in entropy.Maximum work, maximum useful work for a system and control volume, irreversibility, second law efficiency (effectiveness). Gibbs and Helmholtz functions, Maxwell relations, Clapeyron equation, Joule Thomson coefficient, general relations for change in entropy, enthalpy , internal energy and specific heats.

Pure Substances: P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat).Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams.Steam tables and its use.Throttling calorimeter, separating and throttling calorimeter.

10 Hours

MODULE 5

Ideal gases: Ideal gas mixtures, Daltons law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases,

Air- Water mixtures and related properties, Psychrometric properties, Construction and use of Psychrometric chart. Real gases – Introduction , Air water mixture and related properties, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Redlich and Kwong equation of state Beattie-Bridgeman equation , Law of corresponding states, compressibility factor; compressibility chart.Difference between Ideal and real gases.

10 Hours

5.0 Relevance to future subjects/Area

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
03	Aerospace Industray

7.0 Books Used and Recommended to Students

Text Books

- Basic Engineering Thermodynamics, A.Venkatesh, Universities Press, 2008
- Basic and Applied Thermodynamics, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002

Reference Books

- Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications,2002
- Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
- Fundamentals of Classical Thermodynamics, G.J.VanWylen and R.E.Sonntag, Wiley Eastern.
- An Introduction to Thermodynamcis, Y.V.C.Rao, Wiley Eastern, 1993.
- B.K Venkanna, Swati B. Wadavadagi "Basic Thermodynamics, PHI, New Delhi, 2010

Additional Study material & e-Books

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

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

Website and Internet Contents References

1. http://www.nptel.ac.in
2. http://nptel.ac.in/media/pdf/nptel_2018_booklet.pdf

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
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/

10.0 Examination Note

CIE : 40 Marks Assignment marks = 10
Internal Assessment Marks = 30
Semester End Examination: 60 Marks

11.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1	Fundamental Concepts & Definitions: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems,	20
	2	Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive , extensive properties,	
	3	specific properties, pressure, specific volume Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes;	
	4	Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics,	
	5	Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer	
	6	Work and Heat: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention.	
	7	Displacement work; as a part of a system boundary, as a whole of a system boundary,	
	8	Expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work.	
	9	Heat; definition, units and sign convention	
	10	Problems.	
2	11	First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics	40
	12	extension of the First law to non - cyclic processes,	
	13	energy, energy as a property, modes of energy,	
	14	Extension of the First law to control volume; steady flow energy equation(SFEE), important applications.	
	15	Second Law of Thermodynamics: limitations of first law of thermodynamics	
	16	Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle.	
	17	Thermal reservoir, Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine,	
	18	Schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics;	
	19	PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles.	
	20	Problems.	
3	21	Reversibility: Definitions of a reversible process, reversible heat engine, importance and superiority of a reversible heat engine and irreversible processes;	60
	22	Factors that make a process irreversible, reversible heat engines.	
	23	Unresisted expansion, remarks on Carnot's engine,	
	24	Internal and external reversibility, Definition of the thermodynamic temperature scale.	
	25	Problems	
	26	Entropy: Clasius inequality,	
	27	Statement- proof, Entropy- definition, a property, change of entropy,	
	28	entropy as a quantitative test for irreversibility, principle of increase in entropy,	
	29	Calculation of entropy using Tds relations, entropy as a coordinate.	
	30	Problems	
4	31	Availability, Irreversibility and General Thermodynamic relations. Introduction,	80

		Availability (Exergy), Unavailable energy (anergy),	
	32	Relation between increase in unavailable energy and increase in entropy.	
	33	Maximum work, maximum useful work for a system and control volume, irreversibility,	
	34	Second law efficiency (effectiveness). Gibbs and Helmholtz functions, Maxwell relations,	
	35	Clapeyron equation, Joule Thomson coefficient, general relations for change in entropy, enthalpy , internal energy and specific heats.	
	36	Pure Substances: P-T and P-V diagrams, triple point and critical points.	
	37	Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example.	
	38	Enthalpy of change of phase (Latent heat).Dryness fraction (quality), T-S and H-S diagrams,	
	39	Representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter.	
	40	Problems	
5	41	Ideal gases: Ideal gas mixtures, Daltons law of partial pressures,	**100**
	42	Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases,	
	43	Air- Water mixtures and related properties,	
	44	Psychrometric properties, Construction and use of Psychrometric chart.	
	45	Real gases – Introduction , Air water mixture and related properties,	
	46	Vander Waal's Equation of state, Van-der Waal's constants in terms of critical properties,	
	47	Redlich and Kwong equation of state Beattie-Bridgeman equation ,	
	48	Law of corresponding states, compressibility factor; compressibility chart.	
	49	Difference between Ideal and real gases.	
	50	Problems	

12.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected: students able to	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	The seminar will be conducted on uncovered portion of the subject after the II IA and evaluated the activity.					

12.0 QUESTION BANK

Sample Questions	Questions
I	**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

II	**Module 2** 17. Describe the Joule's experiment and analyze the formulation. 18. Define and explain the first law of thermodynamics. 19. Apply the first law of thermodymics to non-cyclic processes and control volume. 20. Explain the specific heat and enthalpy and their relations. 21. Derive the SFEE and formulate the different applications of SFEE. 22. Explain what are the significance of SFEE 23. Explain PMM I 24. Solve numericals on first law of thermodynamics 25. Define and explain the different definitions of Second Law of Thermodynamics. 26. Explain thermal energy reservoir, sink 27. Explain the two statements on second law and draw similarity between them 28. Explain PMM II and differentiate between PMM-I and PMM-II. 29. Explain and differentiate reversible and irreversible processes and their factors to make different principles. 30. Define heat engine and heat pump. Explain their schematic diagram.
III	**Module 3** 31. Define the "Entropy" and explain the Classius's inequality. 32. Derive the proof of inequality statement and explain its applications. 33. Derive to show that the entropy of universe is always increasing. 34. Solve the examples by using TDS relation. 35. Explain different available and unavailable energy.
IV	**Module 4** 36. Concept of Maxwell Relation 37. Concept of Clausius Clayperson's Equations 38. 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. 39. Evaluate heat and work for different qausi-static process. 40. Explain PT and PV diagram of pure substances. 41. Define the dryness fraction and the change of phase. 42. Represent the various processes on T-S and H-S diagram. 43. Use the steam tables. 44. Explain the throttling and separating calorimeter.
V	**Module 5** 45. Derive and explain Vander Waal's Equation and also define compressibility factor. 46. Describe and use of compressibility chart. 47. Derive and Explain Dalton Law of partial pressure 48. Define Amagat's law of additive volumes, evaluation of properties, Analysis of various process.

13.0 University Result

Examination	FCD	FC	SC	% Passing
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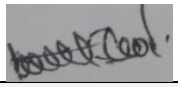
Prepared by	Checked by		
			
Prof. Jagadeesh A	**Prof. K M Akkoli**	**HOD**	**Principal**

Subject Title	**MATERIAL SCIENCE**		
Subject Code	18ME34	**CIE**	40
Number of Lecture Hrs / Week	03	**SEE**	60
Total Number of Lecture Hrs	40	**Exam Hours**	03
CREDITS – 04			

FACULTY DETAILS:		
Name: Prof. K G Ambli	**Designation:** Asst. Professor	**Experience:** 07
No. of times course taught:04	**Specialization:** Product Design and Manufacturing	
Name: Prof.Mahantesh Tanodi	**Designation:** Asst.Professor	**Experience:**07
No. of times course taught:02	**Specialization:** Machine Design	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical	III / IV	MTO, Metal Casting and Welding

2.0 Course Objectives

This course provides'

1. The foundation for understanding the structure and behaviour of materials common in mechanical engineering.
2. Topics to explore the mechanical properties of metals and their alloys, polymers, ceramics, smart materials and composites.
3. To understand modifications of material properties by heat treatment processes.
4. Selections of different materials for various applications are highlighted.
5. Impart knowledge of various failure modes of materials.

