B.TECH/CE/3RD SEM/CIVL 2101/2021

FUNDAMENTALS OF STRENGTH OF MATERIALS
(CIVL 2101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The loading on the conjugate beam is the
(a) load actually applied on the given beam
(b) shear force diagram/EI
(c) elastic curve of the beam under the given load system
(d) bending moment diagram/EI.

(ii) Shear force is zero, where bending moment is
(a) Maximum (b) Minimum (c) Changes slope (d) Zero.

(iii) The shape of the bending moment diagram for a simply supported beam carrying udl will be
(a) Triangular (b) Parabolic
(c) Circular (d) Cubical.

(iv) A simply supported beam of length L, cross-section A carrying an udl of W. The value of maximum bending moment will be
(a) $WL^2/2$ (b) $WL^2/8$ (c) $WL^2/4$ (d) $WL^2/16$.

(v) When a rectangular section of a beam is subjected to a shearing force, the ratio of maximum shear stress to the average shear stress is
(a) 2.0 (b) 1.75 (c) 1.5 (d) 1.25.

(vi) The value of Poisson's ratio ranges between
(a) 0 and 0.5 (b) -0.5 and 0.5
(c) 0 and 1 (d) -1 and 0.5.

(vii) Young's modulus of a wire is defined as the stress which will increase the length of wire compared to its original length by
(a) Half (b) Same amount
(c) One-fourth (d) Double.

(viii) The radius of Mohr's circle when the particle is subjected to pure shear stress τ is
(a) τ/2 (b) τ (c) 2τ (d) 0.

(ix) The radius of Mohr's circle of stress of a strained element is 20 MPa and minor principal tensile stress is 10 MPa. The major principal stress is
(a) 30 MPa (b) 50 MPa
(c) 60 MPa (d) 100 MPa.

(x) The ratio of critical buckling load for columns with both ends hinged to columns with both ends fixed is
(a) 0.25 (b) 4 (c) 0.5 (d) 2.

Group – B

2. (a) Determine the location of centroid of the area shown in Fig. 1 with an opening (PQRS) in it. [(CO1)(Evaluate/HOCQ)]

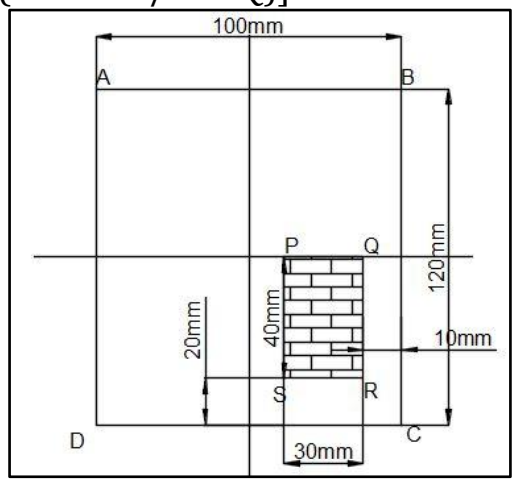

Fig.1

(b) Compute the moment of inertia (about both the centroidal axes) of the above mentioned figure. [(CO1)(Evaluate/HOCQ)]

6 + 6 = 12

3. (a) Determine the stresses in various segments of the circular bar.
(i) Compute its total elongation assuming modulus of elasticity of steel = 195 GPa.
(ii) Determine the length of the middle segment so that the bar length does not change under the applied loads. [(CO1) (Evaluate/HOCQ)]

