Ref No:

< SRI KRISHNA INSTITUTE OF TECHNOLOGY, BENGALURU>

COURSE PLAN

Academic Year 2019-20

Program:	B E – Mechanical Engineering
Semester :	3
Course Code:	18ME32
Course Title:	Mechanics of Materials
Credit / L-T-P:	4 / 3-2-0
Total Contact Hours:	50
Course Plan Author:	CHANDRAIAH M T

Academic Evaluation and Monitoring Cell

< #29, Hesaraghatta Main road, Chimney Hills, Chikkabanavara P.O.,
Bengaluru – 560090, Karnataka, INDIA
Phone / Fax :+91 80 23721477 -STD- 080 23721315>

<http://www.skit.org.in: skit1princi@gmail.com: >

Table of Contents

Note : Remove “Table of Content” before including in CP Book
Each Course Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

18ME32: Mechanics of Materials

A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	ME
Semester:	3	Academic Year:	2019-20
Course Title:	Mechanics of Materials	Course Code:	18ME32
Credit / L-T-P:	4 / 3-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Chandraiah M T	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : 80 %	SEE Target:	65%

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute. Identify 2 concepts per module as in G.

Module	Content	Teaching Hours	Identified Module Concepts	Blooms Learning Levels
1	Stress, strain, Hook's Law, Poisson's ratio and their relations mechanical properties of engineering materials including elastic constants and their relations, thermal stress and strains and their relation Determine stresses, strains and deformations in bars with varying circular and rectangular cross-sections subjected to normal and temperature loads	10 (4,6)	-Uni axial stresses & strains - Deformation	UnderstandL2, Apply L3,
2	Plane stress and strain, major and minor principle stresses and their planes, maximum shear stress and their planes, Hoop's stress, Longitudinal stress, Radial stress. Determine principal stress, maximum shear stress and their orientations using analytical method and Mohr' circle method and dimensions of thick and thin cylinder and also stress distribution in thick and thin cylinders.	10 (5,5)	-Biaxial stresses -Hoop's & Radial Stresses	L3 Apply, L3 Apply,
4	Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts Maximum Principal Stress theory, Maximum shear stress theory	10 (5,5)	- Torque & Twist -Theories of failure	L3 Apply, L3 Apply,
5	Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions and also dimensions of elastic stability of columns using Rankin's and Euler's theory Castigliano's theorem I and II, Load deformation diagram, Strain energy due to normal stresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion	10 (5,5)	-Crippling load -Strain energy	L3 Apply, L3 Apply,
3	Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples. And also bending stress, shear stress and its distribution in beams of circular, rectangular, symmetrical I and T sections subjected to point loads and UDL Types of beams, loads, supports, relation between load, force and moment, Pure bending, Curvature of a beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections	10 (5,5)	- Shear force & Bending Moment - Bending stress distribution	L3 Apply, L3 Apply,
-	**Total**	**50**	-	-

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).

1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source

3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
1,2,3,4, 5	Strength of Material, James M Gere, Barry J Goodno, Indian Edition, Cengage Learning, 2009	1, 2 3, 5,7,9,11, 13,14	In Lib / In Dept
1,2,3,4, 5	Strength of Materials, R Subramanian , Oxford. 2005	1, 2, 3, 4, 5,8,9,11	In Lib/ In Dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	-	-
1,2,3,4, 5	Strength of Materials,S S Rattan, Second Edition, McGraw Hill, 2011.	1, 2, 4, 5,6,8,11, 12,	In Lib
1,2,3,4, 5	Mechanics of Materials, Ferdinand Beer and russell Johnston, Tata McGraw Hill. 2003	1, 2, 3, 5,7,9,10, 12	In Lib
C	**Concept Videos or Simulation for Understanding**	-	-
C1	https://www.youtube.com/watch?v=cMdVzMRWZTk -17.23 Mins		
C2	https://www.youtube.com/watch?v=SBiU3M7Dl6s -3.14 Mins		
C3	https://www.youtube.com/watch?v=C207JS-HM4Q -8.27 Mins		
C4	https://www.youtube.com/watch?v=Ja03J1RQ3Hw -8.38 Mins		
C5	https://www.youtube.com/watch?v=ICDZ5uLGrI4 -5.26 Mins		
C6	https://www.youtube.com/watch?v=qbv2rOEMyiA -13.36 Mins		
C7	https://www.youtube.com/watch?v=Fzjd-6hzVko -7.27 Mins		
C8	https://www.youtube.com/watch?v=WB__FR_l_LU -22.22 Mins		
C9	https://www.youtube.com/watch?v=UahfUvcS24o -16.42 Mins		
C10	https://www.youtube.com/watch?v=xGPGrS-k6eo -10.31 Mins		
D	**Software Tools for Design**	-	-
1	https://www.youtube.com/watch?v=bMZaiTsMo-U -3.58 Mins		
E	**Recent Developments for Research**	-	-
1	https://www.youtube.com/watch?v=J0ZMi83oUjk -4.38 Mins		
F	**Others (Web, Video, Simulation, Notes etc.)**	-	-
1	https://www.youtube.com/watch?v=I1lNUlKj8P8 -10.38 Mins		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	18CIV13/ 23	Elements of Civil Engineering	1. Knowledge force, Moments	1/2		L3

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Advanced strength of materials nptel.ac.in/courses/112101095/	Higher Study, Gate	Gap	Apply L3
-				

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs. Identify a max of 2 Concepts per Module. Write 1 CO per Concept.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
1	18ME32.1	Understand simple, thermal stresses & strains and their relations	04	Unidirectional Stresses & Strain	Chalk and Board	Assignment, Unit Test & CIE	L2 Understand
1	18ME32.2	Determine the stress, strain and deformation in bars with varying cross section and temperature change	06	Deformation	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
2	18ME32.3	Determine principal stresses and planes using analytical and graphical method.	05	Biaxial Stresses	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
2	18ME32.4	Determine stress distribution in thick and thin cylinder	05	Hoop's & Radial Stress	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
3	18ME32.5	Determine, torsional strength, rigidity, flexibility & dimensions of shaft	05	Torque & Twist	Chalk and Board	Assignment, Unit Test & CIE	L2 Apply
3	18ME32.6	Determine dimensions of bars, beams & rods using Maximum principal & Maximum Shear stress theory of failure	05	Theories of failure	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
4	18ME32.7	Determine elastic stability of columns using Rankine's & Euler's theory	05	Crippling load	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
4	18ME32.8	Determine dimensions of bars, beams & rods using strain energy methods	05	Strain energy methods	Chalk and Talk	Assignment & CIE	L3 Apply
5	18ME32.9	Draw shear force diagram & Bending moment diagram for a Simply supported beam & cantilever beam with point load, UDL & UVL	05	Shear force, & Bending moment	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
5	18ME32.10	Determine the bending stress distribution of rectangular, symmetrical I &T section	05	Bending stress distribution	Chalk and Board	Assignment, Unit Test & CIE	L3 Apply
-	**-**	**Total**	**50**	-	**-**	**-**	**L2-L3**

2. Course Applications

Write 1 or 2 applications per CO.

Students should be able to employ / apply the course learning's to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Stress and strain to find an application in analyzing as structure	CO1	L2

1	Structural analysis	CO2	L3
2	Combined loading in structural and machine parts	CO3	L3
2	Pressure vessels	CO4	L3
4	Design of shaft	CO5	L3
4	Failure theories analysis	CO6	L3
5	Design of columns	CO7	L3
5	Strain energy stored in the materials	CO8	L3
3	Design of Bridges,	CO9	L3
3	Structural analysis in the field of construction of bridges, etc.	CO10	L3

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.
To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Modules	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
1	CO1	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Stress and strain is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L2
1	CO1	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of relation between stress and strain to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
1	CO2	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Deformation of materials is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
1	CO2	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of deformation of different section of materials to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
2	CO3	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Compound stresses is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
2	CO3	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of Biaxial loads to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
2	CO4	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Hoop Stress and radial stress is essential to accomplish in stress distribution thin and thick cylinder	L3
2	CO4	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of Hoops and radial load to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
3	CO5	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Torque and twist is essential to accomplish dimensions of solid and hollow shafts in Mechanical Engineering.	L3
3	CO5	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of torque and twist to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
3	CO6	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Theories of failure is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
3	CO6	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of theories of failure to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
4	CO7	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of crippling load is essential to accomplish different end condition of columns.	L3
4	CO7	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of Crippling load to accomplish different end condition of columns.	L3
4	CO8	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Strain energy is essential to accomplish solutions to find the energy absorption in different load condition	L3

4	CO8	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of Strain energy to accomplish solutions to find the energy absorption in different load condition	L3
5	CO9	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of SFD and BMD is essential to accomplish solutions to beams with different load condition	L3
5	CO9	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of SFD and BMD to accomplish solutions to beams with different load condition	L3
5	CO10	PO1	3	'Engineering Knowledge:' - Acquisition of Engineering Knowledge of Bending stress is essential to accomplish solutions to complex engineering problems in Mechanical Engineering.	L3
5	CO10	PO2	2	Problem Analysis': Analyzing problems require knowledge / understanding of bending stress distributionto accomplish solutions to complex engineering problems in Mechanical Engineering.	L3

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes															-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18ME32.1	Understand simple, thermal stresses & strains and their relations	3															L2
1	18ME32.2	Determine the stress, strain and deformation in bars with varying cross section and temperature change	3	2														L3
2	18ME32.3	Determine principal stresses and planes using analytical and graphical method.	3	2														L3
2	18ME32.4	Determine stress distribution in thick and thin cylinder	3	2														L3
3	18ME32.5	Determine, torsional strength, rigidity, flexibility & dimensions of shaft	3	2														L3
3	18ME32.6	Determine dimensions of bars, beams & rods using Maximum principal & Maximum Shear stress theory of failure	3	2														L3
4	18ME32.7	Determine elastic stability of columns using Rankine's & Euler's theory	3	2														L3
4	18ME32.8	Determine dimensions of bars, beams & rods using strain energy methods	3	2														L3
5	18ME32.9	Draw shear force diagram & Bending moment diagram for a Simply supported beam & cantilever beam with point load, UDL & UVL	3	2														L3
5	18ME32.10	Determine the bending stress distribution of circular, rectangular symmetrical I &T section	3	2														L3
-	**18ME32**	**Average attainment (1, 2, or 3)**	**3**	**2**														-
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

5. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Advanced mechanics	Seminar	2nd Nov 2019	Dr. M H Annaiah	PO1

				Prof. And Vice Principal SCE, Bengaluru	

6. Content Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Modules	Gap Topic	Area	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Advances in Construction of beams and columns	Placement, GATE, Higher Study, Entrepreneurship.	Presentation	11th Nov 2018	Mr. Gowtham	PO9

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation. Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Stresses and Strain	10	2	-	-	1	1	2	CO1, CO2	L2, L3
2	Analysis of Stress and Strain and Cylinders	10	2		-	1	1	2	CO3, CO4	L3
4	Torsion and Theories of Failure	10	-	2	-	1	1	2	CO5, CO6	L3
5	Columns and strain Energy	10	-	2	-	1	1	2	CO7, C08	L3
3	Shear Force and Bending Moment and stresses in beams	10	-	-	4	1	1	2	CO9, CO10	L3
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

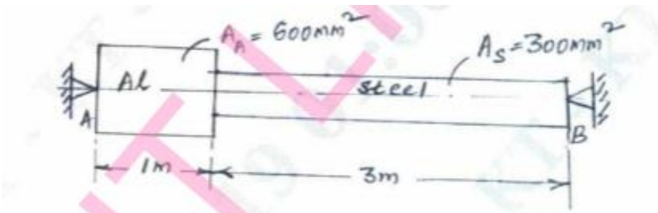
Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2, CO3,Co4	L2,L3,L3,L3
4, 5	CIA Exam – 2	30	CO5, CO6, CO7, C08	L3,L3,L3,L3
3	CIA Exam – 3	30	CO9, CO10	L3,L3
1, 2	Assignment - 1	10	CO1, CO2, CO3,Co4	L2,L3,L3,L3