3.0 Course Outcomes

The student shall be able to;

1. Understand the mechanical properties of metals and their alloys.
2. Analyze the various modes of failure and understand the microstructures of ferrous and nonferrous materials
3. Describe the processes of heat treatment of various alloys.
4. Acquire the Knowledge of composite materials and their production process as well as applications.
5. Understand the properties and potentialities of various materials available and material selection procedures.

4.0 Course Content

MODULE 1

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

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

MODULE 2

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

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, S-N diagram, fatigue testing.

Creep: Description of the phenomenon with examples, three stages of creep, creep properties, Stress

relaxation. Concept of fracture toughness, numerical on diffusion, strain and stress relaxation.

Alloys, Steels, Solidification:

Concept of formation of alloys:Typesofalloys,solidsolutions,factorsaffectingsolidsolubility(HumeRotheryrules) ,Binary phasediagrams:Eutectic,andEutectoidsystems,Leverrule,Intermediatephases,(The same type of process will study in Iron Carbon Phase Diagrams) Gibbs phase rule, Effect of non-equilibrium cooling, Coring and Homo genization Iron-Carbon (Cementite) diagram: description of phases, Effect of common alloying elements in steel, Common alloy steels, Stainless steel, Tool steel, Specifications of steels. Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, Crystal growth, cast metal structures, Solidification of Steels and Cast irons. Numerical on Lever rule.

MODULE 3

Heat Treatment, Ferrous and Non-Ferrous Alloys: Heat treating of metals: Time-TemperatureTransformation (TTT) curves, Continuous Cooling Transformation (CCT) curves, Annealing: Recovery, Re crystallization and Grain growth, Types of annealing, Normalizing, Hardening, Tempering, Mar tempering, Austempering, Concept of harden ability, Factors affecting harden ability. Surface hardening methods: carburizing, cyaniding, nit riding, flame hardening and induction hardening, Age hardening of aluminium-copper alloys and PH steels. Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel.

MODULE 4

Composite Materials : Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, Fundamentals of production of composites, characterization of composites, constitutive relations of composites, determination of composite properties from component properties, hybrid composites. Applications of composite materials. Numerical on determining properties of composites.

MODULE 5

Other Materials, Material Selection

Ceramics: Structure type sand properties and applications of ceramics. Mechanical/ Electrical behaviour and processing of Ceramics.

Plastics: Various types of polymers/plastics and their applications. Mechanical behaviour and processing of plastics, Failure of plastics.

Other materials: Brief description of other materials such as optical and thermal materials.

Smart materials–fiber optic materials, piezo-electrics,shapememoryalloys–Nitinol,superelasticity. Biological applications of smart materials-materials usedasim plants in human Body, selection of materials, performance of materials in service. Residual life assessment–use of non-destructive testing, economics, environment and Sustainability.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Advanced / Composite Material Testing

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Aerospace Industries, Automobile Industries
02	Research and Development

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Lecture	Topic: Shape / Super Memory Alloys, PVD Techniques

8.0 Books Used and Recommended to Students

Text Books
1. Smith, Foundations of Materials Science and Engineering, 4th Edition, McGraw Hill, 2009. 2. William D. Callister, Material science and Engineering and Introduction, Wiley, 2006. 3. Shackle ford., & M. K. Muralidhara, Materials Science, 2007
Reference Books
1. V.Raghavan, Materials Science and Engineering, , PHI, 2002 2. Donald R. Askland and Pradeep.P. Phule, The Science and Engineering of Materials, Cengage Learning, 4lh Ed., 2003. 3. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill. 4. ASM Handbooks, American Society of Metals. 5. H. VanVlack, Elements of Materials Science and Engineering, 1998 6. Alan Cottrell, An introduction to Metallurgy 1974.
Additional Study material & e-Books
1. A V Avner. Principle of Metallurgy

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

Website and Internet Contents References
14) http://nptel.ac.in/courses/113106032/ 15) https://www.youtube.com/channel/UC9sKRSg8Kn5axYdORJUnqFw 16) http://freevideolectures.com/Subject/Metallurgy-and-Material-Science 17) http://www.vssut.ac.in/lecture-notes.php?url=metallurgy-materials-engineering

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

CIE : 40 Marks
Assignment marks = 10
Internal Assessment Marks = 30

Semester End Examination: 60 Marks
Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
1	1	**Introduction to Crystal Structure:** Coordination number, atomic packing factor, Simple Cubic, BCC,FCC and HCP Structures,	20%
	2	Crystal imperfections–point, line, surface and volume imperfections.	
	3	Atomic Diffusion: Phenomen on, Fick's laws of diffusion (First and Second Law);Factors affecting diffusion.	
	4	**Mechanical Behaviour:** Stress-strain diagrams showing ductile and brittle behaviour of materials, Engineering stress and true strains,	
	5	Linear and non- linear elastic behaviour and properties,	
	6	Mechanical properties in plastic range: Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness.	
	7	Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.	
	8	Problems	
2	9	**Failure of Materials Fracture:** Type I, Type II and Type III,	20%
	10	**Fatigue**: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, S-N diagram, fatigue testing.	
	11	**Creep:** Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation. Concept of fracture toughness, numerical on diffusion, strain and stress relaxation.	
	12	**Alloys, Steels, Solidification: Concept of formation of alloys**: Typesofalloys, solid solutions, factors affecting solidsolubility (HumeRotheryrules) ,	
	13	phase Binary diagrams: Eutectic, and Eutectoid systems, Leverrule, Intermediate phases, (The same type of process will study in Iron Carbon Phase Diagrams)	
	14	Gibbs phase rule, Effect of non-equilibrium cooling, Coring and Homo genization	
	15	Iron-Carbon (Cementite) diagram: description of phases, Effect of common alloying elements in steel, Common alloy steels, Stainless steel, Tool steel, Specifications of steels.	
	16	Solidification: Mechanism of solidification, Homogenous and Heterogeneous nucleation, Crystal growth, cast metal structures, Solidification of Steels and Cast irons. Numerical on Lever rule.	
3	17	**Heat Treatment, Ferrous and Non-Ferrous Alloys:** Heat treating of metals: Time-TemperatureTransformation (TTT) curves, Continuous Cooling Transformation (CCT) curves	20%
	18	Annealing: Recovery, Re crystallization and Grain growth, Types of annealing,	
	19	Normalizing, Hardening, Tempering, Mar tempering,	
	20	Austempering, Concept of harden ability, Factors affecting harden ability.	
	21	Surface hardening methods: carburizing, cyaniding, nitriding,	
	22	flame hardening and induction hardening, Age hardening of aluminium-copper alloys and PH steels.	
	23	Ferrous materials: Properties, Compositions and uses of Grey cast iron and steel.	
	24		
4	25	**Composite Materials :** Composite materials - Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs),	20%
	26	Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs),	

	27	Particulate-reinforced and fiber- reinforced composites,	
	28	Fundamentals of production of composites, characterization of composites, constitutive relations of composites	
	29	determination of composite properties from component properties, hybrid composites.	
	30	Applications of composite materials.	
	31	Numerical on determining properties of composites.	
	32	Numerical on determining properties of composites.	
5	33	**Other Materials, Material Selection** **Ceramics:** Structure type sand properties and applications of ceramics. Mechanical/ Electrical behaviour and processing of Ceramics.	20%
	34	**Plastics:** Various types of polymers/plastics and their applications.	
	35	Mechanical behaviour and processing of plastics, Failure of plastics.	
	36	**Other materials:** Brief description of other materials such as optical and thermal materials.	
	37	**Smart materials–**fiber optic materials, piezo-electrics,shapememoryalloys–Nitinol,superelasticity.	
	38	Biological applications of smart materials-materials usedasim plants in human Body,	
	39	selection of materials, performance of materials in service.	
	40	Residual life assessment–use of non-destructive testing, economics, environment and Sustainability	