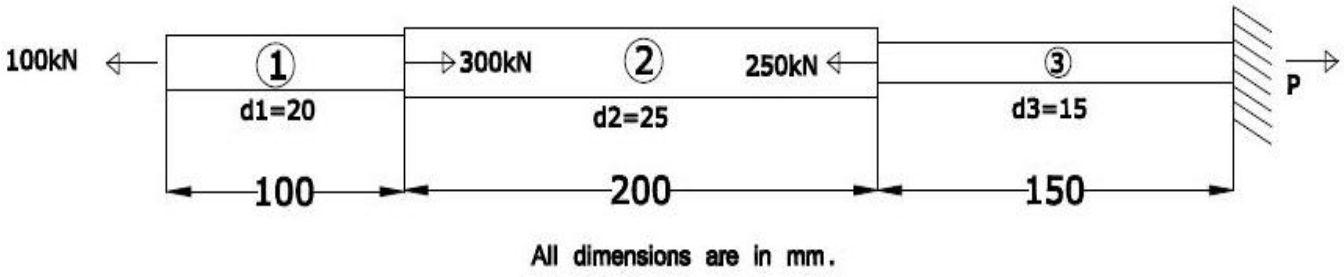

Fig.2

(b) Draw and explain the stress-strain diagram of mild steel. [(CO2)(Evaluate/HOCQ)]

6 + 6 = 12

Group – C

4. Apply the concept of shear force and bending moment to draw the SFD and BMD of the following. [(CO4)(Apply/IOCQ)]

(i)

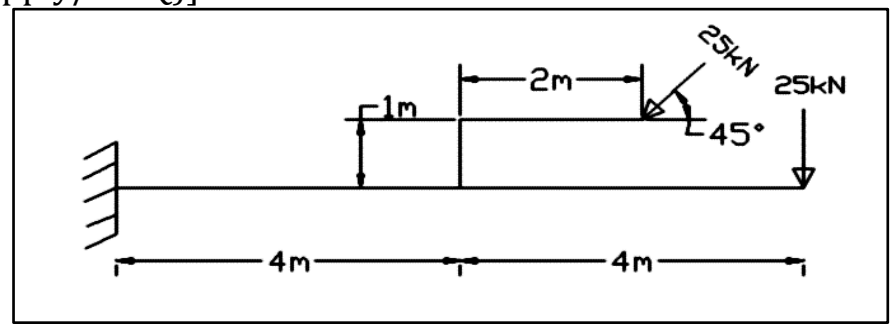

Fig.3

(ii)

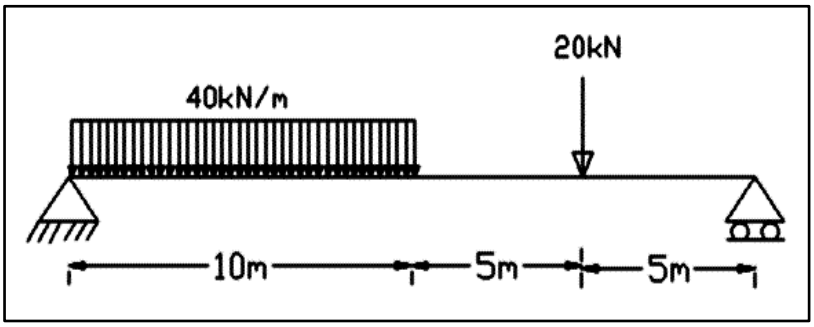

Fig.4

(6 + 6) = 12

5. (a) A cylindrical steel pressure vessel 400 mm. in diameter with a wall thickness of 20 mm. is subjected to an internal pressure of 4.5 MPa.
   (i) Calculate the hoop stress and meridonial stress in the steel.
   (ii) To what value may the internal pressure be increased if the stress in the steel is limited to 120 MPa. [(CO3) (Evaluation/HOCQ)]

   (b) An element is subjected to pure shear where the shear stress is 90 N/mm^2. Draw a Mohr Circle and identify the principal plane. What are the major and minor principal stresses? [(CO3)(Create/HOCQ)]

6 + 6 = 12

Group – D

6. (a) Recall the assumptions in Theory of simple bending. [(CO3)(Remember/LOCQ)]
   (b) Show that the following relation holds true. Symbols have their usual meanings.
   $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ [(CO3)(Remember/LOCQ)]
   (c) A timber beam 100mm wide and 150mm deep supports a uniformly distributed load over a span of 2m. If the safe stresses are 28 N/mm^2 longitudinally and 2 N/mm^2 in transverse shear. Determine the maximum load that can be supported by the beam. [(CO3)(Analyse/IOCQ)]

4 + 4 + 4 = 12

7. (a) Find out the member forces in the truss as shown in Fig. 5 using method of joints. [(CO3)(Analyze/IOCQ)]

