Course Title: **ENGINEERING MECHANICS AND STRENGTH OF MATERIALS**		
Credits (L:T:P) : **4:0:0**	Total Contact Hours: **52**	Course Code: **15CE31T**
Type of Course: **Lectures, Self Study& Student activity**	Credit :**04**	Core/ Elective: **Core**
CIE- 25 Marks		SEE- 100 Marks

Prerequisites: Knowledge of basic Mathematics and Science.

Course Objectives: The students shall be able to

1. Define and identify the differences among types of forces, stresses and strains.
2. Determine the geometrical properties of the structural sections and to analyze the effect of geometry on strength properties of structural elements.
3. Evaluate the response and behavior of various materials to forces, stresses and strains and to assess the properties of a material and identify its usage in structural elements.
4. Identify, formulate and solve engineering problems of structural elements subjected to flexure, shear.
5. Provide procedural knowledge to analyses of structural system, component of elements such as beams and columns subjected to various load combinations with different boundary conditions.

On successful completion of this course, the student will be able to

	Course Outcome	**CL**	**Linked PO**	**Teaching Hrs**
CO1	Compare the various forces acting and apply the force equilibrium condition.	R/U/Ap	1,2	5
CO2	Explain the mechanical properties and describe the different types of stress, strains and elastic constants and compute the factor of safety in sustainability of material aspects.	R/U/Ap/Ay	1,2,5,6	10
CO3	Compute geometrical properties of the sections knowing the importance of geometry in structural engineering	R/U/Ap	1,2,,5,9	10
CO4	Correlate the concept of free body diagram, & analyze the different types of end conditions in supports for various loads &beams developing shear force diagram& bending moment diagram,	R/U/Ap/Ay/ C	1,2, 3, 5,9	10
CO5	Describe Pure bending theory and applying geometrical properties of beam to calculate strength parameters& develop flexural stress and shear stress diagram of structural members (beams) for different loading conditions.	R/U/Ap/Ay/ C	1,2,3, 5,6,7,9	8
CO6	Inspect and calculate the deformation (Slope &deflection) of basic beams	R/U/Ap/Ay	1,2,5	4
CO7	Explain the types of column and apply the eulers theory to find the parameters for different end condition	R/U/A/Ay	1,2,5,6	5
CO8	Manage the suggested or identified structural engineering problems, formulate and solve in teams, in order to improve future problem solving ability and able to present it.	U/Ay/Ap/ C	1,2,3,4, 5,6,7,8, 9,10	*
			Total sessions	**52**

Legend- R; Remember U: Understand, Ap: Application Ay: Analysis C:Creation,

*Related to Student activity beyond classroom hours.

Programme outcome Attainment Matrix

Course	Programme Outcome									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
	Basic knowledge	Discipline knowledge	Experiments and Practice	Engineering Tools	Engineer and society	Environment & Sustainability	Ethics	Individual and Team work	Communication	Life long learning
Strength Of Materials	3	3	2	1	3	3	1	1	3	1

Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If ≥40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If < 5% of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

COURSE CONTENT

UNIT	COURSE CONTENTS	HOURS
1	**INTRODUCTION TO ENGINEERING MECHANICS** Force and characteristics of a force, Force system: - Definition, classification of force system according to plane and line of action, Composition of Forces: - Definition, Resultant force, moment of a force,Principle of transmissibility of forces,Law of moments Simple Problems on forces.	6
2	**SIMPLE STRESSES AND STRAINS** Definition of rigid body, plastic body, mechanical properties of metal-(Rigidity, Elasticity, Plasticity, Compressibility, Hardness, Toughness, Stiffness, Brittleness, Ductility, Malleability, Creep, Fatigue, Tenacity, Durability) Definition of stress, strain, Classification of stress, strain, (Types of stresses -Tensile, Compressive and Shear stresses Types of strains - Tensile, Compressive and Shear strains - Elongation and Contraction - Longitudinal and Lateral strains - Poisson's Ratio) Stress-strain curve for mild steel, HYSD bar and non-ferrous materials, (yield stress/ proof stress, Hooke's law, St. Venant"s principle, Ultimate stress, breaking stress and percentage elongation. Working stress - Factor of safety - Percentage reduction in area - Significance of percentage elongation and reduction in area of cross section), Stresses in bars of composite section (Modular ratio – Problems on axially loaded composite sections like RC.C / Encased columns.) Principles of superposition, Deformation of uniform bars and bars of varying cross-section, Volumetric strain & change in volume, Relation among elastic constants Types of loading – gradual, suddenly applied load & Impact load Definition of strain energy, modulus of resilience and proof resilience. Comparison of stresses due to gradual load, sudden load and impact load. Thermal stresses.	12

