53 (CE 501) DGST

2019

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. *(a)* State the assumptions made in the theory of elastic bending. Why do we use less factor of safety for steel as compared to concrete? What is modular ratio? What is its significance in design? Give steps for determining the moment of resistance of T-beam.

2+1+1+2+4=10

Contd.

(b) An R.C.C. beam section $300mm \times 500mm$ effective depth is subjected to a load of $12kN/m$ including its self-weight over an effective span of $6m$. It is reinforced with 4 bars of $16mm$ diameter bars. Determine allowable and ultimate moment of resistance. Use M20 grade concrete and Fe 415 steel. 10

2. (a) Explain the stress-strain relationship for concrete and steel (with sketches) used in limit state method of design. Give steps for determining moment of resistance of a rectangular beam section. 3+2=5

(b) Determine the ultimate moment of resistance of a doubly-reinforced beam section of size $250mm \times 400mm$ effective depth, if it is reinforced with $3-22\phi$ as compression reinforcement and $3-28\phi$ as tensile reinforcement. Assume M20 concrete and Fe415 steel. 10

(c) The term 'balanced section' is used in both Working Stress Method (WCM) and Limit State Method (LSM). Discuss the

difference in meaning. Why does the code limit the compressive strength of concrete in structural design to 0.67 f_{ck} and no f_{ck}? 5

3. (a) A rectangular reinforced concrete beam, given that its size is limited to $250mm \times 400mm$, located inside a building in a coastal town, is simply supported on two 230-mm thick and $6m$ apart masonry walls centre-to-centre. The beam has to carry, in addition to its own weight, a distributed live load of $10kN/m$, a dead load of $5kN/m$ and a concentrated dead load of $60kN$ placed at the midspan point. Design the beam section for maximum moment at midspan. Assume Fe415 steel. 12

(b) Also for the beam section given above, design the shear reinforcement at support and midspan. Assume any missing data. 8

4. Define one-way and two-way slabs with figure. Design a reinforced concrete slab for a room of clear dimensions $4m \times 5m$, having two adjacent edges discontinuous. The slab is supported on walls of width $300mm$. The slab is carrying a live load of $4kN/m^2$ and floor finish $1kN/m^2$. Use M20 concrete and Fe415 steel. 20

5. Explain the differences between long and short column. What is the function of transverse reinforcement in a column? Design a circular column having an axial load of $2200kN$. The unsupported length of the column is $3.2m$. Use M25 grade concrete and Fe415 steel. Consider both ends of the column as effectively held in position but not restrained against rotation. 5+15=20

6. Design an isolated footing to support a column of size $250 \times 400mm$ to carry an axial load of $1200kN$. The safe bearing capacity of soil is $130kN/m^2$. The width of the footing is limited to $3m$. Assume M20 concrete and Fe415 steel. 20