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:	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1 of the syllabus	2	Individual Activity.	Book 1, 2 of the text book list and 1,2,3 of the Reference list
2	Assignment 2:	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 text book list and 1,2,3 of the Reference list
3	Assignment 3:	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 text book list and 1,2,3 of the Reference list
4	Assignment 4:	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 text book list and 1,2,3 of the Reference list
5	Assignment 5:	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 text book list and 1,2,3 of the Reference list

14.0 QUESTION BANK

MODULE 1

1. Define unit cell, space lattice, 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 tension and explain the behavior of the material till fracture.
12. Draw a neat sketch of stress strain diagram of a) ductile material and brittle material.
13. Define a) elastic strength b) stiffness c) resilience d) toughness e) ductility
14. Compare true stress strain diagram and conventional stress strain diagram for typical ductile material.
15. Draw on the same plot, schematic stress strain curves of mild steel, gray cast iron and copper.
16. Differentiate between ductile material & brittle material.
17. What is plastic deformation & with neat sketches plastic deformation by slip
18. With neat sketches plastic deformation by twinning.
19. Differentiate between slip and twinning deformations in materials.
20. With neat sketches explain stages in a ductile type of fracture.
21. Differentiate between ductile and brittle fractures.
22. Explain with a neat sketch the cup and cone fracture.
23. Derive Griffith's criterion for brittle fracture.
24. Define and explain the phenomenon of fatigue.
25. Explain the mechanism of fatigue crack growth in ductile materials.
26. Draw S-N curve for steel and aluminum.
27. Define creep and explain a typical creep curve.
28. Explain stress relaxation.
29. Explain two important creep mechanisms.
30. Explain briefly temperature effect on creep curve and endurance limit and fatigue strength.

MODULE 2

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

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 and tougher. Explain?
14. What is the purpose of case hardening? Classify the methods of case hardening and describe briefly any two of them.
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 4

1. What is a ceramic material**?**
2. What are the different types of ceramics?
3. Explain the structures of the ceramics.
4. Explain the different properties & applications of ceramics.
5. Explain the mechanical behavior & processing of ceramics.
6. Explain the electrical behavior & processing of ceramics.
7. Define a polymer/ plastic.
8. Write down the applications of plastics/ polymers.
9. Explain the mechanical behavior & processing of plastics.
10. Explain the failure of plastics.
11. Briefly explain the thermal & optical materials (smart materials).
12. Briefly explain the term superelasticity.
13. Write down the biological applications of smart materials.
14. What is the use of non-destructive?
15. List advantages & disadvantages of composite materials.
16. Write down the applications of composite materials.

MODULE 5

1. Define composite material
2. Classify composite materials
3. List & explain different types of matrix materials & reinforcements
4. What is a reinforced composite? List & explain its types.
5. Explain FRP with its applications
6. Explain MMC with its applications
7. List advantages & disadvantages of composite materials.
8. What are hybrid composites?
9. Write down the applications of composite materials.

15.0 University Result

Examination	FCD	FC	SC	% Passing
2015-16	03	15	43	96.82

Examination	+S	S	A	B	C	D	E	F	% Passing
2016-17	0	3	13	32	56	20	8	11	92.3
2017-18	0	3	13	32	32	18	15	11	91.08

Faculty : K. G. Ambli M. I. Tanodi	Module coordinator	HOD	Principal

Subject Title	**METAL CUTTING AND FORMING**		
Subject Code	18ME35A/45A	**CIE Marks**	40
Teaching Hours / Week (L:T:P)	3:0:0	**SEE Marks**	60
Total No of Lecture + Practical Hrs	40+0	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Mr. Kushal G Ambli	**Designation:** Asst. Professor	**Experience:** 07Years
No. of times course taught: 01 Time	**Specialization:** Product Design and Manufacturing.	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
1	Mechanical Engineering	3rd and 4th	Metal Casting and Welding
2	Mechanical Engineering	3rd and 4th	Machine Tools and Operations

2.0 Course Objectives

- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To introduce students to different machine tools to produce components having different shapes and sizes.
- To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
- To acquaint with the basic knowledge on fundamentals of metal forming processes
- To study various metal forming processes.

3.0 Course Outcomes

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

CO1: Explain the construction & specification of various machine tools.
CO2: Discuss different cutting tool materials, tool nomenclature & surface finish.
CO3: Apply mechanics of machining process to evaluate machining time.
CO4: Analyze tool wear mechanisms and equations to enhance tool life and minimize machining cost.
CO5: Understand the concepts of different metal forming processes.
CO6: Apply the concepts of design of sheet metal dies to design different dies for simple sheet metal components.

4.0 Course Content

MODULE -1

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

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

MODULE -2

Milling: Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling & down milling. Indexing: need of indexing, simple, compound & differential indexing.

Drilling: Difference between drilling, boring & reaming, types of drilling machines. Boring operations & boring machines.

Shaping, Planing and Slotting machines-machining operations and operating parameters.

Grinding: **Grinding operation, classification of grinding processes: cylindrical, surface & centerless grinding.**

MODULE -3

Introduction to tool wear, tool wear mechanisms, tool life equations, effect of process parameters on tool life, machinability. Cutting fluid-types and applications, surface finish, effect of machining parameters on surface finish. Economics of machining process, choice of cutting speed and feed, tool life for minimum cost and **production time. Numerical problems.**

MODULE -4

MECHANICAL WORKING OF METALS

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

MODULE -5

Sheet Metal Operations: Blanking, piercing, punching, drawing, draw ratio, drawing force, variables in drawing, Trimming, and Shearing.
Bending — types of bending dies, Bending force calculation,
Embossing and coining.
Types of dies: Progressive, compound and combination dies.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	VIII	Project Work	Cutting & Forming of parts

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Production of different metallic components by forming and cutting the metal in different shape and size with the application of different methods.

7.0 Books Used and Recommended to Students

Text Books
1. Manufacturing Technology Vol I & II, P.N.Rao, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 1998. 2. A textbook of Production Technology Vol I and II, Sharma, P.C, S. Chand & Company Ltd., New Delhi 1996. 3. Manufacturing Science, Amithab Gosh &A.K.Malik, East-West press, 2001.
Reference Books
1. Workshop Technology Vol. I and II, Chapman W. A. J., Arnold Publisher New Delhi, 1998. 2. Elements of Manufacturing Technology Vol II, Hajra Choudhary, S. K. and HajraChoudhary, A.K., Media Publishers, Bombay,1998. 3. Metal Forming Handbook, Schuler, Springer Verlag Publication. 4. Metal Forming: Mechanics and Metallurgy, Hosford,WF and Caddell,R.M, Prentice Hall, 1993. 5. Manufacturing Engineering and Technology, Kalpakjian, Addision Wesley Congmen Pvt. Ltd. 2000. 6. Production Technology HMT
Additional Study material & e-Books
1.Nptel.ac.in 2.VTU, E- learning.