3	**GEOMETRICAL PROPERTIES OF SECTIONS** Centroid, centre of gravity, Concept of moment of inertia, Centre of gravity of plane areas such as rectangle, triangle, circle, semicircle and quarter circle. Parallel axis and perpendicular axis theorem, Radius of gyration & polar moment of inertia, problems on C.G of irregular sections, M.I of symmetrical and unsymmetrical sections (I, T, C, L-section) problems,	10
4	**BENDING MOMENTS AND SHEAR FORCE** Types of beams –(simply supported, cantilever, fixed and continuous beams,)Types of loading- (Axial load, Transverse load, point load, uniformly distributed load, uniform varying load moment load) support reactions for determinate structures, End conditions, Concept of shear force and bending moment, sign convention. Relation between bending moment, shear force and rate of loading Shear force and bending moment diagrams for simply supported beams, overhanging beams and cantilever subjected to point loads, UDL, point of contra flexure.	10
5	**THEORY OF SIMPLE BENDING** Introduction – Bending stress in beam, Assumptions in simple bending theory, bending equation, neutral axis, Modulus of rupture, section modulus, flexural rigidity, moment of resistance, Problems on Bending stress distribution diagram-variation of bending stresses across the cross section of the beams only rectangular and T section. Shear Stress distribution diagram for rectangular, I, T-section beams.	6
6	**SLOPE AND DEFLECTION OF BEAMS** Introduction – Definitions of slope, deflection - Slope and deflection using Moment area method for simply supported and cantilever, subjected to symmetrical point loads and UDL.	4
7	**COLUMNS** Introduction – Short and long columns - Euler's theory on columns - Effective length, slenderness ratio - radius of gyration, buckling load - Assumptions, Euler's Buckling load for different end conditions - Limitations of Euler's theory - and problems.	4
	TOTAL	**52**

Course Delivery: The course will be delivered through lectures and Power point presentations/ Video

🎯 SUGGESTED STUDENT ACTIVITIES

The topic should be related to the course in order to enhance the student's knowledge, practical skill, lifelong learning, communication, and modern tool usage.

1. Drawing Shear force and Bending Moment diagrams on Graph Paper simply supported beam, Cantilever and Draw the load diagram (free body diagram) by knowing SFD (each 6 problems).
2. To determine the moments of inertia of the given irregular body, composite sections, built up sections.
3. In spread sheet finding centre of gravity; I_{ZZ} and I_{YY} of I, L,T and channel sections
4. Using MS excel prepare the abstract sheet with given data and calculate moment of inertia using formula bar
5. Writing report on (any one)

a. Study on Deformation behavior of Simply Supported Beam, measurement of Young's Modulus and Deflection of Beam.
b. Conduct a experiment calculating the tensile stress of Bamboo if used as a reinforcing material
c. Calculate the tensile stress induced in the hanging rod of ceiling fan and suggest an alternate material
d. Calculate the tensile stress induced in the rope made up of jute
e. Determine the rigidity modulus of the material of the suspension wire.
f. Determine the flexural strength of the given tile by conducting a bending test
g. Conduct a deflection test on wooden beam and determine the value of Young's Modulus of wood.
h. Draw a graph "load Vs deflection".
i. Conduct a compression test on the given wooden cube and find its ultimate strength parallel to its fibres
j. Maxwell's Theorem of Reciprocal Deflection
k. Write material specifications for any two structural steels.

6. Visit the Institute's Library / internet center and list the books/journals/conference proceedings, e-books and any other resources available on the topics suggested by the teacher. Prepare references consisting name of the author, title of the book/paper, publication and place of publication, volume No.s, page numbers and year of publication(any one). Some examples:
   a) Tensometer,
   b) Strain hardening
   c) Punching shear.
   d) Comparison of Compressive strength of Bricks, Blocks and Concrete.
   e) Tension test on Mild steel and HYSD bars.
   f) Compression test of Mild Steel, Cast iron and Wood.
   g) Bending Test on Wood and Mild steel.
   h) Plastic deflection
   i) Compound stress
   j) Torsion
   k) Thick and thin cylinders
   l) Glass fibres
   m) Carbon fibres
   n) Hoop stress
   o) Varignons theorem
   p) Euler–Bernoulli beam theory
   q) Trusses
   r) Statically indeterminate structures
   s) Prismatic beam

NOTE:
1. Students should select any one of the above or other topics relevant to the subject approved by the concerned faculty, individually or in a group of 3 to 5. Students should mandatorily submit a written report and make a presentation on the topic. The task should not be repeated among students. Report will be evaluated by the faculty as per rubrics. Weightage for 5 marks Internal Assessment shall be as follows: (Unsatisfactory **1,** Developing **2,** Satisfactory **3,** Good4**,** Exemplary **5**)
2. Reports should be made available along with bluebooks to IA verification officer

Example of model of rubrics / criteria for assessing student activity

Dimension	Students score (Group of five students)				
	STUDENT 1	STUDENT 2	STUDENT 3	STUDENT 4	STUDENT 5
Rubric Scale	Unsatisfactory **1**, Developing **2**, Satisfactory **3**, Good **4**,Exemplary5				
1.Literature	1				
2.Fulfill team's roles & duties	4				
3.Conclusion	3				
4.Convensions	5				
Total	13				
Average=(Total /4)	3.25				
Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks One activity to attain last CO (course outcome) may be given to a group of FIVE students					