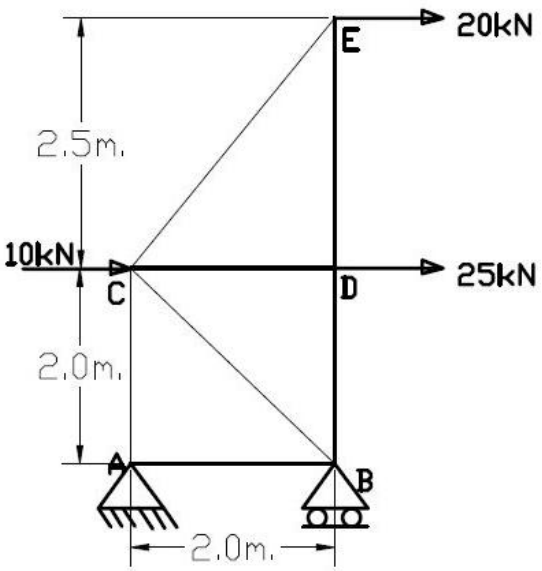

Fig.5

(b) Determine the maximum stress and deformation of a shaft of 100 mm. external diameter, 10 mm. wall thickness and 2.7 m. length subjected to a torque of 30 kN-m. Assume G = 75 GPa for the material. [(CO5)(Evaluate/HOCQ)]

7 + 5 = 12

Group – E

8. A beam of span L carries a point load as shown in Fig. 6. The moment of inertia (I) of the beam varies as shown. Evaluate slope and deflection at the free end and at the midpoint. Use conjugate beam method. Assume material to be uniform throughout. [(CO4) (Evaluation/HOCQ)]

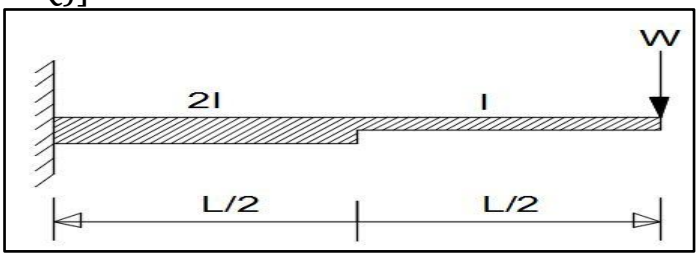

Fig.6

12

9. (a) Find out the critical load for a long column having one end fixed and other end free using Euler'theory. The column has length '*l*', uniform cross-sectional area 'A' and rigidity 'EI'. [(CO6) (Analyse/IOCQ)]

(b) Determine the minimum thickness required for a steel pipe column of outer diameter 160 mm. and 7.2 m. length, to carry an axial load of 200 kN. Assume a factor of safety of 2.5. Take E = 200kN/mm^2. [(CO6) (Evaluation/HOCQ)]

6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	8.4	30.2	61.4

Course Outcome (CO):

After the completion of the course students will be able to

1. Illustrate the equilibrium conditions and the concept of centre of gravity, moment of inertia of various sections.
2. Explain the elastic properties of ductile and brittle materials through stress-strain curves.
3. Determine various types of forces and stresses developed in structural elements.
4. Calculate the bending moment, shear force and deflection of beams along with developed strain energy under various loads and shear center and shear flow of prismatic sections.
5. Identify torsional moment and twist on a circular shaft.
6. Calculate the buckling load of columns using Euler's theory for different support conditions.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission Link
CE & SEC A	https://classroom.google.com/c/NDA2MDAyNjYzNjcy/a/NDc0NjQ4MDM3NDAz/details
	Classroom joining link: https://classroom.google.com/c/NDA2MDAyNjYzNjcy?cjc=eil4p6v
CE & SEC B	https://classroom.google.com/c/NDA2MDAyNjYzNjk0/a/NDc0NjQ4MDM3NTEx/details
	Classroom joining link: https://classroom.google.com/c/NDA2MDAyNjYzNjk0?cjc=kyzwnsi
Backlog	https://classroom.google.com/c/NDc1MTQxNjg0MzUz/a/NDc1MTQyNzcyNzAy/details
	Classroom joining link: https://classroom.google.com/c/NDc1MTQxNjg0MzUz?cjc=vcbqns7