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	**Metal Forming Magazine**	http://www.metalformingmagazine.com/home
2	International Journal of Material Forming	https://link.springer.com/journal/12289

10.0 Examination Note

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

11.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1		**Introduction to Metal cutting:**	22.5
	1.	Orthogonal and oblique cutting. Classification of cutting tools:	
	2.	Single, and multipoint; tool signature for single point cutting tool	
	3.	Mechanics of orthogonal cutting; chip formation. Merchant circle diagram.	
	4.	Shear angle and its significance	
	5.	Cutting tool materials and applications. Numerical problems.	
	6.	**Introduction to basic metal cutting machine tools: Lathe**- Parts of lathe machine	
	7.	Accessories of lathe machine.	
	8.	Various operations carried out on lathe.	
	9.	Kinematics of lathe. Turret and Capstan lathe.	
2		**Milling:**	22.5
	10.	Various Milling operations, classification of milling machines.	
	11.	Vertical & Horizontal milling.	
	12.	Up milling & down milling. Indexing: need of indexing.	
	13.	Compound & differential indexing.	
	14.	**Drilling:** Difference between drilling, boring & reaming, types of drilling machines.	
	15.	Boring operations & boring machines.	
	16.	**Shaping, Planing and Slotting machines**-machining operations and operating parameters.	
	17.	**Grinding:** Grinding operation, classification of grinding processes:	
	18.	Cylindrical, surface & centerless grinding.	
3		**Introduction to tool wear :**	20
	19.	Tool wear mechanisms, tool life equations.	
	20.	Effect of process parameters on tool life.	
	21.	Machinability. Cutting fluid-types and applications.	
	22.	Surface finish, effect of machining parameters on surface finish.	
	23.	Economics of machining process, choice of cutting speed and feed.	
	24.	Tool life for minimum cost and production time.	
	25.	Numerical problems.	
	26.	Numerical problems.	
4		**MECHANICAL WORKING OF METALS:**	22.5
	27.	Introduction to metal forming processes & classification of metal forming processes.	
	28.	Hot working & cold working of metals.	
	29.	Forging: Smith forging, drop forging & press forging.	
	30.	Forging Equipment, Defects in forging.	
	31.	Rolling: Rolling process, Angle of bite.	
	32.	Types of rolling mills.	
	33.	Variables of rolling process, Rolling defects.	
	34.	Drawing & Extrusion: Drawing of wires, rods & pipes, Variables of drawing process.	

	35.	Difference between drawing & extrusion. Various types of extrusion processes.	
5		**Sheet Metal Operations:**	12.5
	36.	Blanking, piercing, punching, drawing	
	37.	Draw ratio, drawing force, variables in drawing,	
	38.	Trimming, and Shearing. Bending — types of bending dies.	
	39.	Bending force calculation, Embossing and coining.	
	40.	Types of dies: Progressive, compound and combination dies.	

12.0 QUESTION BANK

INTRODUCTION TO METAL CUTTING:

1. Explain briefly orthogonal cutting & oblique cutting?
2. Explain with neat sketch single point cutting tool nomenclature
3. Explain the Merchants circle diagram & analysis?
4. Derive the equation for shear angle of Ernst Merchant solution with assumptions.
5. In an orthogonal cutting, the following data were observed : depth of cut=0.25mm,horizontal force=1135N,thrust force=110N,rake angle=200,width of cut=4mm,cutting velocity=30m/min,chip thickness ratio=0.47.Determine friction angle, shear plane angle, resultant cutting force & the power required
6. What is tool wear? Explain its different types.
7. Define tool life. List the factors affecting tool life.
8. Explain briefly tool failure criteria.
9. What are the desirable properties of cutting tool material
10. What are the desirable properties of cutting fluids
11. Explain briefly the salient features of HSS, carbides coated carbides, ceramics
12. List the various methods of measuring the chip-tool interface temperature.
13. Explain with neat sketch the different zones of heat generation in metal cutting.
14. Explain briefly heat distribution in tool-work piece in metal cutting.
15. What is Lathe? Classify.
16. Explain constructional features of Turret and Capstan Lathe.

MILLING, DRILLING, SHAPING, PLANING AND SLOTTING MACHINES:

1. Difference between 1) up milling and down milling 2)Face & end milling.
2. With the help of neat sketch explain the horizontal milling m/c
3. Explain the nomenclature of milling cutter with its neat sketch
4. Explain briefly the various operation of milling m/cs
5. Define indexing. Name the different methods.
6. Explain compound indexing method
7. Differentiate simple indexing & differential indexing method
8. Show the calculation for indexing 87 divisions in a milling m/c by compound indexing method.
   The following Brown & sharp type index plates are available.

Plate No.1	**15**	**16**	**17**	**18**	**19**	**20**
Plate No.2	**21**	**23**	**27**	**29**	**31**	**33**
Plate No.3	**37**	**39**	**41**	**43**	**47**	**49**

9. With the help of neat sketch explain the following operations 1)Reaming 2)Boring 3)Counter sinking 4)Tapping
10. Explain the nomenclature of drill bit with its neat sketch.
11. With the help of neat sketch explain the radial drilling m/c
12. List the drill bit material.
13. Find the time required for drilling a 18mm (D) hole in a workpiece having thickness of 50mm.Assume cutting speed of 12mtr/min &feed 0.2mm/rev.Tool approach=0.29D & tool over travel is 1.5mm

MECHANICAL WORKING OF METALS

1. How do you classify rolling processes?
2. What are the different types of rolling mills?
3. Derive the expression for rolling load.
4. What is the effect of front and back tension in roll pressure? Sketch curves to indicate these effects.
5. Discuss briefly the defects in rolled products.
6. Calculate the rolling load if a steel sheet is hot rolled from a 40 mm thick slab of width 760 mm. The reduction in thickness is achieved is 30 % and the roll dia is 900mm. The plane straight flow stress is 140MPa at the entrance and 200 MPa at the exit from the roll gap because of the increasing velocity. Assume the coefficient of friction as 0.3. is the roll speed is 100 RPM, what power is required to drive the rolls?
7. The thickness of the metal strip is reduced from 5mm to 4.5 mm thick by cold rolling.
8. Determine the roll pressure at entrance at the neutral point and the exit in the absence of the front and back tension. The coefficient of friction of 0.1. mean flow stress is 350 N/mm^2 and the dia of the roll is 50 cm. assume no side flow.
9. Explain the process of wire drawing.
10. With a neat sketch explain the features of a typical wire drawing die.
11. Discuss the optimum cone angle in drawing dies used in wire drawing.
12. Derive an expression for drawing force.
13. What ado you meant by redundant work in wire drawing process?
14. Classify different [processes used in tube drawing. With the help of a neat sketch explain the process using moving mandrel.
15. Discuss the defects in drawn wires and rods.
16. A steel wire is drawn from an initial dia 12.5 mm to a final diameter of 10mm at the speed of 120 m/ min. the half cone angle of the die of 6^0 and the coefficient of friction at the die – wire interfaces is 0.12, yield strength is 210 N/mm^2. Determine the draw force the power required, assuming there is no back tension applied.
17. Determine the drawing stresses to produce a 25 % reduction in a 15 mm steel wire. The flow stress is given by $\sigma_0 = 1200\ \epsilon^{0.25}$MPa. If the wire is drawn at 5 m/s , determine the power required to produce the deformation . Also calculate the maximum possible reduction.
18. Calculate the drawing load for 40% reduction of area of 25 mm * 6 mm annealed mild steel strip using 12 mm radius dies , and compare this with the load using straight tapered dies, i) of the same entry angle ii) of the same mean angle. Assume $\mu = 0.1$. Neglect the effect of redundant work.
19. Define extrusion. Give a brief classification of extrusion processes.
20. Explain the process of direct extrusion.
21. How does direct extrusion different from indirect extrusion?
22. Write a note on extrusion of seamless pipe.
23. What are the defects in extrusion?
24. Write a note on extrusion equipments.
25. What are the different extrusion dies? Explain with simple sketches.
26. Calculate the maximum force required for extrusion of cylindrical aluminum billet of 50 mm dia and 75 mm length to final dia of 10 mm. The average tensile yield stress for aluminum is 170 N / mm^2. Also estimate the loss of total power input in friction.