Note: Dimension should be chosen related to activity and evaluated by the course faculty

Dimension	Rubric Scale				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary
1.Literature	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed
2.Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles
3.Communication	Poor	Less Effective	Partially effective	Effective	Most Effective
4.Convensions	Frequent Error	More Error	Some Error	Occasional Error	No Error

Course Assessment and Evaluation Scheme:

	What		To whom	When/Where (Frequency in the course)		Max Marks	Evidence collected	Course outcomes
Direct Assessment meth	CIE	IA	Students	Thrice test (Average of three tests)	Test 1	20	Blue books	CO1,CO2
					Test 2			CO3,CO4
					Test 3			CO5, CO6,CO7
				Activities		05	Written Report	CO8
	SEE	End Exam		End of the course		100	Answer scripts at BTE	1,2,3,4,5,6,7
Indirect Assessment	Student Feedback on course		Students	Middle of the course			Feedback forms	1, 2,3 Delivery of course
	End of Course Survey			End of the course			Questionnaires	1,2,3, 4 & 5, 6, 7 Effectiveness of Delivery of instructions & Assessment Methods

*CIE – Continuous Internal Evaluation   *SEE – Semester End Examination

Note: I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

Weightage of Marks and blue print of marks for SEE

Unit	Major Topics	Hours Allotted	Questions to be set for SEE					Marks weightage	weightage (%)	A*	B*
			Cognitive Levels								
			R	U	Ap	Ay	C				
1	Introduction to engineering mechanics	5	33.33% **5**	33.33% **5**	33.34% **5**	0.00% **0**	0.00% **0**	15	10	1	1
2	Simple stresses and strains	10	20.00% **5**	20.00% **5**	40.00% **10**	20.00% **5**	0.00% **0**	25	19	1	2
3	Geometrical properties of sections	10	20.00% **5**	20.00% **5**	60.00% **15**	0.00% **0**	0.00% **0**	25	19	1	2
4	Bending moments and shear force	10	10.00% **3**	10.00% **3**	20.00% **6**	20.00% **6**	40.00% **12**	30	19	2	2
5	Theory of simple bending	8	10.00% **2**	20.00% **4**	20.00% **4**	20.00% **4**	30.00% **6**	20	15	2	1
6	Slope and deflection of beams	4	20.00% **3**	13.33% **2**	40.00% **6**	26.67% **4**	0.00% **0**	15	8	1	1
7	Columns	5	13.33% **2**	20.00% **3**	40.00% **6**	26.67% **4**	0.00% **0**	15	10	1	1
	Total	**52**	18.1% **25**	18.6% **27**	35.9% **52**	15.9% **23**	12.4% **18**	**145**	**100**	**9**	**10**

Legend- R; Remember U: Understand Ap: Application Ay: Analysis C: Creation E: Evaluation

A*-SEE questions to be set for (05marks) in Part – A

B*- SEE questions to be set for (10marks) in Part – B

Questions for CIE and SEE will be designed to evaluate the various educational components such as:

Sl. No	Bloom's taxonomy	% in Weightage
1	Remembering and Understanding	37
2	Applying the knowledge acquired from the course	36
3	Analysis	16
4	Synthesis (Creating new knowledge)	12
5	Evaluation	0

FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year		Course/Course Code	Max Marks
Ex: I test/6 th weak of sem 10-11 Am	I/II SEM			20
	Year:			
Name of Course coordinator :				Units:__ CO's:____

Questio n no	Question	MARKS	CL	CO	PO
1					
2					
3					
4					

Note: Internal choice may be given in each CO at the same cognitive level (CL).

CIVIL

Model Question Paper for CIE(Tests)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks
Ex: I test/6 th week of sem 10-11 Am	III SEM	Engineering Mechanics And Strength Of Materials	20
	Year: 2015-16	Course code:15CE31T	

Name of Course coordinator :
Course outcome :CO1, CO2   Note: Answer all questions

	Question	M	CL	CO	PO
1	List different classification of force system	4	R	1	1,2
2	Differentiate between moment and couple?	4	U	1	1,2
3	Define: modulus of resilience. A ceiling fan hanging over a rod of 1.50 m long and outer diameter 20mm and thickness 2mm is subjected to an axial pull of 20 KN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm^2, Determine 1. Stress 2.Strain 3.Elongation of the rod. OR Define: Proof resilience. Determine the total elongation of the component, if its modulus of Elasticity is 200GPa 160KN A$_1$=50mm^2 A$_2$=100mm^2 160KN A B C	6	UAp	2	1,2,5
4	Write an expression between modulus of elasticity and modulus of rigidity ?The ultimate stress for a hollow steel column which carries an axial load of 2MN is 500 N/mm2 .If the external diameter of the column is 250mm, determine the internal diameter Take the factor of safety as 2.	6	R/Ap	2	1,2,6

