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Roll No. :

320552(20)

B. E. (Fifth Semester) Examination, Nov.-Dec. 2021

(New Course)

(Civil Engg. Branch)

STRUCTURAL ENGINEERING DESIGN-I

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : In each question, part (a) carries 2 marks and is compulsory; attempt any two parts worth ~~4~~ 6 marks each from the remaining parts. Use of IS-456:2000 code is permitted.

Unit-I

1. (a) Write down two differences between working stress method and limit state method of design. 2

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- (b) The cross-section of a simply supported reinforced beam is 200 mm wide and 300 mm deep to the center of the reinforcement which consists of 3 bars of 16 mm diameter. Determine the depth of NA and the maximum stress in concrete when steel is stressed to 120 N/mm^2 . Take $m = 19$. 7
- (c) Drive an expression for moment of resistance of a balanced rectangular section reinforced only in tension, having width b , effective depth d , area of steel A_{st} , and permissible stresses in steel and concrete as σ_{st} & σ_{cbc} respectively. 7
- (d) A cantilever beam 3m span is to carry a superimposed load of 8 kN/m. The beam has a constant cross-section of 300 mm \times 500 mm throughout. Determine the tension reinforcement if mild steel bars are to be used. Take unit weight of concrete as 25 kN/mm^3 . 7

Unit-II

2. (a) Write the minimum grade of concrete for following : 2
- (i) RCC

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- (ii) RCC exposed to sea water
- (b) Design a balanced singly reinforced concrete beam section for an applied moment of 60 kN-m. The width of the beam is limited to 175 mm. Use M-20 concrete and Fe-415 steel bars. 7
- (c) A reinforced concrete beam has width equal to 300 mm and total depth equal to 700 mm, with a cover of 40 mm to the center of the reinforcement. Design the beam if it is subjected to a total bending moment of 150 kN-m. Use M-20 concrete and HYSD bars of grade 415. 7
- (d) Design the reinforcement for a reinforced concrete beam 300 mm wide and 400 mm deep of grade M20 to resist an ultimate moment of 150 kN-m, using mild steel bars of grade Fe 250. 7

Unit-III

3. (a) Write any two limit state of collapse and two limit states of serviceability. 2
- (b) Design a two way slab for a room 5.5 m \times 4.0 m

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clear in size if the superimposed load is 5 kN/m^2 . Use M-25 concrete and Fe-415 steel. The edges of the slab are simply supported with corners held down. Also draw a neat diagram of reinforcement detailing.

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- (c) A T-beam has the following data : width of flange = 750 mm, breadth of beam = 250 mm, effective depth = 500 mm, thickness of flange = 90 mm. Applied moment = 230 kN-m. Design the beam using M-20 concrete and Fe-415 steel.

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Unit-IV

4. (a) Write down the effective length of following braced and unbraced RC columns for designing.

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- (i) Fixed at both ends.
- (ii) Hinged at both ends.
- (iii) Hinged at one end and fixed at another end.
- (iv) Fixed at one end and free at another end.

- (b) Design an RCC column of size $450 \text{ mm} \times 600 \text{ mm}$.

The axial load under the service load condition is

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2000 kN and unsupported length is 3 m. Use M-20 concrete and Fe-415 steel.

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- (c) Design reinforcement for a spiral column of 500 mm diameter subjected to a factored load of 1500 kN. Column has unsupported length of 3.4 m and is braced against side away. Use M-25 concrete and Fe-415 steel.

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- (d) Design a tied square short column for factored axial load of 1750 kN, and effective length of 3.5 m. Use M-20 concrete and Fe-415 steel.

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Unit-V

5. (a) As per IS-456:2000 what is the minimum thickness at the edge of footing and the minimum clear cover for footing.

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- (b) Design a dog-legged stair for a building in which the vertical distance between floors is 3.6 m. The stair hall measures $2.5 \text{ m} \times 5 \text{ m}$. The line load is 2.5 kN/m^2 . Use M-20 concrete and Fe-415 steel bars.

Also neatly draw the reinforcement detailing.

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(c) Design a rectangular isolated footing of uniform thickness for RC column bearing a vertical load of 600 kN and having a base size of 400 mm × 600 mm. The safe bearing capacity of soil may be taken as 120 kN/m². Use M-20 concrete and Fe-415 steel. Also check for one way shear and two way shear.

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