4, 5	Assignment - 2	10	CO5, CO6, CO7, C08	L3,L3,L3,L3
3	Assignment - 3	10	CO9, CO10	L3,L3
1, 2	Seminar - 1		-	-
4, 5	Seminar - 2		-	-
3	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
4, 5	Quiz - 2		-	-
3	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-	-	-
	Final CIA Marks	**40**	**-**	**-**

D1. TEACHING PLAN - 1

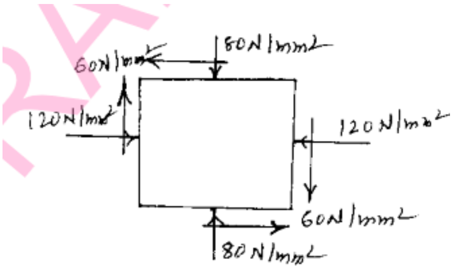
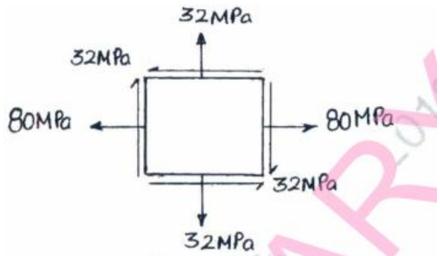
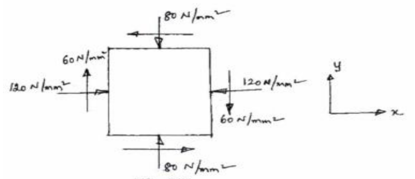
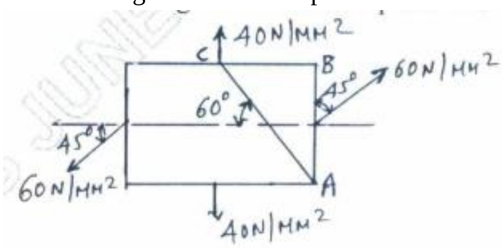
Module - 1

Title:	Stress & Strain	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Understand simple, thermal stresses & strains and their relations	CO1	L2
2	Determine the stress, strain and deformation in bars with varying cross section and temperature change	CO2	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	Introduction to Stress & Strain, Hooke's law	C01	L2
2	Calculation of stresses in straight bar & stepped bar	C01	L3
3	Calculation of stresses in tapered sections	C01	L3
4	Composite sections & problems	C01	L3
5	Stresses due to temperature changes	C01	L3
6	Shear stress & strain,	C01	L2
7	Lateral strain, Poisson's ratio, Generalized Hooke's law	C02	L2
8	Bulk modulus, relation between elastic constants	C02	L2
9	Problems	C02	L3
10	Problems	C02	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learning's to . . .	-	-
1	Stress and strain to find an application in analyzing as structure	CO1	L2
2	Structural analysis	CO2	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Define I) Hooke's law (ii) Poisson's ratio (iii) Volumetric strain (iv) Modulus of rigidity v)	CO1	L1

	Normal stress vi) Shear stress vii) Factor of safety viii) Bulk Modulus ix) Modulus of elasticity x) Elasticity xi) plasticity xii) Resilience xiii) Toughness xvi) stiffness,		
2	The tensile test was conducted on mild steel bar. The following data was obtained from the test, Diameter of steel bar = 16 mm, Load at proportionality limit = 72 KN , Load at failure = 80 KN, diameter of the rod at failure = 12mm, gauge length of the bar = 80 mm, extension at load of 60 KN = 0.115 mm, Final gauge length of bar = 104 mm. Determine (I) Young's modulus (ii) Proportionality limit (iii) Percentage elongation (iv) Percentage decrease in area (v) Breaking stress.	CO1	L3
3	Draw and explain stress-strain diagram of a mild steel specimen subjected to tension test. Mark the salient points on it.	CO1	L2
4	A circular rod of 100mm diameter and 500 mm length is subjected to a tensile load of 1000 KN. Determine the I) Modulus of rigidity ii) Bulk modulus iii) Change in volume. Take Poisson's ratio = 0.30 and E = 200 GPa.	CO2	L3
5	Derive a relation between modulus of elasticity and bulk modulus.	CO2	L2
6	A bar of brass 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The bar and the tube fastened at the ends and are 1.5m long. Find the stresses in the two materials when the temperature raises from 30^0 C to 80^o C	CO2	L3
7	Derive an expression for total extension of tapering circular bar cross section of diameter 'D' and 'd' when subjected to an axial pull of load P	CO1	L2
8	Derive an expression for extension of bar due to its self weight only having area A and length L suspended from its top.	CO1	L3
9	Derive an expression for volumetric strain of rectangular bar subjected to normal stress along its axis.	CO1	L2
10	Derive the relationship between modulus of rigidity and Young's modulus of elasticity and define elastic constants.	CO1	L2
11	The modulus of rigidity for a material is 51 GPa. A 10 mm diameter rod of the material was subjected to an axial load of 10KN and the change in diameter was observed to be 3 x 10^{-3} mm. Calculate the Poisson's ratio and the modulus of elasticity.	CO2	L3
12	A concrete column is of square section with 250 mm size and is reinforced with 08 steel bars of 16 mm diameter. The member supports an axial load of 270 KN. Evaluate the stresses in steel and concrete assuming a modular ratio as 18	CO2	L3
13	Derive an expression for the deformation of tapering circular bar subjected to axial force.	CO1	L2
14	When a bar of 25 mm diameter is subjected to pull of 61KN, the extension on a 50 mm gauge length is 0.1 mm and decrease in diameter is 0.013 mm. Calculate the values of elastic constants E, G, K and μ.	CO2	L3
15	A compound bar is made up of a central aluminium plate 24mm wide and 6mm thick to which steel plates of 24mm wide and 9mm thick are connected rigidly on each side. The length of compound bar at temperature 20 °C is 100mm. If the temperature of the whole assembly is raised by 60°C, determine the stress in each of the material. If at the new temperature a compressive load of 20kN is applied to the composite bar. What are the final stresses in steel and aluminum? Given Es = 2 x 10^5 N/mm^2, E_A = — 2 X 10^5 N/mm^2 a_s = 12 X 1 0^{-6} °C and a_A = 23 x 10^{-6} / °C.	CO2	L3
16	A composite bar is rigidly fitted at the supports A and B as shown in Fig. Determine the reactions at the supports when temperature rises by 20°. Take EA = 70 GPa, Es = 200 CPA, a_A = 11 x 10-6/°C and a_s = 12 x 10-61"C 	CO2	L3
e	**Experiences**	-	-
1		CO1	L2
2			
3			
4		CO2	L2
5			

Module – 2

Title:	Analysis of Stress and Strain and Cylinders	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Determine principal stresses and planes using analytical and graphical method.	CO3	L4
2	Determine stress distribution In thick and thin cylinder	CO4	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
11	Plane stress, stresses on inclined planes	CO3	L2
12	Principal stresses and maximum shear stress principal angles	CO3	L2
13	Shear stresses on principal planes, Maximum shear stress	CO3	L3
14	Mohr's circle for plane stress conditions.	CO3	L3
15	Problems on Mohr's Circle	CO3	L3
16	Thin Cylinder Hoop's stress Maximum shear stress	CO4	L2
17	Circumferential and longitudinal strains	CO4	L2
18	Problems on thin cylinder	CO4	L3
19	Thick cylinders Lames equation	CO4	L2
20	Problems on thick cylinder	CO4	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Combined loading in structural and machine parts	CO3	L3
2	Pressure vessels	CO4	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
17	A tension member is formed by connecting two wooden scantling each 75mm x 150 mm at their ends, which are cut at an angle of 60^o as shown in Fig.15. The member is subjected to a pull F. Find the safe value of F, if the permissible normal and shear stress in the glue are $1.5 N/mm^2$ and $1 N/mm^2$ respectively.	CO3	L3
18	A point in a strained material is subjected to a tensile stress of $500 N/mm^2$ and $300 N/mm^2$ in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliquity on a plane making an angle of 30^o with the axis of the second stress. Also find the maximum shear stress.	CO4	L3
19	A point in a plate grinder is subjected to a horizontal tensile stress of $100 N/mm^2$ and vertical shear stress of $60 N/mm^2$. Find the magnitude of principal stresses and its location.	CO3	L3
20	The state of stress in a two dimensionally stressed body is as shown in Fig. Determine (I) Normal stress on maximum shear stress on plane AC. ii) Principal stresses, principal planes and maximum shear stress and its location iii) Normal stress on maximum shear stress plane. iv) Verify answers by Mohr's circle method.	CO3	L2

			
21	An element is subjected to stresses as shown in Fig. determine I) Principal stresses and their directions.. ii) Normal and tangential stress on plane AC 	CO3	L3
22	Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the plane. The greatest principal stress at the point due to these is 150 N/mm^2. Determine (I) Magnitude of shearing stress on the two planes. (ii) Maximum shearing stress at the point.	CO3	L2
23	The state of stress at a point in a strained material is as shown in Fig. Q3 (a). Determine : (i) The magnitude of principal stresses. (ii) The direction of principal stresses and (iii) The magnitude of the maximum shear stress and its direction. Indicate all the planes by a sketch.  Fig.Q3	CO3	L3
24	A point in a strained material in subjected to a tensile stress of 500N/mm` and 300N/mm^2 in a two mutually perpendicular planes and also these planes carries a shear stress of 100N/mm^2. Calculate the normal, tangential, resultant stresses on a plane making an angle of 30^{0}C with the vertical axis (x-plane). Also find principal stresses.	CO3	L3
25	An element is subjected to stresses as shown in Fig. Determine: i) Principal stresses and their directions ii) Normal and tangential stress on plane AC 	CO3	L3
26	At a Certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa, both tensile and there is a shear stress of 32 MPa cw on the plane carrying 80 MPa stresses across the planes. Determine (I) Maximum and minimum stresses and locate their planes. (ii) Maximum shear stress and specify its plane. (iii) Normal stress on maximum shear stress plane. (iv) Verify the answer by Mohr's circle method.	CO3	L3
27	Obtain an expression for volumetric strain in case of thin cylindrical shell of internal diameter 'd' subjected to internal pressure 'p'.	CO4	L2
28	Derive Lame's equation for radial and hoop stress in case of thick cylinders.	CO4	L2

29	For a thin cylinder subjected to internal pressure 'p' prove that the circumferential stress = $\frac{pd}{2t}$ and longitudinal stress = $\frac{pd}{4t}$ where 'd' is internal diameter and 't' is thickness of wall.	CO4	L2
30	The maximum stress permitted in a thick cylinder radii 200 mm and 300 mm is 16 N/mm^2. If the internal pressure is 12 N/mm^2 , what external pressure can be applied? Plot curves showing the variations of hoop and radial stresses through the material.	CO4	L3
31	A thick metallic cylindrical shell is 150 mm internal diameter is required to with stand an internal pressure of 8 MPa. Find the necessary thickness of shell if permissible tensile stress in the section is 20 MPa.	CO4	L3
32	A Cylindrical pressure vessel has inner and outer diameter 340 mm and 440 mm respectively. Taking allowable stress for the material of the cylinder as 50 N/mm^2, determine (I) Maximum value of external pressure that can be applied (ii) Circumferential stress induced in the outer surface.	CO4	L3
33	A Cylindrical pressure vessel of 250 mm inner radius Is subjected to internal pressure of 10 N/mm^2 allowable stress for the material of the cylinder is 40 N/mm^2. Determine (I) Wall thickness of cylinder (ii) percentage error involved when the thickness is calculated based on thin cylinder.	CO4	L3
34	A thin cylindrical shell of 1200 mm diameter, 15 mm thick and 6m long is subjected to internal fluid pressure of 2.5 N/mm^2 E = $2x10^5$ N/mm^2, $\frac{1}{m}$=0.3. Calculate (I) Change in diameter, (ii) change in length, (iii) change in volume	CO4	L3
35	A cylindrical pipe of diameter 2m and wall thickness 20 mm is subjected to an internal fluid pressure of 1.5 N/mm^2, Determine (I) Longitudinal stress and (ii) Circumferential stress developed in the pipe material.	CO4	L3
36	A thin cylindrical shell 2m long has 200 mm internal diameter and thickness of metal 10 mm. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in find the pressure developed and hoop stress developed. Also find the change in diameter and length. E = $2x10^5$ N/mm^2 and $\frac{1}{m}$= 0.3	CO4	L3
e	**Experiences**	-	-
1		CO3	L2
2			
3			
4		CO4	L2
5			