📕 **TEXT BOOKS**

1. Ramamurtham. S., *"Strength of Materials",* 14th Edition, Dhanpat Rai Publications, 2011
2. Khurmi R S, *"Applied Mechanics and Strength of Materials ",* 5 Edition, S.Chand and company
3 S SBhavikatti, Strength of Materials.
3. Fundamentals of strength of materials by P N Chandramouli" PHI New delhi
4. Basavarajaiah and Mahadevappa, "Strength of Materials", CBS Publishers, New Delhi.
5. Ferdinand Singer, "Strength of Materials", Harper and Row Publications
6. Srinath L S, Prakash Desayi,.Srinivasa Murthy N, S.AnanthaRamu, "Strength of Materials", MacMillan, India, New Delhi.
7.

REFERENCES
1. Madan Mohan das, Mimi das Saikia, Bhargab Mohan das – Basic Engineering Mechanics And Strength of Materials- PHI Learning private limited, New Delhi.
2. Popov E.P, *"Engineering Mechanics of Solids",* 2nd Edition, Prentice-Hall of India, New Delhi, 2002.
3 Nash W.A, *"Theory and problems in Strength of Materials",*Schaum Outline Series, McGraw-Hill Book Co., New York, 1995.
4 Kazimi S.M.A, *"Solid Mechanics"*, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
5 Ryder G.H, *"Strength of Materials",* 3rd Edition, Macmillan India Limited, 2002.
6 Bansal R. K, *"Strength of Materials",*Laxmi Publications, New Delhi, 2012.
7 Timoshenko S.P, *"Elements of Strength of Materials",* Tata McGraw-Hill, Delhi.
8 James M. Gere, "Mechanics of Materials" - (5th Edition), Thomson Learning.
9 Beer & Johnston, "Mechanics of Materials", TATA McGraw Hill.
10 E P Popov, "Mechanics of Solids", Prentice Hall of India.
11 Relevant IS Codes

E–Learning

1. http:// nptel.ac.in
2. http://nptel.ac.in/courses/Webcoursecontents/IITROORKEE/strength%20of%20materials/homepage.htm
3. http://nptel.ac.in/courses/105105108/
4. http://theopenacademy.com/content/strength-materials
5. http://www.slideshare.net/Nuumero1/strength-of-materials-and-mechanics-of-solids-by-r-k-rajput
6. http://www.eng.uokufa.edu.iq/staff/wissam/Strength%20Material-2.pdf
7. http://www.learn2build.in/free/ebooks/appliedstrength.pdf
8. http://engineeringfreedownload.blogspot.jp/search/label/manual

Model Question Paper
Diploma in Civil Engineering
3RD semester
Course title: **STRENGTH OF MATERIALS**
Time; 3Hrs.Max.marks: 100

Part –A
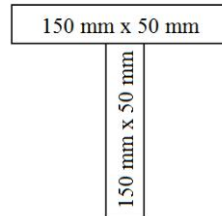### Answer any six each question carries 5 marks

1. Differentiate between moment and couple?
2. State "Parallel axis and perpendicular axis" theorem
3. Draw Stress-strain curve for mild steel? Define terms ultimate stress, working stress and factor of safety.
4. Show that cantilever beam with w kN/m UDL overall its length has maximum shear force is $= wl$ and maximum bending moment$= \frac{wl^2}{2}$
5. Name the types of beams, loading and supports with sketches?
6. What are the assumptions in theory of simple bending?
7. State moment area method? Derive an expression for the slope and deflection for a cantilever carrying UDL w/ unit length over the span L by moment area method.
8. Calculate polar MI of square section having 200mm as side.
9. What is effective length of column? With neat sketches mention the length and crippling load of columns for different end conditions?
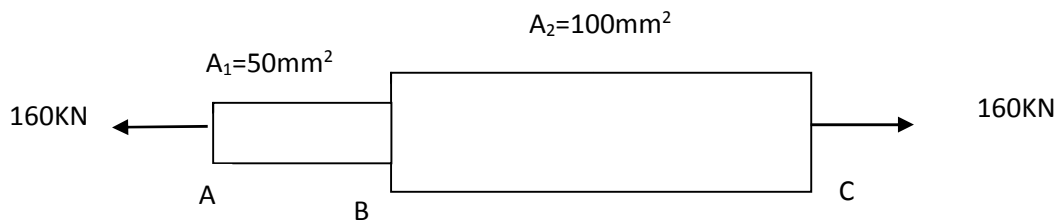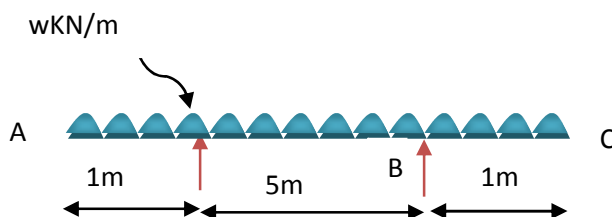
10. a) Classify force system according to plane and line of action?
    b) Find the horizontal and vertical component of following forces
       A. 20kN acting at an angle 30° to the horizontal
       B. 40kN acting at an angle 60° to the vertical.
11. Find radius of gyration about x-x axis of symmetrical T-section shown in figure

