

Total number of printed pages-4

53 (CE 501) DGST-I

2021

**DESIGN OF STRUCTURE-I**

Paper : CE 501

Full Marks : 100

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

Answer **any five** questions.

1. Given percentages of tension steel ( $p_t$ ) and compression steel ( $p_c$ ) of a doubly-reinforced section, how is it possible to decide whether the beam is under-reinforced or over-reinforced at the ultimate limit state? A doubly-reinforced beam section of size  $250 \times 400$  total depth is reinforced as 3-22 $\phi$  as compression steel and 3-28 $\phi$  as tensile steel. Assuming M 20 concrete and Fe 415 steel, determine ultimate moment of resistance. Assume clear cover = 30mm.

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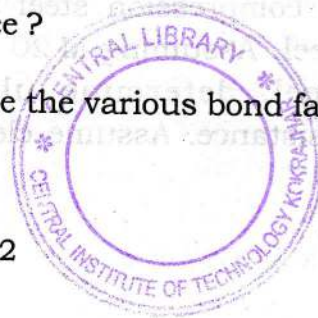
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2. The term balanced section is used in both Working Stress Method (WSM) and Limit State Method (LSM). Discuss the difference in meaning.

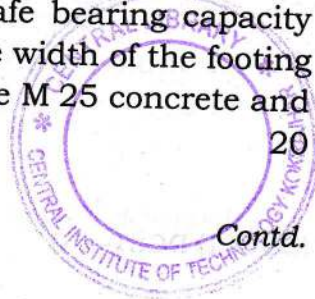
A rectangular reinforced concrete beam, its size limited to  $250 \times 400\text{mm}$  is located in a coastal town is simply-supported on two  $230\text{mm}$  thick masonry wall and 6 metre apart centre-centre. The beam has to carry in addition to its own weight, a distributed live load of  $10\text{kN/m}$ , a dead load of  $5\text{kN/m}$  and a concentrated dead load of  $30\text{kN}$  placed at the midspan point. Assuming the beam subjected to moderate exposure condition and Fe 415 steel, design the beam section.

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3. (a) Explain clearly the difference between flexural bond and development bond. What is development length? What is its significance? 5
- (b) Briefly describe the various bond failure mechanisms. 3



- (c) Define shear reinforcement with figure. A reinforced concrete beam of size  $250 \times 450\text{mm}$  effective depth is reinforced with 3- $28\phi$  as tensile reinforcement. The shear reinforcement consists of 2-legged  $8\phi$  stirrup @  $150\text{mm}$  c/c. Estimate the shear capacity of the section for M 25 concrete and Fe 415 steel. 12
4. Explain the need of corner reinforcement in two-way rectangular slabs whose corners are prevented from lifting up. Design a reinforced concrete slab for a room of clear dimensions of  $3.5\text{m} \times 4.5\text{m}$ , having one long edge discontinuous. The slab is supported on walls of thickness  $320\text{mm}$ . The slab is carrying a live load of  $3\text{kN/m}^2$  and a floor finish of  $0.8\text{kN/m}^2$ . use M 25 concrete and Fe 415 steel. 20
5. Design an isolated footing to support a column of size  $300 \times 400\text{mm}$  to carry an axial load of  $1500\text{kN}$ . The safe bearing capacity of soil is  $130\text{kN/m}^2$ . The width of the footing is limited to  $3\text{m}$ . Assume M 25 concrete and Fe 415 steel. 20



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6. (a) Distinguish between unsupported length and effective length of a compression member. What is meant by slenderness ratio of a compression member? 5
- (b) Design a circular column having an axial load of  $2000\text{kN}$ . The unsupported length of the column is  $3.1\text{m}$ . Use M 20 concrete and Fe 415 steel. Consider both ends of the column as effectively held in position but not restrained against rotation. 15