E1. CIA EXAM – 1

a. Model Question Paper - 1

Crs Code:	18ME32	Sem:	3	Marks:	30	Time:	90 minutes
Course:	Mechanics of Materials						

-	-	**Note: Answer all questions, each carry equal marks. Module : 1, 2**	**Marks**	**CO**	**Level**
1	a	Derive the relationship between young's Modulus, Bulk Modulus, and Shear Modulus	6	CO2	L2
	b	The tensile test was conducted on mild steel bar. The following data was obtained from the test, Diameter of steel bar = 16 mm, Load at proportionality limit = 72 KN , Load at failure = 80 KN, diameter of the rod at failure = 12mm, gauge length of the bar = 80 mm, extension at load of 60 KN = 0.115 mm, Final gauge length of bar = 104 mm. Determine (I) Young's modulus (ii) Proportionality limit (iii) Percentage elongation (iv) Percentage decrease in area (v) Breaking stress.	9	CO1	L3
2	a	Derive an expression for total extension of tapering circular bar cross section of diameter 'D' and 'd' when subjected to an axial pull of load P	5	CO1	L2
	b	A concrete column is of square section with 250 mm size and is reinforced with 08 steel bars of 16 mm diameter. The member supports an axial load of 270 KN. Evaluate the stresses in steel and concrete assuming a modular ratio as 18	10	CO2	L3
3	a	Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the plane. The greatest principal stress at the point due to these is 150 N/mm^2. Determine (I) Magnitude of shearing stress on the two planes. (ii) Maximum shearing stress at the point.	7	CO3	L3
	b	Obtain an expression for volumetric strain in case of thin cylindrical shell of internal diameter 'd' subjected to internal pressure 'p'.	5	CO4	L2
4	a	At a Certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa, both tensile and there is a shear stress of 32 MPa cw on the plane carrying 80 MPa stresses across the planes. Determine (I) Maximum and minimum stresses and locate their planes. (ii) Maximum shear stress and specify its plane. (iii) Normal stress on maximum shear stress plane. (iv) Verify the answer by Mohr's circle method.	7	CO3	L3
	b	A Cylindrical pressure vessel of 250 mm inner radius Is subjected to internal pressure of 10 N/mm^2 allowable stress for the material of the cylinder is 40 N/mm^2. Determine (I) Wall thickness of cylinder (ii) percentage error involved when the thickness is calculated based on thin cylinder.	8	CO4	L3

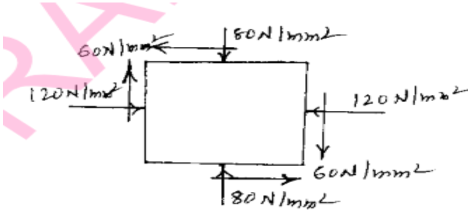
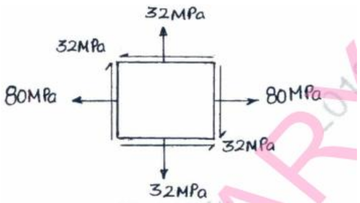
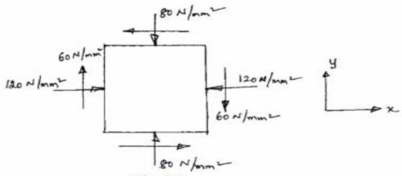
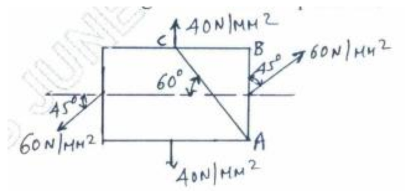
b. Assignment -1

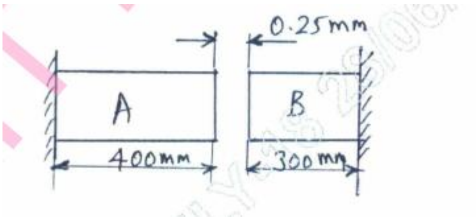
Note: A distinct assignment to be assigned to each student.

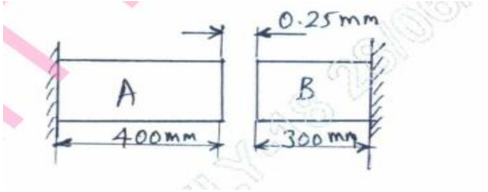
Model Assignment Questions							
Crs Code:	18ME32	Sem:	3	Marks:	10	Time:	90 – 120 minutes
Course:	Mechanics of Materials			Module : 1, 2			
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	**USN**	**Assignment Description**	**Marks**	**CO**	**Level**

1		Define I) Hooke's law (ii) Poisson's ratio (iii) Volumetric strain (iv) Modulus of rigidity v) Normal stress vi) Shear stress vii) Factor of safety viii) Bulk Modulus ix) Modulus of elasticity x) Elasticity xi) plasticity xii) Resilience xiii) Toughness xvi) stiffness,	10	CO1	L1
2		The tensile test was conducted on mild steel bar. The following data was obtained from the test, Diameter of steel bar = 16 mm, Load at proportionality limit = 72 KN , Load at failure = 80 KN, diameter of the rod at failure = 12mm, gauge length of the bar = 80 mm, extension at load of 60 KN = 0.115 mm, Final gauge length of bar = 104 mm. Determine (I) Young's modulus (ii) Proportionality limit (iii) Percentage elongation (iv) Percentage decrease in area (v) Breaking stress.	10	CO1	L3
3		Draw and explain stress-strain diagram of a mild steel specimen subjected to tension test. Mark the salient points on it.	10	CO1	L2
4		A circular rod of 100mm diameter and 500 mm length is subjected to a tensile load of 1000 KN. Determine the I) Modulus of rigidity ii) Bulk modulus iii) Change in volume. Take Poisson's ratio = 0.30 and E = 200 GPa.	10	CO2	L3
5		Derive a relation between modulus of elasticity and bulk modulus.	10	CO2	L2
6		A bar of brass 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The bar and the tube fastened at the ends and are 1.5m long. Find the stresses in the two materials when the temperature raises from 30^0 C to 80^o C	10	CO2	L3
7		Derive an expression for total extension of tapering circular bar cross section of diameter 'D' and 'd' when subjected to an axial pull of load P	10	CO1	L2
8		Derive an expression for extension of bar due to its self weight only having area A and length L suspended from its top.	10	CO1	L3
9		Derive an expression for volumetric strain of rectangular bar subjected to normal stress along its axis.	10	CO1	L2
10		Derive the relationship between modulus of rigidity and Young's modulus of elasticity and define elastic constants.	10	CO1	L2
11		The modulus of rigidity for a material is 51 GPa. A 10 mm diameter rod of the material was subjected to an axial load of 10KN and the change in diameter was observed to be 3 x 10^{-3} mm. Calculate the Poisson's ratio and the modulus of elasticity.	10	CO2	L3
12		A concrete column is of square section with 250 mm size and is reinforced with 08 steel bars of 16 mm diameter. The member supports an axial load of 270 KN. Evaluate the stresses in steel and concrete assuming a modular ratio as 18	10	CO2	L3
13		Derive an expression for the deformation of tapering circular bar subjected to axial force.	10	CO1	L2
14		When a bar of 25 mm diameter is subjected to pull of 61KN, the extension on a 50 mm gauge length is 0.1 mm and decrease in diameter is 0.013 mm. Calculate the values of elastic constants E, G, K and μ.	10	CO2	L3
15		Derive the relationship between Young's Modulus and Shear Modulus	10	CO2	L2
16		A tension member is formed by connecting two wooden scantling each 75mm x 150 mm at their ends, which are cut at an angle of 60^o as shown in Fig.15. The member is subjected to a pull F. Find the safe value of F, if the permissible normal and shear stress in the glue are 1.5N/mm^2 and 1 N/mm^2 respectively.	10	CO3	L3
17		A point in a strained material is subjected to a tensile stress of 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate the normal, tangential, resultant stresses and its obliquity on a plane making an angle of 30^o with the axis of the second stress. Also find the maximum shear stress.	10	CO4	L3
18		A point in a plate grinder is subjected to a horizontal tensile stress of 100 N/mm^2 and vertical shear stress of 60 N/mm^2. Find the magnitude of principal stresses and its location.	10	CO3	L3
19		The state of stress in a two dimensionally stressed body is as shown in Fig. Determine (I) Normal stress on maximum shear stress on plane AC. ii) Principal stresses, principal planes and maximum shear stress	10	CO3	L2

		and its location iii) Normal stress on maximum shear stress plane. iv) Verify answers by Mohr's circle method. 			
20		An element is subjected to stresses as shown in Fig. determine I) Principal stresses and their directions.. ii) Normal and tangential stress on plane AC 	10	CO3	L3
21		Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the plane. The greatest principal stress at the point due to these is 150 N/mm^2. Determine (I) Magnitude of shearing stress on the two planes. (ii) Maximum shearing stress at the point.	10	CO3	L2
22		The state of stress at a point in a strained material is as shown in Fig. Q3 (a). Determine : (i) The magnitude of principal stresses. (ii) The direction of principal stresses and (iii) The magnitude of the maximum shear stress and its direction. Indicate all the planes by a sketch.  Fig.Q3	10	CO3	L3
23		A point in a strained material in subjected to a tensile stress of 500N/mm` and 300N/mm^2 in a two mutually perpendicular planes and also these planes carries a shear stress of 100N/mm^2. Calculate the normal, tangential, resultant stresses on a plane making an angle of 30^{0}C with the vertical axis (x-plane). Also find principal stresses.	10	CO3	L3
24		An element is subjected to stresses as shown in Fig. Determine: i) Principal stresses and their directions ii) Normal and tangential stress on plane AC 	10	CO3	L3
25		At a Certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa, both tensile and there is a shear stress of 32 MPa cw on the plane carrying 80 MPa stresses across the planes. Determine (I) Maximum and minimum stresses and locate their planes. (ii) Maximum shear stress and specify its plane. (iii) Normal stress on maximum shear stress plane. (iv) Verify the answer by Mohr's circle method.	10	CO3	L3
26		Obtain an expression for volumetric strain in case of thin cylindrical shell of internal diameter 'd' subjected to internal pressure 'p'.	10	CO4	L2