150 mm x 50 mm

150 mm x 50 mm

12. a)Compare between centroid and centre of gravity ?
    b)Find the centroid about X-axis and Y-axis for an angle section having dimensions 100 mm x 80 mm x 20 mm. where 100 mm side is vertical
13. Determine the total elongation of the component, if its modulus of Elasticity is 200GPa

$A_2=100mm^2$

$A_1=50mm^2$

160KN

160KN

A

B

C

14. A square bar 6mm x6mm in cross section having modulus of rigidity 0.8×10^5 the cross section of the bar is reduced to 5.9991mm x 5.9991mm after the application of tensile load of 3600 N, Determine the modulus of elasticity and poisons ratio.
15. A simply supported beam of a span 6 m carries a udl of 10 KN/m over 4 m length from the left support and a udl of 5 KN/m over remaining length along with a point load of 20KN at 4m from the left support. Draw SF diagram.
16. Draw the bending moment and shear force diagram for the below figure

wKN/m

A

C

1m   5m   B   1m

17. Sketch the bending stress distribution diagram across the cross section of a rectangular beam section 230 × 400 m subjected to 60 KNm
18. A column of timber section 150 x 200mm is 6m long, both ends being fixed. Find the safe load for the column. Use Euler's formula and allow a factor of safety of 3 Take E $=17500N/mm^2$
19. A cast iron beam 50mm wide and 80mm deep is simply supported on a span of 1m .the beam caries a point load of 2kN at the centre. find the deflection at the centre take E=1x $10^5 N/mm^2$.

Model Questions Bank

Unit 1-Introduction To Engineering Mechanics

Cognitive level -Remember

What are the characteristics of a force?

Define resultant of a force system?

Cognitive level -Understand

Differentiate between Concurrent and non concurrent force system ?

Differentiate between coplanar and non-coplanar force system?

Differentiate between like parallel and unlike parallel force system ?

Differentiate between moment and couple ?

State the principle of transmissibility of forces

State the conditions of equilibrium?

Cognitive level -Application

Find the horizontal and vertical component of the following forces.
   A. 20kN acting at an angle 30° to the horizontal
   B. 40kN acting at an angle 60° to the vertical

Unit 2-Simple Stresses And Strains

Cognitive level -Remember

What are the Elastic Constants?

Define: Resilience, proof resilience and modulus of resilience.

Define stress and strain.

Define Shear stress and Shear strain.

Define elastic limit.

Define volumetric strain.

Define tensile stress and compressive stress.

Define young's Modulus.

Define modulus of rigidity.

Define thermal stress.

Define Punching shear

Write an expression between modulus of elasticity and modulus of rigidity ?

Define plasticity and stiffness.

Define Poisons Ratio & modular of elasticity.

Write an expression between modulus of elasticity and modulus

What is meant by direct stress?

Explain the terms ultimate stress, working stress and factor of safety.

Cognitive level -Understand

What is Hooke's Law?

Define Poisson's Ratio.

Distinguish between rigid and deformable bodies.

Define Hardness & Brittleness.

Draw stress-strain diagram for ductile material.

Distinguish between lateral strain and longitudinal strain, nominal stress

Distinguish between lateral strain and longitudinal strain, nominal stress

 Draw the stress strain curve for ductile material and explain the term ultimate stress.

Define hooks law? Write relation between modulus of elasticity, modulus of rigidity and bulk modulus?

A rod of 1.50 m long and diameter 20mm is subjected to an axial pull of 20 KN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm2 Determine 1. Stress 2. Strain 3. the elongation of the rod.

The extension in a rectangular steel bar of length 400mm and thickness 10mm is found to 0.21mm .The uniformly in width from 75mm If E for the bar is 2×10^5 N/mm2 , Determine the axial load on the bar.

A square bar 30mm of 2.50 m long is subjected to an axial pull of 30 KN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm2 Determine 1. Stress 2. Strain 3. the elongation of the rod

Find the young's modulus of a rod of diameter 30mm and of length 300mm which is subjected to a tensile load of 60 KN and the extension of the rod is equal to 0.4 mm

The extension in a rectangular steel bar of length 400mm and thickness 3mm is found be 0.21mm .The bar width 60mm E for the bar is 2×10^5 N/mm2 Determine the load on the bar.

The ultimate stress for a hollow steel column which carries an axial load of 2MN is 500 N/mm2 .If the external diameter of the column is 250mm, determine the internal diameter Take the factor of safety as 2.

A strut as an internal diameter 150mm. what should be the minimum external diameter so that it may carry a load of 1500KN with a factor of safety 4, ultimate stress of steel is 450 N/mm2.