SHEET METAL OPERATIONS

1. What is a curling die?
2. Explain with sketch a compound die.
3. Write a note on die and punch materials.
4. What are the different forming methods?
5. Explain the terms – blanking, Drawing, coining and embossing.
6. Describe with a neat sketch difference between blanking and piercing.
7. Explain draw ability and LDR in deep drawing.
8. List advantages and limitations of deep drawing.
9. With an example explain how the size of a blank is calculated for drawing a cup?
10. Show the set up of drawing cups by deep drawing.
11. It is required to punch a hole of 10mm dia in a mild steel of 10mm thickness. Determine whether it is feasible or not, taking shear strength of a plate as 600 N / mm^2. And compressive strength of the punch as 2000 N/ mm^2. If it is not possible what could be done to produce this hole?
12. A blanking die is required to handle blanks of 150 mm dia on 3 mm thick M S sheet. Each blanking takes place in 0.25 sec. Shear strength of M S sheet is 400 N/mm^2. Find the power of driving motor (Neglect frictional losses).
13. Estimate the shear angle on a punch used to produce a hole of 50 mm dia in steel plate of 3 mm thick with an ultimate shear stress 450 N / mm^2 , if the blanking force is one half of the force using a punch without shear. Assume a penetration of 1 mm before rupture.
14. Estimate the blanking force required to punch 20 mm * 25 mm rectangular blank form 1.5 mm thick metal strip, if the ultimate shear strength of the material is 450 N / mm^2. Also calculate the work done if the percentage penetration is 20 % of the material thickness.
15. It is required to punch a It is required to punch a round blank of 25 cm form a 2.5 mm thick sheet , with zero shear angle on the punch. What is the maximum cutting force required? Calculate the average force required if fraction of penetration is 0.3. Also determine the energy required to punch the blank. (Take shear stress = 80 N / mm^2)

14.0 University Result

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

Faculty : K. G. Ambli	Module coordinator	HOD	Principal

Subject Title	**COMPUTER AIDED MACHINE DRAWING**		
Subject Code	**18ME36A**	**IA Marks**	40
Number of Lecture Hrs / Week	05	**Exam Marks**	60
Total Number of Lecture Hrs	70	**Exam Hours**	03
		CREDITS – 03	

FACULTY DETAILS:		
Name: Prof. BIRADAR.A.M	**Designation:** Asst.Professor	**Experience:**11
No. of times course taught: 01	**Specialization:** Machine Design	

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

1. To acquire the knowledge of CAD software and its features.
2. To familiarize the students with Indian Standards on drawing practices.
3. To impart knowledge of thread forms, fasteners, keys, joints and couplings.
4. To make the students understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.
5. To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.

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
CO1	Identify the national and international standards pertaining to machine drawing.
CO2	Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings
CO3	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
CO4	Interpret the Machining and surface finish symbols on the component drawings.
CO5	Preparation of the part or assembly drawings as per the conventions.

4.0 Course Content

PART A

INTRODUCTION TO COMPUTER AIDED SKETCHING

Review of graphic interface of the software. Review of basic sketching commands and navigational commands.

Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problemson, axis inclinations, spheres and hollow solids), True shape of section.

Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section.(Bureau of Indian Standards conventions are to be followed for the drawings), Hidden line conventions, Precedence of lines.

Thread forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal and External),square, Acme and Sellers thread, American Standard thread.
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, counter sunk head screw, grub screw, Allen screw.

PART B

Keys and Joints: Parallel, Taper, Feather Key, Gib head key and Woodruff key
Riveted joints: Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).
Joints: Cotter joint (socket and spigot), Knuckle joint (pin joint) for two rods.

Couplings: Split muff coupling, Protected type flange coupling, Pin (bush) type flexible coupling, Oldham's coupling and Universal coupling (Hook's Joint).

PART C

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry.

Assembly Drawings: (Part drawings shall be given)
1. Plummer block (Pedestal Bearing)
2. Rams Bottom Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Lathe square tool post **(15 Hours)**

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. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum. 2. 'Machine Drawing', N.D.Bhat&V.M.Panchal, Published by Charotar Publishing House, 1999. 3. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.
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
1. "Machine Drawing", K.L.Narayana, P.Kannaiah and K. Venkata Reddy, 3rd Edition, New Age Publishers, 2007. 2. "Machine Drawing", N D Bhatt, 44th Edition, Charotar Publishers, 2009. 3. "Machine Drawing", Dhawan, S.Chand Publications, 2005. 4. "Machine Drawing" ,P.S.Gill, S.Chand Publications, 2005.

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

Website and Internet Contents References
18) https://hareeshang.wordpress.com/tutorials/camd/ 19) http://m.noteboy.in/vtuflies/machine%20drawing.pdf 20) https://www.edx.org/school/iitbombayx?utm_source=bing&utm_medium=cpc&utm_term=iit-bombay&utm_campaign=partner-iit-bombay 21) 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

Internal Assessment: 20 Marks
Sketches shall be in sketch books and drawing shall through use of software on A3/A4 sheets. Sketch book and all the drawing printouts shall be submitted.

Scheme of Evaluation for Internal Assessment (40 Marks)
(a) Class work (Sketching and Computer Aided Machine drawing printouts in A4/A3 size sheets): 20 Marks.
(b) Internal Assessment test in the same pattern as that of the main examination: 20 marks.

Scheme of Examination:
Two questions to be set from each Part A, part B and Part C.
Student has to answer one question each from Part A, Part B for 25 marks each and one question from Part C for 50 marks.
Part A 1 x 25 = 25 Marks
Part B 1 x 25 = 25 Marks
Part C 1 x 50 = 50 Marks
Total = 100 Marks

INSTRUCTION FOR COMPUTER AIDED MACHINE DRAWING EXAMINATION
1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours.
2. It is desirable to do sketching of all the solutions before computerization.
3. Drawing instruments may be used for sketching.
4. For Part A and Part B, 2D drafting environment should be used.
5. For Part C 3D part environment should be used for parts assembly drawing and extract 2D views.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
		PART - A	
MODULE 1	1	**INTRUDUCTION TO COMPUTER AIDED SKETCHING:** Review of graphic interface of the software. Review of basic sketching commands and navigational commands.	3.84%
	2	Starting a new drawing sheet. Sheet sizes. Naming a drawing, Drawing units, grid and snap.	
	3	**Sections of Solids:** Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids). True shape of sections	15.38%
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12	**Orthographic Views:** Conversion of pictorial views into orthographic projections. Of **simple machine parts** with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings) Hidden line conventions. Precedence of lines.	
	13		
	14		
	15		
MODULE 2	16	**Thread Forms:** Thread terminology, sectional views of threads. ISO Metric (Internal & External) BSW (Internal & External) square and Acme. Sellers thread, American Standard thread.	15.38%
	17		
	18		
	19		
	20		

	21 22 23 24 25	**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, counter sunk head screw, grub screw, Allen screw.	
		PART – B	
MODULE 3	26 27 28 29	**Keys & Joints :** Parallel key, Taper key, Feather key, Gib head key and Woodruff key	15.38%
	29 30 31 32	**Riveted Joints:** Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets). Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.	
MODULE 4	33 34 35 36 37 38 39 40	**Couplings:** Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, Oldham's coupling and universal coupling (Hooks' Joint)	15.38%
		PART-C	
MODULE 5	41 42 43 44 45	**Limits, Fits and Tolerances**: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry	34.61%
	46 47 48 49	1. Plummer blocks (Pedestal Bearing).	
	50 51 52 53	2 Rams bottom safety valve.	
	54 55 56	3. I.C. Engine connecting rod	
	57		
	58 59 60	4. Screw jack (Bottle type).	
	61 62 63 64	5. Tailstock of lathe.	
	65 66 67	6. Machine vice.	
	68 69 70	7. Tool Head of a shaper	