27		Derive Lame's equation for radial and hoop stress in case of thick cylinders.	10	CO4	L2
28		For a thin cylinder subjected to internal pressure 'p' prove that the circumferential stress = $\frac{pd}{2t}$ and longitudinal stress = $\frac{pd}{4t}$ where 'd' is internal diameter and 't' is thickness of wall.	10	CO4	L2
29		The maximum stress permitted in a thick cylinder radii 200 mm and 300 mm is 16 N/mm^2. If the internal pressure is 12 N/mm^2 , what external pressure can be applied? Plot curves showing the variations of hoop and radial stresses through the material.	10	CO4	L3
30		A thick metallic cylindrical shell is 150 mm internal diameter is required to with stand an internal pressure of 8 MPa. Find the necessary thickness of shell if permissible tensile stress in the section is 20 MPa.	10	CO4	L3
31		A Cylindrical pressure vessel has inner and outer diameter 340 mm and 440 mm respectively. Taking allowable stress for the material of the cylinder as 50 N/mm^2, determine (I) Maximum value of external pressure that can be applied (ii) Circumferential stress induced in the outer surface.	10	CO4	L3
32		A Cylindrical pressure vessel of 250 mm inner radius Is subjected to internal pressure of 10 N/mm^2 allowable stress for the material of the cylinder is 40 N/mm^2. Determine (I) Wall thickness of cylinder (ii) percentage error involved when the thickness is calculated based on thin cylinder.	10	CO4	L3
33		A thin cylindrical shell of 1200 mm diameter, 15 mm thick and 6m long is subjected to internal fluid pressure of 2.5 N/mm^2 E = 2x10^5 N/mm^2, $\frac{1}{m}$=0.3. Calculate (I) Change in diameter, (ii) change in length, (iii) change in volume	10	CO4	L3
34		A cylindrical pipe of diameter 2m and wall thickness 20 mm is subjected to an internal fluid pressure of 1.5 N/mm^2, Determine (I) Longitudinal stress and (ii) Circumferential stress developed in the pipe material.	10	CO4	L3
35		A thin cylindrical shell 2m long has 200 mm internal diameter and thickness of metal 10 mm. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in find the pressure developed and hoop stress developed. Also find the change in diameter and length. E = 2x10^5 N/mm^2 and $\frac{1}{m}$= 0.3	10	CO4	L3
36		A room temperature the gap between bar A and bar B shown in Fig is 0.25 mm. What are the stresses induced in the bars , if temperature rise is 35^{o}C. Given, A_A= 1000 mm^2; A_B= 800 mm^2; E_A= 200GPa; E_B= 100 GPa; α_a= 12 x 10^{-6} per ^{o}C;α_b= 23 x 10^{-6} per ^{o}C; L_A = 400 mm; L_B = 300 mm; 	10	CO2	L3
37		A composite bar shown in Fig. Is 0.25 mm short of distance between the rigid supports at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find stresses induced when temperature rise is 400^{o}C. Given α_s= 12 x 10^{-6} per ^{o}C; α_c= 17.5 x 10^{-6} per ^{o}C; E_s = 2 x 10^5 N/mm^2; E_c = 1.2 x 10^5 N/mm^2; A_s:A_c = 4:3	10	CO2	L3

		 Steel Copper			
38		A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it i rigidly joined at each end. If, at a temperature of 10°C there c is no longitudinal stress, calculate stresses in rod and tube when the temperature is raised to 200°C. Take E for steel and copper as 2.1x105 N/rnm2 and lx105N/mm2 respectively. The value of α for steel and copper is given as $11x10^{-6}/^{0}$ *C and 18* $x10^{-6}/^{0}$ C respectively	10	CO2	L3
39		A bar of brass 25mm diameter is enclosed in a steel tube of 50mm external diameter and 25mm internal diameter. The bar and the tube fastened at the ends and are 1.5m long. Find the stresses in the two materials when the temperature raises from 30°C to 80°C. Take : Estee] = 200 GPa 0 — ; Ebrass = 100GPa, α_s 11.6 x 10-6/°C : α_b. 18.7 x 10^{-6}/°C.	10	CO2	L3
40		A Composite bar made up of aluminium and steel is held between two supports as shown in Fig. The bars are stress free at temperature 42^oC. What will be the stresses in the two bars with the temperature drops to 24^oC if (a) The supports are unyielding (b) The support comes nearer to each other by 0.1 mm. The cross sectional area of steel bar is 160 mm^2 and that of aluminium bar is 240 mm^2. α_A= 24 x 10^{-6} per ^oC; α_s= 12 x 10^{-6} per ^oC; E_A = 0.7 x 10^5 N/mm^2; E_S = 2 x 10^5 N/mm^2	10	CO2	L3
41		A compound bar is made up of a central steel plate 50mm wide and 10mm thick to which copper plates 50 mm wide and 5 mm thick are connected rigidly on each side. The length of compound bar at room temperature is 1000 mm. If the temperature is raised by 100^oC, determine the stress in each material and the change in length of the compound bar. n α_s= 12 x 10^{-6} per ^oC; α_c= 18 x 10^{-6} per ^oC; E_s = 2 x 10^5 N/mm^2; E_c = 1 x 10^5 N/mm^2	10	CO2	L3
42		Determine the change in length, width and thickness of a steel bar which is 4 m long, 30 mm wide and 20 mm thick and is subjected to an axial pull of 30 KN in the direction of length. E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.3. Also determine the volumetric strain, change in volume and final volume of the given bar	10	CO2	L3
43		A steel rod of 4 m long 20 mm diameter is subjected to an xial tensile load of 40 KN. Determine the change in length, diameter and volume of rod . E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.25	10	CO2	L3
44		A metallic bar 250 mm x 80 mm x 30mm is subjected to a force of 20 KN (Tensile), 30 KN (tensile) and 15 KN (tensile) as shown in Fig. Determine the change in volume of the block. Take E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.25	10	CO2	L3
45		A bar 600 mm long is having square section of size 50 mm x 50 mm. If the bar is subjected to an axial load of 120 KN and lateral compression load of 600 KN on faces of size 50 mm x 600 mm, find the change in size and volume. E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.3	10	CO2	L3
46		A bar of 25 mm diameter is tightly fitted into a tube. Find the stresses in the bar and changes in its volume due to a compressive force of 60 KN in the bar if the tube restrain 50 percent of expansion in diameter. Take length of bar = 400 mm, E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.3. also find the change in length and diameter of the bar.	10	CO2	L3
47		A mild steel bar of 200 mm long, 60 mm width and 80 mm depth is subjected to an axial compressive force of 72 KN. Determine the value of the lateral forces necessary to prevent any transverse strain. Also,	10	CO2	L3

		find the alteration or change in length. E = 2 x 10^5 N/mm^2 and poisson's ratio = 0.25			
48		A bar of rectangular cross section 20 mm x 50 mm is 400 mm long and subjected to an axial tensile load of 80 KN. If the modulus of elasticity and modulus of rigidity of the material of bar are 1 x 10^5 N/mm^2 and 0.4 x 10^5 N/mm^2, determine Bulk modulus, change in dimensions and volume.	10	CO2	L3
49		Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 25 mm and length 1.6m, if the longitudinal strain in the bar during tensile test is four times the lateral strain. Also find the change in volume, when the bar is subjected to hydrostatic pressure of 100 N/mm^2. E = 1 x 10^5 N/mm^2.	10	CO2	L3
50		A bar of 20 mm diameter is subjected to a pull of 50 KN. The measured extension on gauge length of 250 mm is 0.12 mm and change in diameter is 0.00375 mm. Determine (I) Young's modulus (ii) Poisson's ratio (iii) Bulk modulus (iv) Modulus of rigidity.	10	CO2	L3

D2. TEACHING PLAN - 2

Module – 4

Title:	Torsion and Theories of failures	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Determine, torsional strength, rigidity , flexibility & dimension of shaft	CO5	L3
2	Determine dimension of bars using theories of failure	CO6	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
21	Circular solid and hallow shafts	CO5	L2
22	Torsional moment of resistance	CO5	L2
23	Power transmission of straight and stepped shafts	CO5	L2
24	Twist in shaft sections, thin tubular section, thin walled sections	CO5	L3
25	Numerical	CO5	L3
26	Maximum Principal stress theory	CO6	L2
27	Numerical	CO6	L3
28	Numerical	CO6	L3
29	Maximum Shear stress theory	CO6	L2
30	Numerical	CO6	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Design of shaft	CO5	L3
2	Failure theories analysis	CO6	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
37	A solid shaft of 250 mm diameter has the same cross sectional area as the hollow shaft of the same material with inside diameter of 200 mm. Determine (I) ratio of power transmitted by the hollow shaft and the solid shaft for the same speed. (ii) Ratio of angle of twist by the hollow shaft and the solid shaft for the same maximum stress.	CO7	L3
38	Show that a hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to 15/16 of that of a solid shaft of same outside diameter.	CO7	L3
39	A solid shaft is required to transmit 300 KW power at 100 rpm. The shear stress of the materiel must not exceed 80 MPa. (I) Determine the diameter of solid shaft (ii) If the shaft is replaced by a hollow one with diameter ratio 3:5 and maximum shear stress remaining unchanged, calculate the percentage saving in weight of the material.	CO5	L3
40	A hollow shaft has to transmit 600 KW power at 80 rpm. The maximum twisting moment	CO5	L3

	may exceed the mean by 40%.Design a suitable section, if the permissible stress is 90 N/mm^2 and the diameter ratio is to be 0.8. What will be the angular twist measured over a length of 2m, if the modulus of rigidity is 84 GPa.		
41	Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft if of solid circular section and second shaft is hollow circular section, whose internal diameter is 0.7 times the outside diameter and the maximum stress developed in each shaft is the same, compare the weight of the shaft	CO5	L3
42	Define polar modulus. Find the expression for polar modulus of a solid shaft	CO5	L2
43	What are the assumptions made in the pure torsion.	CO5	L2
44	Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{Jp} = \frac{\tau}{R} = \frac{G\theta}{l}$	CO5	L2
45	Define the term torsional rigidity and torsional strength.	CO5	L1
46	What do you mean by theories of failure? What is their importance?	CO6	L2
47	Explain the following theories of failure.(i) Maximum normal stress theory (ii) Maximum shear stress theory.	CO6	L2
48	The stress induced at a critical point in a machine component made of steel are as follows : ax = 100N/mm2 , ay = 40N/mm2 , tXy = 80N/mm2. Calculate the factor of safety by i) Maximum shear stress theory ii) Maximum normal stress theory	CO6	L3
49	Find the diameter of round rod subjected to a bending moment of 1.8 kN-m and a torque of 1.2 kN-m, according to i) Maximum normal stress theory ii) Maximum shear stress theory. Take allowable normal stress as 120MPa and allowable shear stress as 72 MPa.	CO6	L3
50	A bolt is acted upon by an axial pull of 16 kN along with a transverse shear force of 10 kN. Determine the diameter of the bolt required, using i) Max. principal stress theory ii) Max. shear stress theory iii) Max. strain theory Elastic limit in tension = 250 MPa Factor of safety = 2.5 Poisson's ratio = 0.3	CO6	L3
51	A plate of 45C8 steel (σyt= 353MPa) is subjected to the following stresses σx = 150 N/mm^2,σy = 100N/mm^2 and τxy = 50N/mm2. Find the factor of safety by i) Rankine's theory ii) Guest's theory.	CO6	L3
e	**Experiences**	-	-
1		CO6	L2
2			
3			
4		CO6	L2
5			

