*Please check that this question paper contains 09 questions and 04 printed pages within first ten minutes.*

[Total No. of Questions: 09] [Total No. of Pages: 04]

Uni. Roll No. .....

EVENING

05 JAN 2023

Program: B.Tech. (Batch 2018 onward)
Semester: 5th
Name of Subject: Structural Engineering
Subject Code: PCCE-113
Paper ID: 16390
Scientific calculator is Allowed

**Detail of allowed codes/charts/tables etc.** – IS 456, IS 800 and Steel Table

**Time Allowed: 03 Hours** **Max. Marks: 60**

**NOTE:**

1) Parts A and B are compulsory
2) Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice
3) Any missing data may be assumed appropriately
4) Use of IS 456, IS 800, steel table and scientific calculator is allowed.

**Part – A** **[Marks: 02 each]**

**Q1.**

a) Discuss in brief, basic principles of structural analysis.

b) Compare the *merits* and *demerits* of a RC structure with that of a steel structure.

c) What do you mean by a *primary structure*? Also, draw all the possible primary structures for a propped cantilever.

d) Differentiate between *one-way slab* and *two-way slab*.

e) Why is the distribution steel tied above the main steel? Also, list the purpose of providing the distribution steel.

f) Why are RC slabs usually designed as under-reinforced sections and are not checked for shear in the routine design process?



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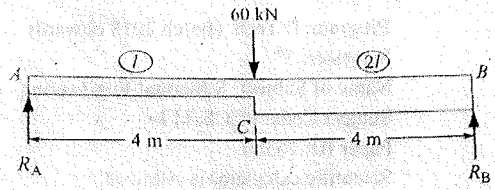
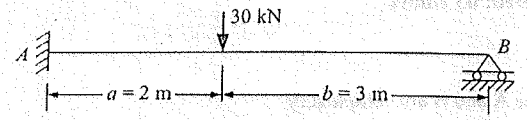
**Part – B** **[Marks: 04 each]**

**Q2.** Use any suitable method to determine the slope and deflection under the load of the beam shown in figure below.




**Q3.** Determine the reaction components in the propped cantilever shown in figure below. *EI* is constant throughout.




**Q4.** Derive an expression for obtaining maximum percentage of tensile steel for a balanced section of a RC beam.

**Q5.** Design a short column to carry a factored axial load of 920 kN. One side of the column is restricted to 250 mm. Use M20 grade of concrete, Fe 415 steel and 20 mm dia. bars for longitudinal steel. Also illustrate the reinforcement details by sketching the column cross-section.

**Q6.** Determine the area of steel (and no. of bars) required in a square footing of uniform thickness for an axially loaded column of 400 mm × 400 mm in size. The safe bearing capacity of soil if 200 kN/mm$^2$, load on column = 1000 kN. Use M20 grade of concrete and Fe 415 steel.

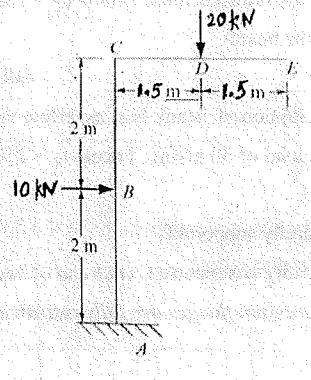
**Q7.** Propose a suitable section for a column of rolled steel I-section to carry an axial load of 500 kN. The column is 4 m long and is effectively held in position at both ends but restrained against rotation at one end only. Take yield stress in steel as 250 N/mm$^2$.



P.T.O.

**Part – C** **[Marks: 12 each]**

**Q8.** Determine the vertical and horizontal deflection at the free end of the bent shown in figure below. Assume uniform flexural rigidity EI throughout.

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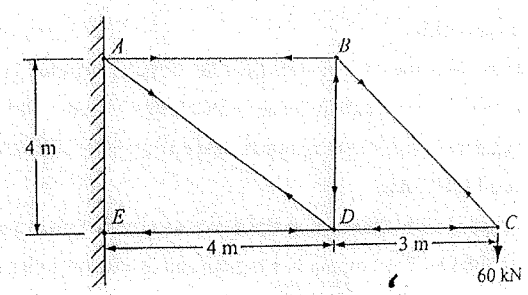
OR

Determine the vertical deflection of point D in the figure shown below. The cross-sectional areas of members AD and DE are 1500 $mm^2$ while those of the other members are 1000 $mm^2$. Tale E = 200 $kN/mm^2$.






P.T.O.

**Q9.** Design a simply supported RC beam with the following data:

Clear span = 5 m, Superimposed deal load = 20 kN/m and Live load = 15 kN/m.

Use Fe 415 steel. *Assume that the beam is located inside the building.*

Also, give the reinforcement details by illustrating the longitudinal section and cross-section of the beam.

OR

A simply supported beam has an effective span of 7 m and carries a uniformly distributed load of 50 kN/m. Taking $f_y$ = 250 $N/mm^2$ and E = $2 \times 10^5$ $N/mm^2$, design the beam, if

(a) it is laterally supported

(b) it is laterally unsupported *(each end of beam is restrained against rotation and ends of compression flanges are fully restrained against lateral bucking)*

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