A square steel bar of hollow cross-section subjected to a tensile load of 60KN with an internal dimension 25X25mm. determine thickness of the bar if the ultimate stress in the bar should not exceed 400N/mm2 with a factor of safety 4.

A square bar 6mm x6mm in cross section having modulus of rigidity 0.8×10^5 the dimension of the bar is reduced to 5.9991mm x 5.9991mm after the application of tensile load of 3600 N, Determine the modulus of elasticity and poisons ratio.

A BAR shown in figure is subjected to a tensile load of 150kN find the diameter of middle section if the stress is limited to 140N/mm2 also find length of the middle portion if the total elongation of the bar is to be 0.15mm take E= 2×10^5 N/mm2

Cognitive level -Analysis

A load of 5KN is to be raised with the help of a steel wire. Find the minimum diameter of the steel wire, if the stress is not to exceed 100MPa.

A steel wire of 5mm diameter is bending into a circular shape of 5 m radius. Determine the minimum bending stress induced in the wire. Take E=200GPa.

A hollow steel column of external dia. 260 mm is required to carry on axial load of 2000 kN. If the ultimate stress of steel is 480 N/mm2, calculate the internal dia. of column taking factor of safety as 4.

Rails of 15 m length were laid on the track when the temperature was 200C. A gap of 1.8 mm was kept between two consecutive rails. At what max temperature the rails will remain stress free? If the temperature is raised further by 150C, what will be the magnitude and nature of stresses induced in the rails?

A steel bar 2.5m long is at a temperature of 200c. Find the free expansion of the bar when the temperature of the bar is raised to 650c. Also find the magnitude & nature of stress developed if the expansion is fully prevented.

A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on a gauge length of 200 mm is 0.09 mm and change in diameter is 0.039 mm. Calculate the poison's ratio and modules of elasticity.

For a certain material E=K, calculate G & Poisson's ratio.

A cube 200mm side is subjected to a compressive force of 3.6MN on each face. Calculate E & K if change in volume is 5000mm3. Take μ = 0.28.

A bar ABCD such that AB=0.75m long & 30mm in diameter, BC=0.5m long & 16mm in diameter, CD=0.75m long & 20mm in diameter is subjected to a tensile load of 180kN at its end. Calculate the change in length of the bar. Use E=200kN/mm2

A brass rod 300mm long & 25mm in diameter is fixed inside a steel tube having 45mm as external & 25mm as internal diameter of same length. Calculate the load sheared by each metal if the assembly is loaded with an axial pull of 120kN. Use Es=200kN/mm2, EB=110kN/mm^2

A BAR shown in figure is subjected to a tensile load of 150kN find the diameter of middle section if the stress is limited to 140N/mm^2 also find length of the middle portion if the total elongation of the bar is to be 0.15mm take E= 2x10^5 N/mm^2

.Determine the total elongation of the component, if its modulus of Elasticity is 200GPa.

A bar 800mm long consists of 3 different cross-sectional areas, first 300mm of its length it is 30mm x 30mm square in section, second 400mm length the bar is 20mm in diameter and 40mm x 40mm square in section for the remaining length if the bar is subjected to an axial tensile load of 60KN determine the stresses in the three parts and the total extension.

A square bar 30mm x30mm in section is subjected to axial forces as shown in figure, find the total change in the bar

A square bar 30mm x30mm in section is subjected to axial forces as shown in figure, find the total change in the bar

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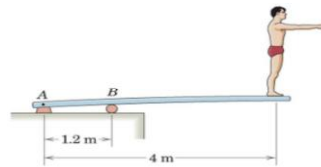| Unit 4-Bending Moments And Shear Force |
|---|
| **Cognitive level -Remember** |
| Write the relationship between loading, Shear force & Bending moment. |
| Define with sketches types of loading and supports. |
| Define point of contra flexure |
| **Cognitive level -Understand** |
| Name the types of beams, loading and supports with sketches? |
| Come out with the relation between bending moment, shear force and rate of loading |
| **Cognitive level -Application** |
| A simply supported beam of span 'L' is subjected to udl of 'w'/unit length. Draw S.F. diagram. and B.M. diagram. Find maximum shear force and maximum bending moment. A simply supported beam of span 'L' is subjected to centrally placed W KN. Draw S.F. diagram. and B.M. diagram. Find maximum shear force and maximum bending moment. A cantilever beam of span 'L' is subjected to udl of 'w'/u nit length. Draw S.F. diagram. and B.M. diagram. Find maximum shear force and maximum bending moment. Draw the bending moment and shear force diagram for a given figure where weight of man is 84 kg (823.7586 Newton) |
| **Cognitive level -Analysis** |
| A simply supported beam of 5 meter span carrying point loads 15 KN, 30 KN, 10 KN at distances of 2m, 3m, & 4 meter respectively from the left end. Draw S.F. diagram and B.M. diagram. State the maximum SF induced in a cantilever of span 4m & carrying a point load of 30kN at its free end. A cantilever beam 2 meter long carries a UDL of 1.5 KN/m over a length of 1.6 m from the free end. Draw shear force and bending moment diagram for the beam. Draw the bending moment and shear force diagram for a given figure where weight of man is 84 kg (823.7586 Newton) Construct the S. F. D. and B. M. D. for the overhanging beam shown in Figure A simply supported beam of a span 6 m carries a udl of 10 KN/m over 4 m length from the left support and a udl of 5 KN/m over remaining length along with a point load of 20KN at 4m from the left support. Draw SF diagram. An overhanging beam ABC, such that span AB = 6 m & overhang BC = 2m carries a UDL of 12 KN/m over entire span ABC and two point loads 10KN at 4m from the left support A & of 5kN at free end C. Draw SF diagram. Draw BM diagram for the beam given in & calculate the point of contra flexure if any. |