Module – 5

Title:	Columns and Strain Energy	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	A column or pillar in architecture and structural engineering is a structural element that transmits, through compression,	CO7	L3
2	The strain energy in the form of elastic deformation is mostly recoverable in the form of mechanical work.	CO8	L3
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
31	Buckling and stability	CO7	L2
32	Critical load Columns with pinned ends	CO7	L2
33	Columns with other support conditions	CO7	L2
34	Effective length of columns, secant formula for columns	CO7	L2
35	Numerical	CO7	L3
36	Castigliano’s Theorem I and II	CO8	L2
37	Load deformation diagram	CO8	L2
38	Strain energy due to normal stresses, shear stresses modulus of resilience	CO8	L3
39	Strain energy due to bending and torsion.	CO8	L3
40	Numerical	CO8	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Design of columns	CO7	L3
2	Strain energy stored in the materials	CO8	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
52	A 2 m long column with hollow circular section of outer diameter 180 mm is subjected to a load of 212.5 KN. Yield stress for the column material is 340 N/mm^2. One end of the column is fixed and the other end is free. Determine the inner diameter, taking E = 210 GPa and FOS = 4	CO7	L3
53	Determine the buckling load for a strut of ‘T’ section, the flange width being 100 mm, overall depth 80 mm and both flange and web 10 mm thick. The strut is 3m long and is hinged at both ends E = 200 GPa	CO7	L3
54	A column of square section is 2m long and pinned at its ends. Young’s modulus for the column material is 12 GPa and the allowable stress being 12 MPa. Determine the size of column to support a load of 200 KN safely, Using a factor of safety of 3	CO7	L3
55	Find Euler’s crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm wall thickness. Length of column is 2.3m and is hinged at both ends. Also estimate Rankine’s load for this column, Rankine’s parameter are 335 N/mm^2 and 1/7500	CO7	L3
56	Find the length of a mild steel rod 25 mm x 25 mm which can be used as a compression member with one end fixed and the other end free to carry a working load of 40 Kn. Given FOS = 4, $\alpha = \frac{1}{7500} \sigma_c = 320$N/mm^2	CO7	L3
57	A cast iron column 140 mm external diameter and 70 mm internal diameter is 3.5 m long. Calculate the safe axial load the column can carry if both ends are fixed. Take $\sigma_c =$ 600MPa; $\alpha = \frac{1}{1600}$ and factor of safety = 3 use Rankine’s formula	CO7	L3
58	What are the assumption and limitation of Euler’s formula	CO7	L2

59	Define slenderness ration and discuss the importance of slenderness ration on the compressive strength of columns.	CO7	L2
60	What are columns, post, strut and a boom	CO7	L2
61	Derive the expression for Euler's critical load for a long column with both ends fixed.	CO7	L2
62	What is the difference between short and long columns	CO7	L2
63	What is meant by the effective length of a column? State the values of effective length for various column end conditions.	CO7	L2
64	Define the terms, strain energy, resilience and modulus of resilience.	CO8	L2
65	State and prove Castigliano's first theorem.	CO8	L2
66	State and prove Castigliano's Second theorem	CO8	L2
67	A 1.6 m long bar is applied an axial pull such that the maximum stress induced is 140 MPa. The larger and smaller area of cross section are 240 mm^2 and 120 mm^2. Determine the strain energy stored in the bar as shown in Fig 83.	CO8	L3
68	A bar of length 400 mm and diameter 50 mm is subjected to a tensile load of 20 KN. Find the stress, elongation and strain energy produced if the load is applied gradually. What would be the instantaneous stress and elongation if the same load is applied suddenly. Take E = 200 GPa.	CO8	L3
69	A weight of 2 KN falls 24 mm on to a collar fixed to a steel bar 14 mm in diameter and 5.5 m long. Determine he maximum sress induced in the bar due to impact. E = 205 GPa	CO8	L3
70	Calculate the strain energy stored in a bar 2 m long, 50 mm wide and 40 mm thick, when it is subjected to tensile load of 50 KN. Take E = 200 GPa.	CO8	L3
71	A Rectangular body 500mm long, 100mm wide and 50 mm thick is subjected to a shear stress of 80 MPa. Determine the strain energy stored in the body, G = 85 GPa.	CO8	L3
72	A stepped steel rod is in two parts, one has diameter 25 mm. The box is lowered at the rate of 1m/sec. When the freely hanging rope is 12 m, the machine gets load is brought to a stop instantaneously. Find the maximum stress in the rope and the instantaneous deformation due to jamming. Take E = 200 GPa.	CO8	L3
73	A cantilever beam is loaded as shown in Fig. Determine the deflection and slope at the free end by using Castigliano's theorem.	CO8	L3
74	A shaft is in two parts as shown in Fig. Find the total strain energy stored in it Take G = 85 GPa.	CO8	L3
75	A simple beam ACB supporting an uniform load w over the first half of the beam and a couple of moment M_o at end B is shown in Fig. 91. Determine the strain energy U stored in the beam due to the load w and the couple M_o acting simultaneously.	CO8	L3
76	A cantilever beam of uniform cross section carries a point load at the free end. Determine strain energy and deflection at the free end. If F = 200kN, E = 200GPa, L = 3mt and I = $10^{-4}m^4$.	CO8	L3
77	Two bars, each of length and of different materials are each subjected to the same tensile force P. The first bar has a uniform diameter 'D' and the second bar has a diameter of D/2 for a length L/4 and a diameter D for the remaining length. Compare the strain energies of the two bars if, (i) E1/E2=4/7 and (ii) E1 = E2	CO8	L3
78	Define strain energy and Resilience	CO8	L1
e	**Experiences**	-	-
1		CO7	L2
2			
3			
4		CO8	L2
5			

E2. CIA EXAM – 2

a. Model Question Paper - 2

Crs Code:	18ME32	Sem:	III	Marks:	30	Time:	90 minutes
Course:	Mechanics of Materials						

-	-	Note: Answer all questions, each carry equal marks. Module : 4, 5	Marks	CO	Level
1	a	Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{Jp} = \frac{\tau}{R} = \frac{G\theta}{l}$	08	CO5	L2

	b	According to the theory of maximum shear stress, determine the diameter of a bolt which is subjected to an axial pull of 9KN together with a transverse shear force of 4.5 KN. Elastic limit in tension is 225N/mm2, factor of safety=3 & Poisson's ratio=0.3	07	CO6	L3
		OR			
2	a	A solid shaft is required to transmit 300 KW power at 100 rpm. The shear stress of the materiel must not exceed 80 MPa. (I) Determine the diameter of solid shaft (ii) If the shaft is replaced by a hollow one with diameter ratio 3:5 and maximum shear stress remaining unchanged, calculate the percentage saving in weight of the material.	8	CO5	L3
	b	Explain the following theories of failure.(i) Maximum normal stress theory (ii) Maximum shear stress theory.	7	CO6	L2
3	a	A cantilever beam of uniform cross section carries a point load at the free end. Determine strain energy and deflection at the free end. If F = 200kN, E = 200GPa, L = 3mt and I = $10^{-4}m^4$.	7	CO8	L3
	b	A cast iron column 140 mm external diameter and 70 mm internal diameter is 3.5 m long. Calculate the safe axial load the column can carry if both ends are fixed. Take $\sigma_c = 600$MPa; $\alpha = \frac{1}{1600}$and factor of safety = 3 use Rankine’s formula	8	CO7	L3
		OR			
4	a	Calculate the strain energy stored in a bar 2 m long, 50 mm wide and 40 mm thick, when it is subjected to tensile load of 50 KN. Take E = 200 GPa.	8	CO8	L3
	b	Derive the expression for the crippling load for tn=he column for the both ends pinned condition	7	CO7	L2

b. Assignment – 2

Note: A distinct assignment to be assigned to each student.

Model Assignment Questions							
Crs Code:	18ME32	Sem:	3	Marks:	10	Time:	90 – 120 minutes
Course:	Mechanics of Materials				Module : 4, 5		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1		A solid shaft of 250 mm diameter has the same cross sectional area as the hollow shaft of the same material with inside diameter of 200 mm. Determine (I) ratio of power transmitted by the hollow shaft and the solid shaft for the same speed. (ii) Ratio of angle of twist by the hollow shaft and the solid shaft for the same maximum stress.	10	CO5	L3
2		Show that a hollow circular shaft whose inner diameter is half the outer	10	CO5	L3

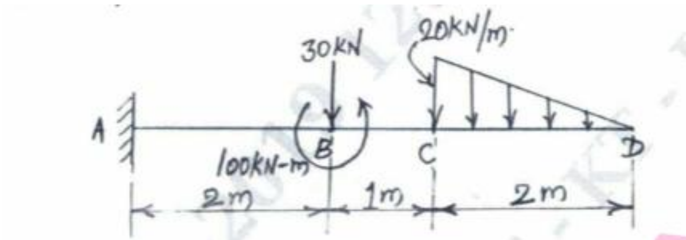
		diameter has a torsional strength equal to 15/16 of that of a solid shaft of same outside diameter.			
3		A solid shaft is required to transmit 300 KW power at 100 rpm. The shear stress of the materiel must not exceed 80 MPa. (I) Determine the diameter of solid shaft (ii) If the shaft is replaced by a hollow one with diameter ratio 3:5 and maximum shear stress remaining unchanged, calculate the percentage saving in weight of the material.	10	CO5	L3
4		A hollow shaft has to transmit 600 KW power at 80 rpm. The maximum twisting moment may exceed the mean by 40%.Design a suitable section, if the permissible stress is 90 N/mm^2 and the diameter ratio is to be 0.8. What will be the angular twist measured over a length of 2m, if the modulus of rigidity is 84 GPa.	10	CO7	L3
5		Two shafts of the same material and of same lengths are subjected to the same torque, if the first shaft if of solid circular section and second shaft is hollow circular section, whose internal diameter is 0.7 times the outside diameter and the maximum stress developed in each shaft is the same, compare the weight of the shaft	10	CO5	L3
6		Define polar modulus. Find the expression for polar modulus of a solid shaft	10	CO5	L2
7		What are the assumptions made in the pure torsion.	10	CO5	L2
8		Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{Jp} = \frac{\tau}{R} = \frac{G\theta}{l}$	10	CO5	L2
9		Define the term torsional rigidity and torsional strength.	10	CO5	L2
10		What do you mean by theories of failure? What is their importance?	10	CO6	L2
11		Explain the following theories of failure.(i) Maximum normal stress theory (ii) Maximum shear stress theory.	10	CO6	L2
12		The stress induced at a critical point in a machine component made of steel are as follows: ax = 100N/mm2, ay = 40N/mm2, tXy = 80N/mm2. Calculate the factor of safety by i) Maximum shear stress theory ii) Maximum normal stress theory	10	CO6	L3
13		Find the diameter of round rod subjected to a bending moment of 1.8 kN-m and a torque of 1.2 kN-m, according to i) Maximum normal stress theory ii) Maximum shear stress theory. Take allowable normal stress as 120MPa and allowable shear stress as 72 MPa.	10	CO6	L3
14		A bolt is acted upon by an axial pull of 16 kN along with a transverse shear force of 10 kN. Determine the diameter of the bolt required, using i) Max. principal stress theory ii) Max. shear stress theory iii) Max. strain theory Elastic limit in tension = 250 MPa Factor of safety = 2.5 Poisson's ratio = 0.3	10	CO6	L3
15		A plate of 45C8 steel (σyt= 353MPa) is subjected to the following stresses σx = 150 N/mm^2,σy = 100N/mm^2 and τxy = 50N/mm2. Find the factor of safety by i) Rankine's theory ii) Guest's theory.	10	CO6	L3
16		A 2 m long column with hollow circular section of outer diameter 180 mm is subjected to a load of 212.5 KN. Yield stress for the column material is 340 N/mm^2. One end of the column is fixed and the other end is free. Determine the inner diameter, taking E = 210 GPa and FOS = 4	10	CO7	L3
17		Determine the buckling load for a strut of 'T' section, the flange width being 100 mm, overall depth 80 mm and both flange and web 10 mm thick. The strut is 3m long and is hinged at both ends E = 200 GPa	10	CO7	L3
18		A column of square section is 2m long and pinned at its ends. Young's modulus for the column material is 12 GPa and the allowable stress being 12 MPa. Determine the size of column to support a load of 200 KN safely, Using a factor of safety of 3	10	CO7	L3
19		Find Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm wall thickness. Length of column is 2.3m and is hinged at both ends. Also estimate Rankine's load for this column, Rankine's parameter are 335 N/mm^2 and 1/7500	10	CO7	L3
20		Find the length of a mild steel rod 25 mm x 25 mm which can be used as a compression member with one end fixed and the other end free to	10	CO7	L3