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 Section of solids and Orthographic views	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 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: University Questions on Thread forms and fasteners	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 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: University Questions on Keys, Joints and Riveted joints	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 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: University Questions Couplings	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 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: University Questions on Assembly Drawings	Students study the Topics and write the Answers. Get practice to solve university questions.	Unit 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: SECTIONS OF SOLIDS

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 to

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

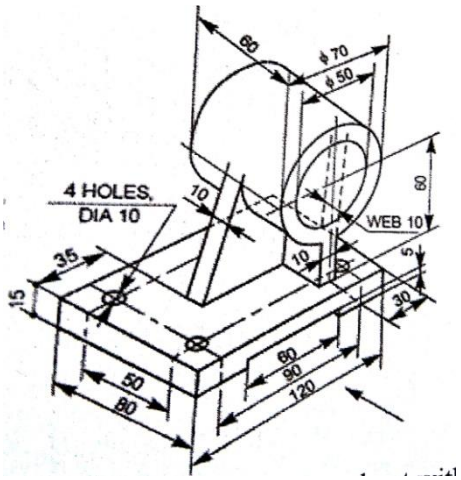
1. A Rectangular prism of height 75mm and cross section 60X37.5mm is resting on its base on the HP with one of its shorter base edges parallel to VP.A VT whose width between its ends is equal to the longer base edge cuts the prism through one of the extreme base edges and pass through the lateral face 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.
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.

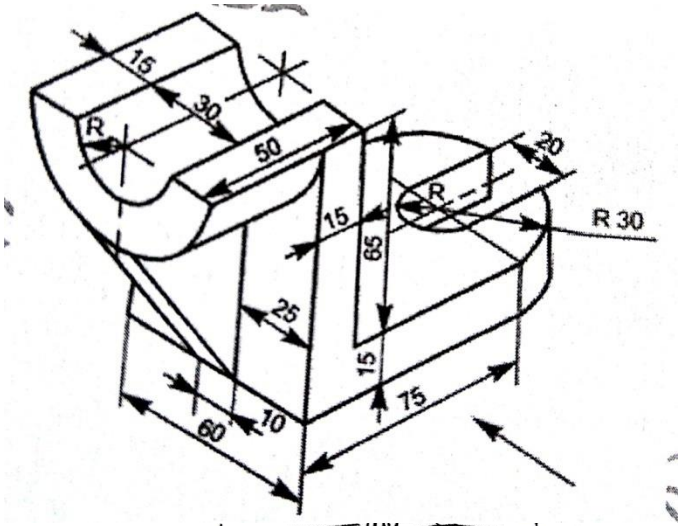
Sections of cylinders

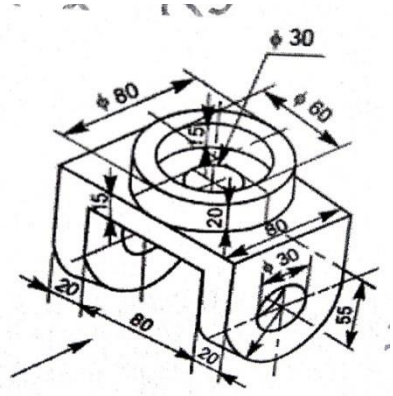
1. A cylinder of base diameter 50mm and 70mm is resting with its base on the HP. A section plane inclined at 50° to the VP and perpendicular to the HP cuts the solid at 10mm in front of it. Draw its top view, sectional front view and true shape of section.
2. A cylinder of base diameter 50mm and axis 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.

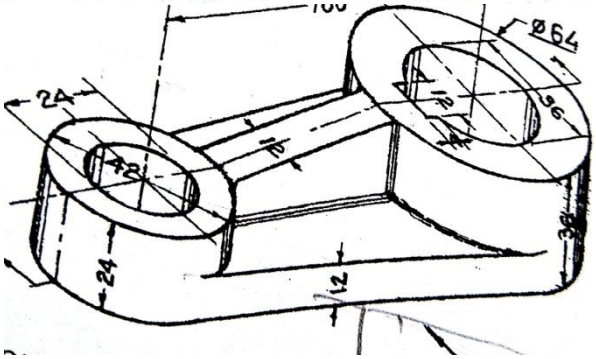
ORTHOGRAPHIC VIEWS

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









MODULE 2: 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 indicates 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.

PART-B

MODULE 3: KEYS AND JOINTS:

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.

RIVEGTED JOINTS:

1. Draw the top view and sectional front view of double rivets butt joint with cover plates with zigzag riveting. The thickness of plate is 14mm. Show at least three rivets in on one row and two rivets in the adjoining rows. Indicate all the dimensions. Use snap head rivets and show all calculation on the drawing sheet.
2. Draw free hand proportionate sketch of a double riveted butt joint with double cover plates and zigzag riveting as indicated below.
3. Sectional front-view, ii) Top view. Take a plate thickness=10mm and indicate clearly all dimensions on the drawing. Use a scale of full size.
4. Prepare free hand sketch of two views of double riveted butt joint with single cover plate to connect two plates of 9mm thick. Adopt chain riveting. Use snap head rivets. Show three rivets in a row. Mark all proportions on the views.
5. Draw to 1:1 scale, top and sectional front views of a double riveted chain lap joint. The thickness of the plate is 9mm. Show at least three rivets. Use snap rivets. Indicate all the dimensions.
6. Draw a neat sketch of a double riveted butt joint with single strap. The rivets are to be arranged in a zigzag fashion. Assume and indicate the dimensions and show the calculations.
7. Draw the sectional front view and top view of a double riveted lap joint with zigzag riveting to connect two plates of 12mm thickness.
8. Draw the following views of a SOCKET and SPIGOT COTTER JOINT used for joining two rods of diameter 20mm: i) Sectional front view. ii) A view looking from socket end.
9. Make a neat and proportionate free hand sketch of a socket and spigot type cotter joint showing sectional front view and side view from socket end. When the diameter of the rods is to be 20mm.
10. Sketch proportionately the half sectional front view of socket and spigot cotter joint assuming diameter of rods=20mm. Indicate all proportions with dimensions. Prepare parts list.
11. Sketch neat and proportioned sectional front view of Knuckle joint to connect two round rods of 25mm diameter. Indicate all proportions with dimensions. Show the parts list.
12. Sketch the sectional front view of a cotter joint with sleeve to connect two rods of diameter 25mm. Indicate all proportions with dimensions. Add a parts list.
13. Sketch neat and proportionate figure of Knuckle joint showing sectional front view and top view. Take diameter of rods as 25mm.
14. Sketch a neat proportional front view of a socket and spigot cotter joint indicating all proportions to connect rods of 25mm.

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.
   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.

15. 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.
16. 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.
17. Sketch half sectional front view of a flange coupling unprotected type to connect two shafts 20mm diameter. Indicate all proportions. Add parts list.
18. Sketch sectional front view of a **Universal** coupling to connect two rods of diameter 30mm. indicates all dimensions, add parts lists.
19. 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.
20. Sketch the sectional front view of a flexible coupling to connect two shafts of 25mm dia with all dimensions.

PART-C

MODULE 5 : LIMITS, FITS AND TOLERANCES

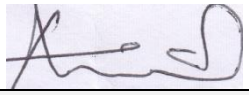
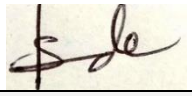
1. Define Limits, Fits and Tolerances
2. Explain with neat sketch Types of fits with symbols and applications

ASSEMBLY DRAWINGS: (Part drawings should be given)

1. Details of a "PLUMMER BLOCK" are 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 "Rams bottom 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.