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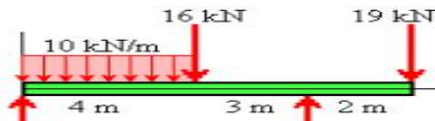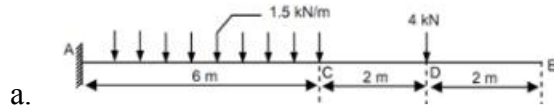| Cognitive level -Creation |
| --- |
| A beam AB 10 m long has hinged supports at its ends A and B .It carries a point load of 5KN at 3 meters from A and a point load of 5KN at 7 meters from A and audl of 1KN per meter between the point loads. Draw S.F. Diagram and B.M. diagram for the beam. |
| A cantilever beam 1.5 meter long is carrying point loads 1000N each at a distance of 0.5 meter, 1.0 meter, and 1.5 meter from the fixed end. Draw S.F. diagram and B. M. diagram for the cantilever beam. |
| A simply supported right side overhanging beam supported at 4 meter and right side 1meter overhang. A Loaded by udl 10 KN /m over entire span. Draw S.F. diagram and B.M diagram. |
| Construct the S. F. D. and B. M. D. for the cantilever beam shown in Figure |
| A simply supported beam of a span 7 m carries audl of 5 KN/m over 4 m length from the left support and a point load of 50 KN at 2m from the right support. Draw SF & BM diagram. |
| A Cantilever of span 3 m carries audl of 4 KN/m over entire span and a point load of 5 KN at 2m from the support. Draw SF and BM diagrams. |
| Construct the S. F. D. and B. M. D. for the overhanging beam shown in Figure |

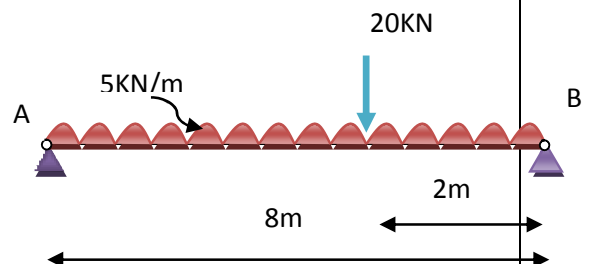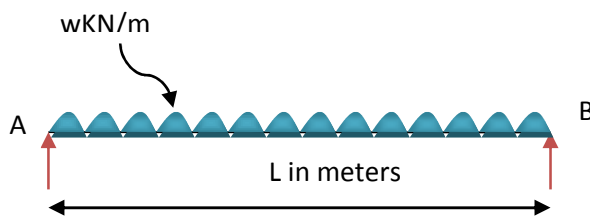Construct the S. F. D. and B. M. D. for the cantilever beam shown in Figure

a.

A)For fig 1Show that maximum shear force is $= \dfrac{wl}{2}$ and maximum bending moment$= \dfrac{wl^2}{8}$

   b.   b) Draw SFD and BMD for figure 2

    1.   2.

Unit 3-Geometrical Properties Of Sections		
Cognitive level -Remember		
Define centre of gravity		
Define centroid		
Cognitive level -Understand		
State Parallel axixtheorm with neat sketch and equation		
State Perpendicular axixtheorm with neat sketch and equation		

Cognitive level -Application
An isosceles triangular section ABC has a base width 80 mm and height 60 mm. Determine the M.I. of the section about centre of gravity of the section and the base BC.

Calculate the MI of circle about XX & YY axis if MI about ZZ axis is 5 x 1012 mm4.Calculate the MI of a rectangular section of size 120mm x 80mm about its longer side.

Calculate the MI of a T-section about the Centrodial axis XX. The top flange is 1200 x 200mm & web is 1800 x 200mm. Total height of the section is of 2000mm.

Calculate the MI of an angle section about the Centro dial axis YY. The longer leg is 150 x 20mm & shorter leg is 100 x 20mm. The longer leg is kept vertical.

Calculate the centre of gravity of the section shown in fig .