		carry a working load of 40 Kn. Given FOS = 4, $\alpha = \frac{1}{7500} \sigma_c = 320 N/mm^2$			
21		A cast iron column 140 mm external diameter and 70 mm internal diameter is 3.5 m long. Calculate the safe axial load the column can carry if both ends are fixed. Take $\sigma_c = 600 MPa$; $\alpha = \frac{1}{1600}$ and factor of safety = 3 use Rankine's formula	10	CO7	L3
22		What are the assumption and limitation of Euler's formula	10	CO7	L2
23		Define slenderness ration and discuss the importance of slenderness ration on the compressive strength of columns.	10	CO7	L2
24		What are columns, post, strut and a boom	10	CO7	L2
25		Derive the expression for Euler's critical load for a long column with both ends fixed.	10	CO7	L2
26		What is the difference between short and long columns	10	CO7	L2
27		What is meant by the effective length of a column? State the values of effective length for various column end conditions.	10	CO7	L2
28		Define the terms, strain energy, resilience and modulus of resilience.	10	CO8	L2
29		State and prove Castigliano's first theorem.	10	CO8	L2
30		State and prove Castigliano's Second theorem	10	CO8	L2
31		A 1.6 m long bar is applied an axial pull such that the maximum stress induced is 140 MPa. The larger and smaller area of cross section are 240 mm^2 and 120 mm^2. Determine the strain energy stored in the bar as shown in Fig 83.	10	CO8	L3
32		A bar of length 400 mm and diameter 50 mm is subjected to a tensile load of 20 KN. Find the stress, elongation and strain energy produced if the load is applied gradually. What would be the instantaneous stress and elongation if the same load is applied suddenly. Take E = 200 GPa.	10	CO8	L3
33		A weight of 2 KN falls 24 mm on to a collar fixed to a steel bar 14 mm in diameter and 5.5 m long. Determine he maximum sress induced in the bar due to impact. E = 205 GPa	10	CO8	L3
34		Calculate the strain energy stored in a bar 2 m long, 50 mm wide and 40 mm thick, when it is subjected to tensile load of 50 KN. Take E = 200 GPa.	10	CO8	L3
35		A Rectangular body 500mm long, 100mm wide and 50 mm thick is subjected to a shear stress of 80 MPa. Determine the strain energy stored in the body, G = 85 GPa.	10	CO8	L3
36		A stepped steel rod is in two parts, one has diameter 25 mm. The box is lowered at the rate of 1m/sec. When the freely hanging rope is 12 m, the machine gets load is brought to a stop instantaneously. Find the maximum stress in the rope and the instantaneous deformation due to jamming. Take E = 200 GPa.	10	CO8	L3
37		A cantilever beam is loaded as shown in Fig. Determine the deflection and slope at the free end by using Castigliano's theorem.	10	CO8	L3
38		A shaft is in two parts as shown in Fig. Find the total strain energy stored in it Take G = 85 GPa.	10	CO8	L3
39		A simple beam ACB supporting an uniform load w over the first half of the beam and a couple of moment M_o at end B is shown in Fig. 91. Determine the strain energy U stored in the beam due to the load w and the couple M_o acting simultaneously.	10	CO8	L3
40		A cantilever beam of uniform cross section carries a point load at the free end. Determine strain energy and deflection at the free end. If F = 200kN, E = 200GPa, L = 3mt and I = $10^{-4} m^4$.	10	CO8	L3
41		Two bars, each of length and of different materials are each subjected to the same tensile force P. The first bar has a uniform diameter 'D' and the second bar has a diameter of D/2 for a length L/4 and a diameter D for the remaining length. Compare the strain energies of the two bars if, (i) E1/E2=4/7 and (ii) E1 = E2	10	CO8	L3
42		Define strain energy and Resilience	10	CO8	L2

D3. TEACHING PLAN - 3

Module – 3

Title:	Shear force and Bending Moment Diagrams Bending Stresses in Beams	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Draw shear force diagram & Bending moment diagram for a Simply supported beam & cantilever beam with point load, UDL & UVL	CO9	L3
2	Determine the bending stress distribution of rectangular, symmetrical I &T section	CO10	L3
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
41	Types of beams, Loads and reactions,	CO9	L2
42	Relationship between loads, shear forces and bending moments	CO9	L2
43	Shear force bending moments of cantilever beams subjected to concentrated loads, UDL / UVL	CO9	L3
44	Shear force bending pin support subjected to concentrated loads, UDL / UVL	CO9	L3
45	Shear force roller supported beam subjected to concentrated loads, UDL / UVL	CO9	L3
46	Pure bending, curvature of beam	CO10	L2
47	Longitudinal strains in beams	CO10	L2
48	Bending stresses in beams with rectangular , flexure formula and bending stress	CO10	L3
49	Bending stresses in beams with circular, flexure formula and bending stress	CO10	L3
50	Bending stresses in beams with ‘I’ and ‘T’ cross section, flexure formula and bending stress	CO10	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Design of Bridges,	CO9	L3
2	Structural analysis in the field of construction of bridges, etc.	CO10	L3

d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
79	What is a beam? What do you mean by statically indeterminate beam?	CO9	L2
80	How are beams classified? Give a brief account.	CO9	L2
81	What are the main type of supports? Distinguish between roller and hinged supports.	CO9	L2
82	Define the terms Axial force, Shear force, bending moment and point of contraflexure.	CO9	L2
83	Explain the sign convection for axial force, Shear force and bending moment.	CO9	L2
84	What are sagging and hogging bending moments?	CO9	L2
85	Derive the relation between intensity of loading, shear force and bending moment in a beam.	CO10	L2
86	The bending moment in a beam is maximum or minimum where shear force is zero. Is the converse true? Why?	CO10	L2
87	Indicate the shape of shear force diagram in case of uniformly distributed load and for triangular loads.	CO10	L2
88	For the beam shown in Fig. Draw the SFD and BMD. Determine the maximum BM and point of Contraflexure.	CO9	L3
89	A simply supported beam is shown in Fig.46. Draw SFD & BMD	CO9	L3
90	Find the reactions at the fixed end draw the shear force diagram and bending moment diagram for the beam loaded as shown in Fig. Locate the point of contraflexure if any. 	CO9	L3
91	A cantilever 2m long is loaded with uniformally distributed load of 10KN/m run over a length of 1.5m from the free end. It also carries a point load of 10 KN at a distance of 0.5 m from the free end. Find the reaction st the fixed end and draw the SFD and BMD.	CO9	L3
92	Derive the relationship between load shear force and bending moment for UDL.	CO9	L2
93	Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.	CO10	L3
94	A simply supported beam of span 5m has a cross section 150mm x 250 mm. If the permissible stress is 10 N/mm^2, find (I) maximum intensity of uniformly distributed load it can carry, (ii) maximum concentrated load P applied at 2m from an end it can carry	CO10	L3
95	A timber cantilever 200 mm wide and 300 mm deep is 3 m long. It is loaded with a UDL of 3 KN/m over the entire length. A point load of 2.7 KN is placed at the free end of the cantilever. Find the maximum bending stress produced.	CO10	L3
96	A rectangular beam 300 mm deep is simply supported over a span of 4m. What uniformly distributed load per meter the beam may carry. If the bending stress is not to exceed 120 N/mm^2 take I= $8x10^6$ mm^4.	CO10	L3
97	Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress.	CO10	L3
98	A rolled steel joint, simply supported across a span of 4 m and carrying a UDL of 80 KN/m, has the following dimensions. Overall depth 350 mm, each flange 150 mm x 25 mm and web 300 x 12 mm. Determine the magnitude of the bending and shearing stresses at the junction of the web with the top flange at a section 1 m away from the support.	CO10	L3
e	**Experiences**	-	-
1		CO10	L2
2		CO9	
3			
4		CO9	L2
5			

E3. CIA EXAM – 3

a. Model Question Paper - 3

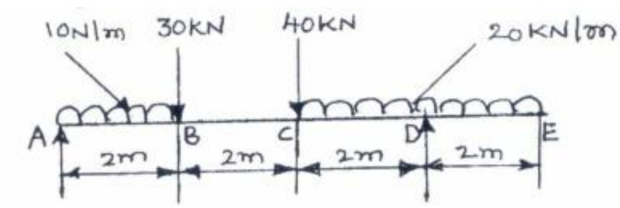
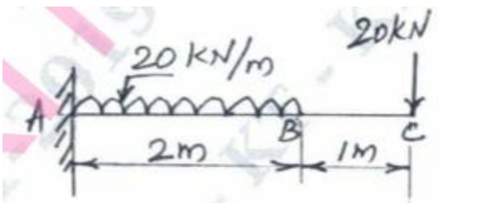
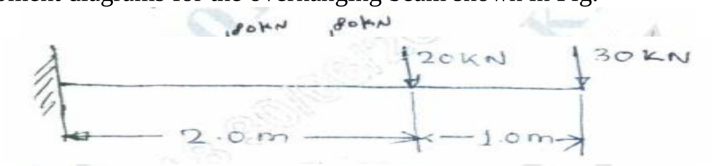
Crs Code:	18ME32	Sem:	III	Marks:	30	Time:	75 minutes
Course:	Mechanics of Materials						

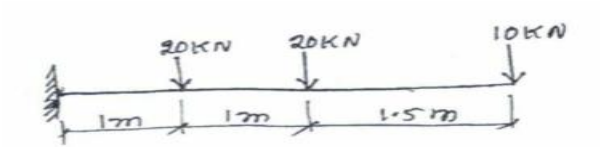
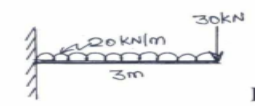
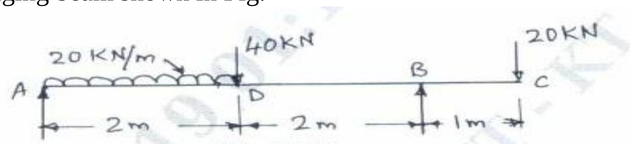
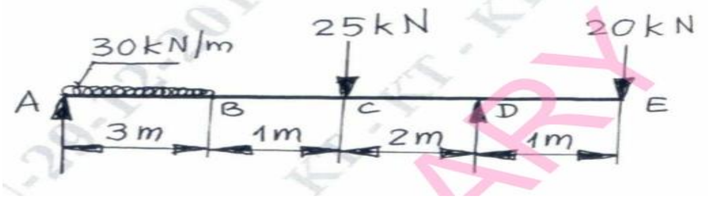
-	-	**Note: Answer all questions, each carry equal marks. Module : 3**	**Marks**	**CO**	**Level**
1	a	For the beam shown in Fig. Draw the SFD and BMD. Determine the maximum BM and point of Contraflexure.	8	CO9	L3
	b	Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$	7	CO10	L2
		OR			
2	a	A cantilever 2m long is loaded with uniformally distributed load of 10 KN/m run over a length of 1.5 m from the free end and draw the SFD and BMD.	8	CO9	L3
	b	Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress.	7	CO10	L2
3	a	Derive the relation between intensity of loading, shear force and bending moment in a beam.	8	CO9	L2
	b	A simply supported beam of span 5m has a cross section 150mm x 250 mm. If the permissible stress is 10 N/mm^2, find (I) maximum intensity of uniformly distributed load it can carry, (ii) maximum concentrated load P applied at 2m from an end it can carry	7	CO10	L3
		OR			
4	a	Define the terms Axial force, Shear force, bending moment and point of contraflexure.	7	CO9	L2
	b	A rolled steel joint, simply supported across a span of 4 m and carrying a UDL of 80 KN/m, has the following dimensions. Overall depth 350 mm, each flange 150 mm x 25 mm and web 300 x 12 mm. Determine the magnitude of the bending and shearing stresses at the junction of the web with the top flange at a section 1 m away from the support.	8	CO10	L3