16.0 University Result

Examination	S+	S	A	B	C	D	E	F	% Passing
2017-18 (EVEN)	14	15	10	04	10	04	--	NIL	**100**
2018-19 (ODD)		07	05	08	06	04	00	00	**100**

Prepared by	Checked by		
			
Prof.Biradar.A.M	**Prof.Santosh Awade**	**HOD**	**Principal**

MATERIAL TESTING LAB			
Subject Code	18MEL37A	**CIE Marks**	40
Teaching Hours / Week(L.T.P)	0:2:2	**Exam Marks**	60
Credits	02	**Exam Hours**	03

FACULTY DETAILS:		
Name: Prof. G A Naik	**Designation:** Asst. Professor	**Experience:** 23 Years
No. of times course taught: 03Times	**Specialization:** Production Technology	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engineering	I	MES
02	Mechanical Engineering	III	Mechanics of Materials

2.0 Course Objectives

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

3.0 Course Outcomes

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

CO	Course Outcome	RBT Level	Pos
CO1	Determine the hardness of the various materials by different hardness test methods.	L1,L2,L3	PO1,PO2,PO3,PO4,PO6,
CO2	Evaluate the impact strength of materials by Izod and Charpy test.	L1,L2,L3	PO1,PO2,PO3,PO4,PO6, PO9
CO3	Evaluate the strength of different materials on universal testing machine.	L1,L2,L3	PO1,PO2,PO3,PO4,PO6, PO9
CO4	Determine the tensional strength of the given mild steel specimen on tensional test rig.	L1,L2,L3	PO1,PO2,PO3,PO4,PO6,
CO5	Identify the metals based on their microstructure.	L1,L2,L3	PO2,PO3,PO4
CO6	Modify the properties of metal specimens by heat treatment processes.	L1,L2,L3	PO2,PO3,PO4
CO7	Evaluate the Progressive loss of the material & coefficient of friction on wear	L1,L2,L3	PO1,PO2,PO3,PO4,PO6,
CO8	Conduct non destructive tests on given metal specimens.	L1,L2,L3	PO1,PO2,PO3,PO4,PO6, PO9,PO10
Total Hours of instruction		**52**	

4.0 Course Content

PART A

1. Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Metallographic specimens of heat treated components to be supplied and students should report microstructures of furnace cooled, water cooled, air cooled, tempered steel. Students should be able to distinguish the phase changes in a heat treated specimen compared to untreated specimen.
3. Brinell, Rockwell and Vickers's Hardness tests on untreated and heat treated specimens.
4. 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.

PART B

5. Tensile, shear and compression tests of steel, aluminum and cast iron specimens using Universal Testing Machine
6. Torsion Test on steel bar.
7. Bending Test on steel and wood specimens.
8. Izod and Charpy Tests on Mild steel and C.I Specimen.
9. To study the wear characteristics of ferrous and non-ferrous materials under different parameters.
10. Fatigue Test (demonstration only).

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	III / IV	Machine Shop Lab	Provides basics of materials to be used in Machine Shop Lab
02	V/VI	Design of Machine Elements	Design of materials
02	VIII	Project work	Generation of components for project

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Testing of Materials by using various equipments
02	Heat treatment procedure

7.0 Books Used and Recommended to Students

Text Books
1. Smith, Foundations of Materials Science and Engineering, 4th Edition, McGraw Hill, 2009. 2. William D. Callister, Material science and Engineering and Introduction, Wiley, 2006.
Reference Books
1. V.Raghavan, Materials Science and Engineering, , PHI, 2002 2. Donald R. Askland and Pradeep.P. Phule, The Science and Engineering of Materials, Cengage Learning, 4lh Ed., 2003. 3. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill. 4. ASM Handbooks, American Society of Metals.
Additional Study material & e-Books
A text book of Materials Science and Engineering by William Callister

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

Website and Internet Contents References
3. http://www.nptel.ac.in
2. Materials Science - Qualify Gate Exam qualifygate.com/download/s%20k%20mondal/**Material**%20**Science**%20IISc.**pd**

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	Materials Today - Journal - Elsevier	https://www.journals.elsevier.com/**materials-today**/
2	**Journal of Materials Engineering and Performance - Springer**	www.springer.com › Home › Materials › Characterization & Evaluation of Materials

10.0 Examination Note

Internal Assessment:
Theoretical aspects as well as relevant sketches should be drawn neatly for questions asked in Internal Assessments
Scheme of Evaluation for Internal Assessment (40 Marks)
(c) Internal Assessment test in the same pattern as that of the main examination: 40marks.

SCHEME OF EXAMINATION:

ONE question from part -A:	30 Marks
ONE question from part -B:	50 Marks
Viva -Voice:	20 Marks
Total :	100 Marks

11.0 Course Delivery Plan

Expt No	Hour	Name of the Experiment	% Of Portion
1	3	Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I,.	42.85
2	3	Preparation of specimen for Metallographic examination of different engineering materials. Identification of microstructures of SG iron, Brass, Bronze & composites.	
3	3	Heat treatment: Annealing, normalizing, hardening and tempering of steel.	
4	3	Hardness studies of heat-treated samples.	
5	3	To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.	
6	3	Non-destructive test experiments like, (a). Ultrasonic flaw detection, to study the defects of Casted and Welded Specimens.	
7	3	Non-destructive test experiments like, Magnetic crack detection and Dye penetration testing, to study the defects of Casted and Welded Specimens.	57.15
8	3	Tensile tests of metallic and non metallic specimens using a Universal Testing Machine	
9	3	shear tests of metallic and non metallic specimens using a Universal Testing Machine	
10	3	compression tests of metallic and non metallic specimens using a Universal Testing Machine	

11	3	Torsion tests
12	3	Bending Test on metallic and nonmetallic specimens.
13	3	Izod and Charpy tests on M.S. Specimen.
14	3	Brinell Hardness test
15	3	Rockwell Hardness test
16	3	Fatigue Test.

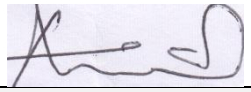
12.0 QUESTION BANK

1. What are the objectives of testing materials?
2. Define stress and strain. In what unit it measures.
3. State hooks law
4. Is this applicable to all materials.
5. Define the terms a) elastic limit b) proportional limit c) yield point d) yield strength e) resilience f) toughness.
6. Does all material have yield point? Give example.
7. What is the use of tensile test?
8. What factor should be considered in selecting the gauge length?
9. Which property in tension test is an indication of stiffness of material?
10. What are the difference between proportional limit and elastic limit?
11. Distinguish between the yield point and yield strength?
12. Distinguish between resilience and toughness.
13. Describe the events that occur when a specimen under goes tension test.
14. How is stress calculated?
15. What additional measurement must be made to determine the true stress?
16. Describe the difference between brittle and ductile materials.
17. Give reasons as why the working stress must be less than the ultimate strength of the material.
18. What is UTM? Describe the mechanism
19. Describe the different types of strain measuring apparatus.
20. List some uses of compression test.
21. Explain compression fractures of the following materials a) cast iron b) wood) c) steel.
22. Define the following terms a) neutral axis b) centroidal axis.
23. Are torsion specimens subjects to other than shearing stress during the test? If so what are these stresses.
24. What physical property of the material is determined by means of an impact test?
25. In what unit is the results of impact test are given.
26. For impact test why are the notch specimen used.
27. What is the difference between charpy and izod test.
28. Define hardness. Why hardness test is conducted instead of tension test.
29. What physical properties of a material can be estimated from hardness test?
30. What is the unit of brinnel hardness number?
31. What is stress concentration?
32. Why is minor load applied? Before setting the Rockwell measuring dial.
33. What is meant by term Fatigue of the metals?
34. Define the following terms. In discussing fatigue tests, stress cycle, maximum stress range of stress minimum stress normal stress, alternating stress, amplitude, mean stress, fatigue life, fatigue limit, stress ratio, SN diagram, cycle ratio, fatigue strength, fatigue ratio.
35. If a material endurance limit how would you estimate its fatigue life.
36. State the resemblance and difference between creep and slip.
37. Does wood creep. State evidence for your answer.
38. Define wear of the material.
39. Name different types of wear.
40. Define micrography.