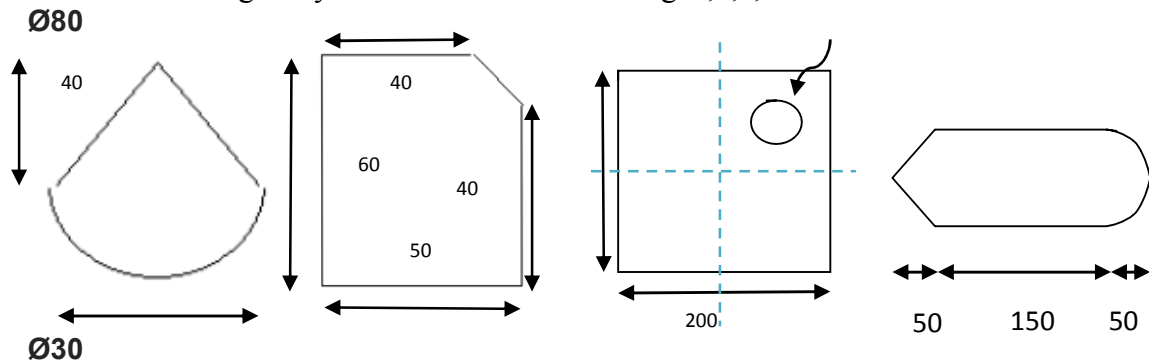Find M.I. of a square 100 mm size about their diagonal.

Find M.I. about x-x axis of T-section having flange 150 mm x 50 mm and web 150 mm x 50 mm, overall depth 200 mm.

An I-section have the following dimensions Top flange 60 mm x 20 mm. bottom flange 100 mm x 20 mm, web 100 mm x 20 mm, overall depth 140 mm .Find the M.I. about y-y axis.

An angle section having dimensions 100 mm x 80 mm x 20 mm. Find M.I. about y-y axis, where 100 mm side is vertical.

An isosceles triangular section ABC has a base width 80 mm and height 60 mm. Determine the M.I. of the section about c.g. of the section and the base BC.

Calculate the centre of gravity of the section shown in fig .a,b,c,d

Ø80

40

Ø30

40

60

40

50

200

50   150   50

Unit 5-Theory Of Simple Bending
Cognitive level -Remember
What is meant by moment of resistance and neutral axis?
Draw shear stress distribution diagram for circular section and define average shear stress.
Define Neutral axis.
Define direct stresses & bending stresses.
Define moment of resistance.
Define shear stress.
Write the Equation for M.I. of Hollow Shaft.
Draw stress distribution diagram if a rectangular section is subjected to direct & bending stresses
Cognitive level -Understand
Differentiate between a) neutral axis and neutral layer b) Moment of resistance and bending moment
State any four assumptions made in the theory of simple bending.
Cognitive level -Application

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A T-beam having flange 200 x 50mm and a web of 200 x 50mm with overall height 250mm is subjected to a shear force of 120kN. Calculate the shear stresses induced in the section & draw the stress distribution diagram. Take I = 1.15x108 mm4 and Ȳ =87.5mm from bottom. Calculate polar MI of square section having 200mm as side.

Cognitive level -Analysis

A simply supported beam of a span 5.8 m is having a cross section of 200 mm wide and 500 mm deep. Calculate the intensity of uniformly distributed load the beam can carry if the bending stress is not to exceed 25 N/mm2.

Cognitive level -Creation

For a T - section with dimensions flange width 100mm, Depth = 200mm and uniform thickness of 40mm. obtain shear stress distribution and calculate maximum and average shear stresses if it is subjected to a S.F. = 100 KN.

Sketch the bending stress distribution across the cross section of a rectangular beam section 230 × 400 m subjected to 60 KNm

Unit 6-Slope And Deflection Of Beams
Cognitive level -Remember
write the relation between slope, deflection and radius of curvature. Define slope Define deflection
Cognitive level -Understand
State moment area method
Cognitive level -Application
A simply supported beam span l meters carries a uniformly distributed load of intensity w kN/m distributed all over its length. Determine the maximum deflection and compare, when same beam with point load at centre of span .

Unit 7-Columns
Cognitive level -Remember
State the effective length for both end hinged column. Define radius of gyration.
Cognitive level -Understand
Write the assumptions made in the Euler's column theory. Define slenderness ratio? state the Limitations of Euler's theory?
Cognitive level -Application
Determine the slenderness ratio for steel column of solid circular section of diameter 150mm and 3.5m effective length
Cognitive level -Analysis
A circular column having 500mm diameter is carrying a load of 180kN at an eccentricity of 300mm from the centrodial axis. Determine the maximum & minimum stresses induced in the section. A hollow cast Iron column having external dimensions 200 x 200 mm and internal dimensions 120 x 120 mm is subjected to a load acting at 50mm from the centrodial axis. Calculate the maximum load the column can carry if permissible stresses in Compression and tension are 600 N/mm2 & 30 N/mm2respectively.

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