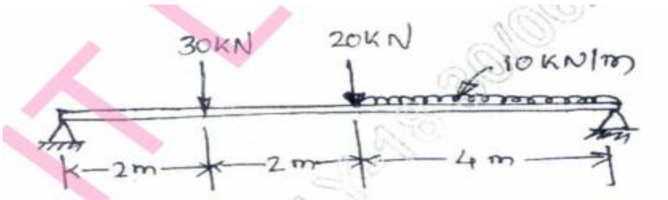
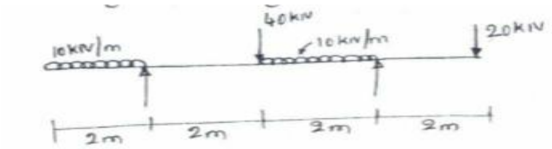
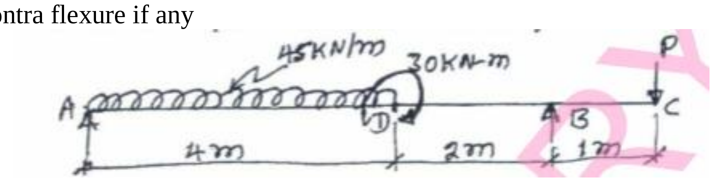
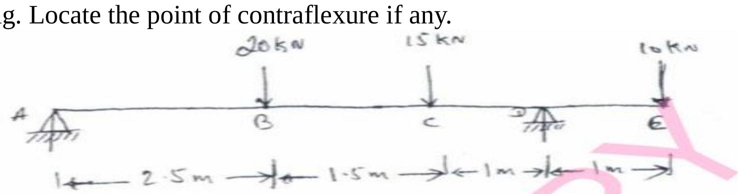
b. Assignment – 3

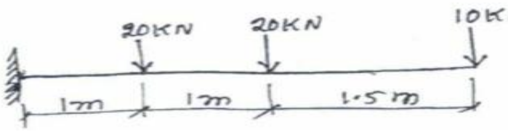
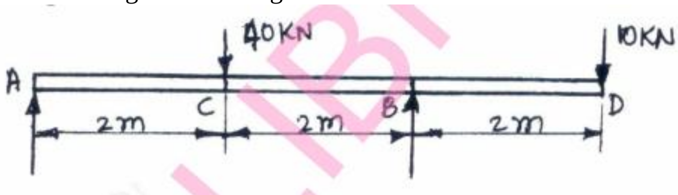
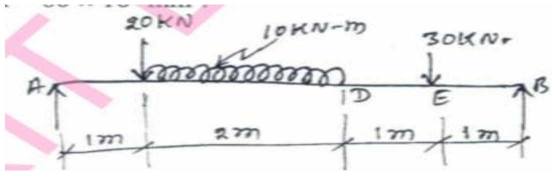
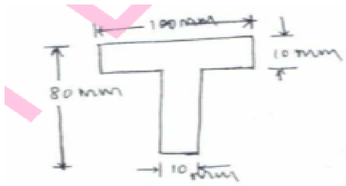
Note: A distinct assignment to be assigned to each student.

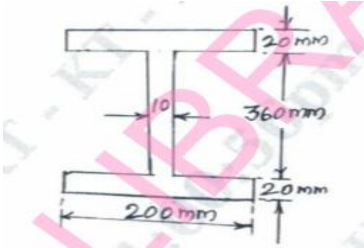
Model Assignment Questions							
Crs Code:	18ME32	Sem:	III	Marks:	10	Time:	90 – 120 minutes
Course:	Mechanics of Materials				Module : 3		
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	USN	Assignment Description	Marks	CO	Level
1		A simply supported beam 6 m long carries a uniformly distributed load of 10 KN/m over the whole span. Calculate the AF, SF and BM at every 2m length and at the mid span.	10	CO9	L3
2		Cantilever beam loaded as shown in Fig Calculate the AF,For a SF & BM values from B and at A.	10	CO9	L2
3		Draw the SFD and BMD for a cantilever beam with an uniformly distributed load.	10	CO9	L2
4		Draw the SFD and BMD for a cantilever beam with a point load at free end.	10	CO9	L2
5		Draw the SFD and BMD for a cantilever beam with an uniformly varying load.	10	CO9	L2
6		For the beam shown in Fig. Draw shear force and bending moment diagram. Locate the point of contraflexure if any. 	10	CO9	L3
7		A cantilever beam carries UDL and point loads as shown in Fig. Find the reactions at the fixed end and draw the SFD and BMD. 	10	CO9	L3
8		Find the reaction at the supports and draw the shear force and bending moment diagrams for the overhanging beam shown in Fig. 	10	CO9	L3
9		Find the reactions at the fixed end and draw the SFD and BMD for the	10	CO9	L3

		cantilever beam loaded as shown in Fig.  			
10		Find the reactions at the free end and draw the shear force diagram and bending moment diagram for the beam loaded as shown in Fig. Locate the point of contraflexure if any.  	10	CO9	L3
11		A cantilever 2m long is loaded with uniformally distributed load of 10 KN/m run over a length of 1.5 m from the free end and draw the SFD and BMD.	10	CO9	L3
12		A cantilever of length 2 m carries a uniformly distributed load of 10 KN/m length over the whole length and a point load of 5 KN at the free end. Find the reactions at the fixed end and draw the SFD and BMD for the beam.	10	CO9	L3
13		Find the reaction at the supports and draw the SFD and BMD for the overhanging beam shown in Fig.  Fig.Q5(b)	10	CO9	L3
14		Find the reactions at the supports and draw the shear force and bending moment diagrams for the overhanging beam as shown in Fig.  	10	CO9	L2
15		Simply supported beam of length 6m, carries point load of 3 kN and 6 kN at distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam.	10	CO9	L2
16		Draw the SFD and BMD for a simply supported beam with a point load at mid point.	10	CO9	L2
17		Draw the SFD and BMD for a simply supported beam with an eccentric point load.	10	CO9	L2
18		Draw the SFD and BMD for a simply supported beam carrying an UDl.	10	CO9	L2
19		Draw the SFD and BMD for a simply supported beam carrying an UVL from zero at each end to w per unit length at the center.	10	CO9	L2
20		Draw the SFD and BMD for a simply supported beam carrying an UVL from zero at one end to w per unit length at the other end.	10	CO9	L2
21		Draw the SFD and BMD for a simply supported beam subjected to a couple at its mid span point.	10	CO9	L2

					
22		A simply supported beam of 6 m long is subjected to loads 2 KN , 5 KN and 4 KN at a distances 1.5 m, 3 m and 4.5 m from the left support. Draw the SFD and BMD.	10	CO9	L3
23		Draw the SFD and BMD of a Overhanging beam loaded as shown in Fig. 	10	CO9	L2
24		A simply supported beam of span 6 m is subjected to a concentrated load of 25 KN acting at a distance of 2 m from the left end. Also subjected to an uniformly distributed load of 10 KN/m over the entire span. Draw the bending moment and shear force diagram indicating the maximum and minimum values.	10	CO9	L3
25		A overhanging beam is loaded as shown in Fig. Draw the SFD and BMD. Also find the position and amount of maximum bending moment. 	10	CO9	L2
26		For the beam AC shown in the Fig, determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw shear force and bending moment diagrams and locate the point of contra flexure if any 	10	CO9	L2
27		Draw the SFD and BMD for a overhanging beam loaded as shown in Fig. Locate the point of contraflexure if any. 	10	CO9	L2
28		Draw the SFD and BMD for a cantilever beam loaded as shown in Fig.	10	CO9	L2

					
29		A beam ABCD is simply supported at B and C, 4.5m apart and overhanging parts AB and CD are 1.5m and 2m long respectively. The beam carries a uniformly distributed load of 10kN/m between A & C. There is a clock wise couple of 60kN-m at D. Then draw S.F and B.M diagrams and mark salient points.	10	CO9	L3
30		Draw shear force and bending moment diagrams for the beam shown in Fig. marking values at salient points. Locate the point of contraflexure and point of maximum bending moment. Determine the value of maximum bending moment.	10	CO9	L3
31		An overhanging beam ABC is loaded as shown in Fig. Draw the SFD and BMD. Also locate point of contraflexure. Determine maximum positive and negative bending moments. 	10	CO9	L3
32		A beam 6 m long rests on two supports with equal over hangs on either side and carries an UDL of 30 KN/m over the entire length of the beam as shown in Fig. Calculate the overhangs if the maximum positive and negative bending moment are to be same. Draw the SFD and BMD and locate salient points.	10	CO9	L3
33		Draw the SFD and BMD for a SSB beam loaded as shown in Fig. 	10	CO9	L3
34		A cantilever has a length of 3m. Its cross — section is of T — section with flange 100mm x 20mm and web 200mm x 12mm, the flange is in tension. What is the intensity of UDL that can be applied if the maximum tensile stress is limited to 30N/mm^2? Also compute the maximum compressive stress.	10	CO10	L3
35		Find the maximum bending stress for the T section shown in Fig. 	10	CO9	L3
36		A cantilever of square section 200 mm x 200 mm, 2 meter long just fails in flexure when a load of 12 KN is placed at its free end. A beam of same material and having a rectangular cross section 150 mm wide and 300 mm deep is simply supported over a span of 3 m. calculate the minimum central concentrated load required to break the beam.	10	CO10	L3
37		simply supported beam of 'T' section carries a uniformly distributed load of 40 kN/m run on entire span of beam of 10 m. If 'T' section is having dimensions as shown in Fig. determine the maximum stress developed due to bending.	10	CO10	L3

					
38		A cantilever beam of square section 200mm x 200mm, 2 m long just fails bending, when a load of 20 KN is placed at its free end. A beam of same material having a rectangular cross section 150mm x 300 mm, simply supported over a span of 3 m is to be used under a UDL 20 KN/m	10	CO10	L3
39		A simply supported beam of span 3m has T-cross section. The flange is 100mm x 20mm and the web is 200mm x 12mm, with the flange in compression. The maximum compressive stress is to be limited to 90MPa. Find the maximum intensity of UDL that can be carried and the corresponding tensile stress induced.	10	CO10	L3
40		A simply supported beam of span 5 m has a cross section 150 mm x 250 mm. If the permissible stress is 10 N/mm^2, find (I) Maximum intensity of uniformly distributed load it can carry. (ii) Maximum concentrated load P applied at 2 m from one end it can carry.	10	CO10	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Mechanics of Materials				Month / Year	Dec /2019
Crs Code:	18ME32	Sem:	III	Marks: 60	Time:	180 minutes

Module	Note	Answer all FIVE full questions. All questions carry equal marks.	Marks	CO	Level
1	a	Derive an expression for total extension of tapering circular bar cross section of diameter ‘D’ and ‘d’ when subjected to an axial pull of load P	08	CO1	L2
	b	A concrete column is of square section with 250 mm size and is reinforced with 08 steel bars of 16 mm diameter. The member supports an axial load of 270 KN. Evaluate the stresses in steel and concrete assuming a modular ratio as 18	12	CO2	L3
		OR			
2	a	Define I) Hooke’s law (ii) Poisson’s ratio (iii) Volumetric strain (iv) Modulus of rigidity v) Normal stress	10	CO1	L1
	b	The tensile test was conducted on mild steel bar. The following data was obtained from the test, Diameter of steel bar = 16 mm, Load at proportionality limit = 72 KN , Load at failure = 80 KN, diameter of the rod at failure = 12mm, gauge length of the bar = 80 mm, extension at load of 60 KN = 0.115 mm, Final gauge length of bar = 104 mm. Determine (I) Young’s modulus (ii) Proportionality limit (iii) Percentage elongation (iv) Percentage decrease in area (v) Breaking stress.	10	CO1	L3
3	a	Direct stresses of 120 N/mm^2 tensile and 90 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the plane. The greatest principal stress at the point due to these is 150 N/mm^2. Determine (I) Magnitude of shearing stress on the two planes. (ii) Maximum shearing stress at the point.	10	CO3	L3
	b	Obtain an expression for volumetric strain in case of thin cylindrical shell of internal diameter ‘d’ subjected to internal pressure ‘p’.	10	CO4	L2
		OR			
4	a	At a Certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa, both tensile and there is a shear stress of 32 MPa cw on the plane carrying 80 MPa stresses across the planes. Determine (I) Maximum and minimum stresses and locate their planes. (ii) Maximum shear stress and specify its plane. (iii) Normal stress on maximum shear stress plane. (iv) Verify the answer by Mohr’s circle method.	10	CO3	L3
	b	A Cylindrical pressure vessel of 250 mm inner radius Is subjected to internal pressure of 10 N/mm^2 allowable stress for the material of the cylinder is 40 N/mm^2. Determine (I) Wall thickness of cylinder (ii) percentage error involved when the	10	CO4	L3