41. Describe the various steps involved in preparation of specimen for micrographic examination.
42. Why it is necessary to wash specimen thoroughly between each stage of the processes during grinding and polishing.
43. What is a function of an etchant?
44. Describe the features of phase diagram.
45. What is the difference between eutectic and eutectoid?
46. Explain the cury point on iron. Iron carbide equilibrium diagram.
47. What is allotropy?
48. Sketch structure and describe the characteristics of ferrite austenite, cementite and martensite and binite.
49. What is annealing? What is the purpose of annealing the steel?
50. How normalizing differ from annealing as applied to steel.
51. What are the advantages of the normalizing process in respect to the final properties?
52. Describe the hardening process. Where does the effect occur after hardening of steel?
53. Explain what happens in steel when it is quench hardened.
54. Name several quenching media.
55. What is age hardening

13.0 University Result

Examination	S+	S	A	B	C	D	E	% Passing
2018-19	-	22	8	1	1	-	-	100
2017-18	-	25	28	09	08	03	-	100

Prepared by	Checked by		
			
Prof. G.A.NAIK	**Prof. A.M.BIRADAR**	**HOD**	**Principal**

Subject Title	**MACHINE SHOP LABORATORY**		
Subject Code	18MEL38A	**IA Marks**	40
No of Lecture Hrs + Practical Hrs/ Week	01+02	**Exam Marks**	100
Total No of Lecture + Practical Hrs	52	**Exam Hours**	03
CREDITS – 02			

FACULTY DETAILS:		
Name: Prof. M A Hipparagi	**Designation:** Asst.Professor	**Experience:**11 Years
No. of times course taught:13	**Specialization:**Prod.Tech	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Mechanical Engineering	I	EME
02	Mechanical Engineering	III	Manufacturing Process I
03	Mechanical Engineering	IV	Manufacturing Process II

2.0 Course Objectives

1 To guide students to use fitting tools to perform fitting operations.
2 To provide an insight to different machine tools, accessories and attachments.
3 To train students into fitting and machining operations to enrich their practical skills.
4 To inculcate team qualities and expose students to shop floor activities.
5 To educate students about ethical, environmental and safety standards.

3.0 Course Outcomes

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

CO	Course Outcome	Cognitive Level	Pos
CO1	Able to prepare fitting models according to drawings using fitting tools	L1,l2	PO1, PO5
CO2	Able to carry out any kind of operation on Machine tools (Lathe)	L1,l2	PO1, PO6, PO9
CO3	Capable of preparing various types of jobs accurately to the given dimensions	L2,L3	PO1, PO6, PO9
CO4	Able to perform groove cutting and gear cutting operations.	L2,L3	PO1, PO6
Total Hours of instruction		**52**	

4.0 Course Content

PART A

PART – A

Preparation of at least two fitting joint models by proficient handling and application of hand tools- Vblock, marking gauge, files, hack saw drills etc.

PART – B

Preparation of three models on lathe involving - Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.
Exercises should include selection of cutting parameters and cutting time estimation

PART –C

Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
Cutting of Gear Teeth using Milling Machine.
Exercises should include selection of cutting parameters and cutting time estimation

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	IV	Machine tool and operations	Provides basics of machine tools to be used in Machine Shop Lab
02	VIII	Project work	Generation of components for project

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Producing different models by machining process.
02	Producing ancillary products for assembly of machines.

7.0 Books Used and Recommended to Students

Text Books
1. Workshop Technology by HazraChaudharyvol I &vol II. 2. Fundamentals of metal cutting and Machine tools By B L Juneja
Reference Books
1. Machine Tool Operations By Anup Goel 2. Metal Processing II BY Kestoor Praveen
Additional Study material & e-Books
A Textbook of Metal processing eBook By O P Khanna PDF.

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

Website and Internet Contents References
4. https://en.wikipedia.org/wiki/Machine_shop 5. https://www.ameslab.gov/mpc/equipment/machine-shop 6. http://www.nptel.ac.in

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	Website
1	International Journal of Machine tool and manufacture	www.journals.elsevier.com/international-journal-of-machine-tools-and-manufacture
2	International Journal of Mechanical and Materials Engg	http://www.springer.com/engineering/mechanics/journal/40712
3	International Journal of Precision engg and manufacturing	http://www.springer.com/engineering/production+engineering/journal/12541
4	International Journal of Machine tool design and Research	http://www.sciencedirect.com/science/journal/00207357

10.0 Examination Note

Internal Assessment:
Theoretical aspects as well as relevant sketches should be drawn neatly for questions asked in Internal Assessments
Scheme of Evaluation for Internal Assessment (40 Marks)
(d) Internal Assessment test in the same pattern as that of the main examination 40marks.

SCHEME OF EXAMINATION:

One Model from Part-A or Part-C: 30 Marks
One Model from Part-B: 50 Marks
Viva – Voce: 20 Marks
TOTAL: 100 Marks

11.0 Course Delivery Plan

Expt No	Lecture/Practical No	Name of the Experiment	% Of Portion
1	1	Introduction to various fitting tools.	47.61
2	2	Performing fitting operations	
3	3	Introduction to various machine tools.	
4	4	Facing and plain turning, Knurling and thread cutting	
5	5	Taper turning and eccentric turning V groove cutting and rectangular groove cutting	
6	6	To study the indexing and milling machine operation	
7	7	Perform gear tooth cutting on milling machine	
8	8	To understand the cutting tool parameters of single point cutting tool using bench grinder	42.39
9	9	Understand surface milling/slot milling	
10	10	Demonstrate the precautions and safety measures followed in machine shop	
11	11	Kea way cutting/slot cutting on shaper	

12.0 QUESTION BANK

1. 1.Define lathe 2. List the operations performed on the lathe 3. What are the principal parts of the lathe? 4. Various parts mounted on the lathe? 5. Mention the types of head stock 6. Mention the four types of tool post 7. What is an apron? 8. Mention the specifications of the lathe 9. List the types of lathe 10. Define semi automatic lathe 11. State the various feed mechanisms of the lathe 12. List 4 holding devices 13. Define 'Conicity'? 14. Advantages of capstan lathe and turret lathe. 15. Define tooling 16. What are 3 stage tool layout 17. Define shaper 18. List and explain Important parts of shaper. 19. Driving Mechanism involved in shaper 20. List and explain Shaping operations 21. Principle of shaping 22. Classification of shaping machine 23. Specifications of milling machine 24. Specifications of milling machine	25. Comparison between universal and plain milling machine 26. What are cutter holding devices 27. Operations of milling machines and explain each of them. 28. Milling cutter nomenclature 29. Advantages of milling machine 30. Define indexing 31. Explain Universal dividing head 32. What is cam milling? 33. Explain spur gear cutting 34. Various parts of single point cutting tool 35. Define tool signature 36. What is the effect of back rake angle and mention its type 37. What is side rake angle and mention its effects? 38. Conditions for positive rake angle 39. Conditions for negative rake angle 40. Define orthogonal and oblique cutting 41. Define cutting force 42. Chip thickness ratio 43. Factors affecting machinability 44. Define machinabilty of metal? 45. What is machinabilty index? 46. How tool life is defined

13.0 University Result

Examination	FCD	FC	SC	% Passing
July 2018	61	00	00	100
July 2017	59	05	01	100

Prepared by	Checked by		
Prof.M A Hipparagi	Prof.M A Hipparagi	HOD	Principal