		thickness is calculated based on thin cylinder.			
5	a	Show that a hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to 15/16 of that of a solid shaft of same outside diameter.	12	CO5	L3
	b	Explain the following theories of failure.(i) Maximum normal stress theory (ii) Maximum shear stress theory.	8	CO6	L2
		OR			
6	a	Derive the relation for a circular shaft when subjected to torsion as given below $\frac{T}{Jp} = \frac{\tau}{R} = \frac{G\theta}{l}$	12	CO5	L3
	b	What do you mean by theories of failure? What is their importance?	8	CO6	L2
7	a	A 2 m long column with hollow circular section of outer diameter 180 mm is subjected to a load of 212.5 KN. Yield stress for the column material is 340 N/mm^2. One end of the column is fixed and the other end is free. Determine the inner diameter, taking E = 210 GPa and FOS = 4	10	CO7	L3
	b	Derive the expression for Euler's critical load for a long column with both ends fixed.	10	CO8	L2
		OR			
8	a	A cast iron column 140 mm external diameter and 70 mm internal diameter is 3.5 m long. Calculate the safe axial load the column can carry if both ends are fixed. Take $\sigma_c = 600$MPa; $\alpha = \frac{1}{1600}$and factor of safety = 3 use Rankine's formula	10	CO7	L3
	b	A 1.6 m long bar is applied an axial pull such that the maximum stress induced is 140 MPa. The larger and smaller area of cross section are 240 mm^2 and 120 mm^2. Determine the strain energy stored in the bar as shown in Fig 83.	10	CO8	L3
9	a	Derive the relation between intensity of loading, shear force and bending moment in a beam.	08	CO9	L2
	b	Derive bending equation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.	12	CO9	L2
		OR			
10	a	A cantilever 2m long is loaded with uniformly distributed load of 10KN/m run over a length of 1.5m from the free end. It also carries a point load of 10 KN at a distance of 0.5 m from the free end. Find the reaction st the fixed end and draw the SFD and BMD.	10	CO9	L3
	b	A simply supported beam of span 5m has a cross section 150mm x 250 mm. If the permissible stress is 10 N/mm^2, find (I) maximum intensity of uniformly distributed load it can carry, (ii) maximum concentrated load P applied at 2m from an end it can carry	10	CO10	L3

2. SEE Important Questions

Course:	Mechanics of Materials					Month / Year		Dec / 2019
Crs Code:	18ME32	Sem:	III	Marks:	60	Time:		180 minutes

	Note	Answer all FIVE full questions. All questions carry equal marks.	-	-	
Module	Qno.	Important Question	**Marks**	**CO**	**Year**
1	a	Define I) Hooke's law (ii) Poisson's ratio (iii) Volumetric strain (iv) Modulus of rigidity v) Normal stress vi) Shear stress vii) Factor of safety viii) Bulk Modulus ix) Modulus of elasticity x) Elasticity xi) plasticity xii) Resilience xiii) Toughness xvi) stiffness,	10	CO1	2018
	b	The tensile test was conducted on mild steel bar. The following data was obtained from the test, Diameter of steel bar = 16 mm, Load at proportionality limit = 72 KN , Load at failure = 80 KN, diameter of the rod at failure = 12mm, gauge length of the bar = 80 mm, extension at load of 60 KN = 0.115 mm, Final gauge length of bar = 104 mm. Determine (I) Young's modulus (ii) Proportionality limit (iii) Percentage elongation (iv) Percentage decrease in area (v) Breaking stress.	10	CO1	2017
	c	Draw and explain stress-strain diagram of a mild steel specimen subjected to tension test. Mark the salient points on it.	8	CO1	2017
	d	A circular rod of 100mm diameter and 500 mm length is subjected to a tensile load of 1000 KN. Determine the I) Modulus of rigidity ii) Bulk modulus iii) Change in volume. Take Poisson's ratio = 0.30 and E = 200 GPa.	10	CO2	2016
	e	Derive a relation between modulus of elasticity and bulk modulus.	8	CO2	2017
2	a	A point is subjected to a tensile stress of 60 N/mm^2 and a compression stress of 40N/mm^2, acting on two mutually perpendicular planes and shear stress of 10 N/mm^2 as shown in Fig.24 Determine the principal as well as Maximum shear stress by Mohr's circle method.	10	CO3	2017
	b	At a Certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa, both tensile and there is a shear stress of 32 MPa cw on the plane carrying 80 MPa stresses across the planes. Determine (I) Maximum and minimum stresses and locate their planes. (ii) Maximum shear stress and specify its plane. (iii) Normal stress on maximum shear stress plane. (iv) Verify the answer by Mohr's circle method.	10	CO3	2017
	c	For a thin cylinder subjected to internal pressure 'p' prove that the circumferential stress = $\frac{pd}{2t}$and longitudinal stress = $\frac{pd}{4t}$where 'd' is internal diameter and 't' is thickness of wall.	10	CO4	2015
	d	The maximum stress permitted in a thick cylinder radii 200 mm and 300 mm is 16 N/mm^2. If the internal pressure is 12 N/mm^2 , what external pressure can be applied? Plot curves showing the variations of hoop and radial stresses through the material.	10	CO4	2015
	e	A thick metallic cylindrical shell is 150 mm internal diameter is required to with stand an internal pressure of 8 MPa. Find the necessary thickness of shell if permissible tensile stress in the section is 20 MPa.	10	CO4	2018
4	a	Derive the torsion equation with usual notation	10	CO5	2018
	b	What do you mean by theories of failure? What is their importance?	6	CO6	2017
	c	Explain the following theories of failure.(i) Maximum normal stress theory (ii) Maximum shear stress theory.	8	CO6	2016
	d	Show that a hollow circular shaft whose inner diameter is half the outer diameter has a torsional strength equal to 15/16 of that of a solid shaft of same outside diameter.	10	CO5	2017
	e	A solid shaft is required to transmit 300 KW power at 100 rpm. The shear stress of the materiel must not exceed 80 MPa. (I) Determine the diameter of solid shaft (ii) If the shaft is replaced by a hollow one with diameter ratio 3:5 and maximum shear stress remaining unchanged, calculate the percentage saving in weight of the material.	10	CO5	2016
5	a	A cast iron column 140 mm external diameter and 70 mm internal diameter is 3.5 m long. Calculate the safe axial load the column can carry if both ends are fixed. Take $\sigma_c = 600\text{MPa}; \alpha = \frac{1}{1600}$and factor of safety = 3 use Rankine's formula	9	CO7	2018
	b	What are the assumption and limitation of Euler's formula	7	CO7	2018
	c	Define slenderness ration and discuss the importance of slenderness ration on the	8	CO7	2018

		compressive strength of columns.			
	d	Define the terms, strain energy, resilience and modulus of resilience.	8	CO8	2015
	e	State and prove Castigliano's first theorem.	8	CO8	2016
3	a	Define the terms Axial force, Shear force, bending moment and point of contra flexure.	6	CO9	2016
	b	Explain the sign convection for axial force, Shear force and bending moment.	6	CO9	2015
	c	What are sagging and hogging bending moments?	4	CO9	2014
	d	Derive the relation between intensity of loading, shear force and bending moment in a beam.	6	CO9	2016
	e	The bending moment in a beam is maximum or minimum where shear force is zero. Is the converse true? Why?	5	CO10	2017

G. Content to Course Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Module- #	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	Stress, strain, Hook's Law, Poisson's ratio and their relations mechanical properties of engineering materials including elastic constants and their relations, thermal stress and strains and their relation	4	- L1 - L2	L2	Understand	- Lecture - -	- Assignment -CIE -Unit Test
1	Determine stresses, strains and deformations in bars	6	- L1	L3	Compute	- Lecture	- Assignment

	with varying circular and rectangular cross-sections subjected to normal and temperature loads		- L2 - L3				-CIE -Unit Test
2	Plane stress and strain, major and minor principle stresses and their planes, maximum shear stress and their planes, Hoop's stress, Longitudinal stress, Radial stress	5	- L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
2	Determine principal stress, maximum shear stress and their orientations using analytical method and Mohr' circle method and dimensions of thick and thin cylinder and also stress distribution in thick and thin cylinders	5	- L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
4	Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts	5	- L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
4	Maximum Principal Stress theory, Maximum shear stress theory	5	- L1 - L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
5	Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions and also dimensions of elastic stability of columns using Rankin's and Euler's theory	5	- L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
5	Castigliano's theorem I and II, Load deformation diagram, Strain energy due to normal stresses, Shear stresses, Modulus of resilience, Strain energy due to bending and torsion	5	- L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
3	Pure bending, Curvature of a beam, Longitudinal strains in beams, Bending stresses in Beams with rectangular, 'I' and 'T' cross sections	5	- L1 - L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test
3	Types of beams, loads, supports, relation between load, force and moment. Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples.	5	- L1 - L2 - L3	L3	Compute	- Lecture	- Assignment -CIE -Unit Test

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Module- #	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*
1	-Stress -Strain	-Uni axial Stress -Uni axial Strain	Uni Axial Stress and Strain	Comprehend the Uni axial stress and Strain and their Relations	-Understand -Stresses strains -stress and strain relations	Understand simple, thermal stresses & strains and their relations
1	-Deformation in Temperature stress -Elastic Constants	-Deformation -Elastic Constants	Deformation	Comprehend the deformation in varying bar section and elastic constants	-Understand -Determine -Deformation	Determine the stress, strain and deformation in bars with varying cross section
2	-Compound stresses, -Mohr's Circle	-Bi axial stress	Bi axial stress	Comprehend the bi axial stress with analytical and graphical method	-Understand -Principal stress and strain -Analytical and Graphical Method	Determine principal stresses and planes using analytical and graphical method.
2	- Thin Cylinder	-Hoops	Hoops and	Comprehend the	-Understand	Determine stress

	-Thick Cylinder	stress -Radial Stress	Radial Stresses	Hoops stress and radial stresses in thick and thin cylinder	-Hoops stress -Radial stresses	distribution in thick and thin cylinder
4	-Torsion -	-Torque & Twist -	Torque & Twist	Understand the torque and twist in solid and hollow shafts	-Understand -torque and twist -shafts	Determine, torsional strength, rigidity, flexibility & dimensions of shaft
4	-Theories of Failures	-Theories of failure -	Theories of failure	Comprehend the basic concept theories of failures	-Understand -Basic concept -theories of failures	Determine dimensions of bars, beams & rods using Maximum principal & Maximum Shear stress theory of failure
5	- Columns - -	-Crippling load -	Crippling load	Comprehend the crippling load of column in different end condition	-Understand -crippling load -end condition	Determine elastic stability of columns using Rankine's & Euler's theory
5	-Stain Energy	-Strain energy methods -	Strain energy methods	Comprehend the strain energy of beams, bars and rods	-Understand -strain energy -beams, bars and rods	Determine dimensions of bars, beams & rods using strain energy methods
3	-SFD and BMD	-Shear force, & Bending moment	Shear force, & Bending moment	Understand the Concept to draw the SFD and BMD	-Understand -Concept -SFD and BMD	Draw shear force diagram & Bending moment diagram for a Simply supported beam & cantilever beam with point load, UDL, UVL and Couple
3	-Stresses in Beams	-Bending stress distribution	Bending stress distribution	Understand the bending stress distribution of different cross section	-Understand -bending stress -stress distribution of different cross section	Determine the bending stress distribution of rectangular symmetrical I &T section