Ref. No. *Ex/CE/PC/B/T/314/2024*

.....*B.E. Civil Engineering 3rd Year 1st Semester*..... EXAMINATION, *2024*

SUBJECT .....*Design of Structures - I*.....

PAPER .....--.....

Full Marks 100
(50 marks for this part)

Time: **Three hours**

Use a separate Answer-Script for each part

No. of Questions

PART I

Marks

(Use of IS:456-2000 and SP:16 are allowed in the examination hall)

Answer Q.1 and ANY ONE questions from the rest

Q1. [CO:3] Beam B2-B3-B4 of a R.C. framed building is subjected to the loads (Dead & Live combined) as shown in Fig.1. Calculate the bending moment and shear force at the critical sections of the beam by '**substitute frame method of analysis**'. Design the **flexural and shear** reinforcement of the beam. Apply '**Limit state method of design**'. Floor-to-floor height is **3.6m**. The cross-sectional dimensions may be assumed as **300mmx400mm** for beam and **350mmx350mm** for column. The grade of concrete is **M25** and grade of steel is **Fe500**. Show the reinforcement details in neat sketch. [30]

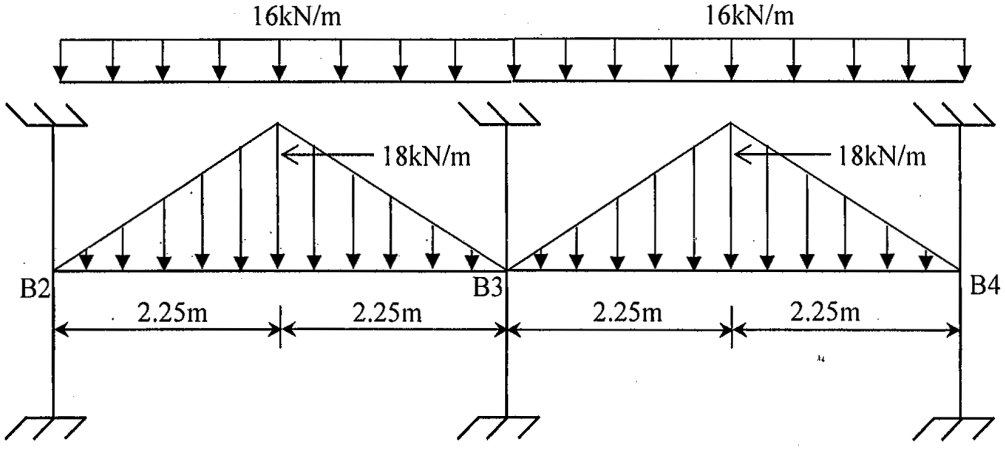

Fig. 1

Q2. [CO:2] Design and detail a ('waist slab' type) dog-legged staircase for an office building based on the data given below: [20]

- Height between floors = **3.2 m**;
- Riser = **160 mm**, Tread = **270 mm**;
- Width of flight = landing width = **1.25 m**;
- Live load = **4.0 kN/m²**;
- Load due to finishes = **0.6 kN/m²**.

Assume the stairs to be supported on 230 mm thick masonry walls at the outer edges of the landing. Grade of concrete is **M20** and grade of steel is **Fe415**. Assume mild exposure conditions. Apply '**Limit state method' of design**.

Q3. [CO:2] A T-beam roof consists of **150mm** thick reinforced concrete slab cast monolithically with **325mm** wide beams spaced **2.25m** centre to centre. The super imposed load (including floor finish, ceiling plaster and live load) over the slab is **4.5kN/m²** and the effective span of each beam is **5.0m**. Design the overall depth, longitudinal reinforcement of any intermediate beam. Grade of concrete is **M20** and grade of steel is **Fe415**. Apply '**Working stress method of design**'. [20]

[Turn over

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B.E. CIVIL ENGINEERING THIRD YEAR FIRST SEMESTER - 2024

SUBJECT: Design of Structures - I

PART-II

Time: 3 Hr. **Full Marks 50**

Use Separate Answer scripts for each Group

No.	**Assume any reasonable values to data not given. Use of IS 456:2000 and SP-16 is allowed.**	
CO1		
1.a)	What is meant by limit state? Discuss the different 'limit states' to be considered in reinforced concrete design?	5
b)	A beam (300mm X 500mm) of effective length 6m, is provided with reinforcement of 3-20Φ bar at tension side and 2-20Φ bar at compression side.	
	i. Find ultimate moment of resistance of the doubly reinforced beam by Limit State Method. Assume M25 concrete and Fe500 steel.	15
	ii. Hence find maximum uniformly distributed dead load and live load (DL+LL) that the beam can carry.	5
	OR	
2. a)	Explain clearly the difference in the behaviour of one-way and two-way slabs.	3
b)	"The deflection of a reinforced concrete flexural member increases with time"-explain the reasons.	3
c)	A floor slab panel of dimension 3m x 4m is supported on 250mm thick reinforced concrete beam, having two adjacent sides discontinuous. Assume a floor finish of 1kN/m^2 and live load 3kN/m^2. Design and detail the slab showing all necessary checks. Use M20 concrete and Fe 415 steel. Assume mild exposure condition. Use Limit State method.	19
CO4		
3. a)	What is meant by slenderness ratio of a compression member. Why is it important in design?	3
b)	Design and detail the reinforcement in a column of size 300mm X 450mm, subjected to a factored axial load of 1000kN and biaxial moments of 150kN-m and 100kNm with respect to the major axis and minor axis respectively. The column has an unsupported length of 3.0m and is braced against sideway in both directions. Use M25 concrete and Fe415 steel. Use Limit State Method. Show all necessary checks.	22
	OR	
4. a)	Define 'development length'. What is its significance?	3
b)	Design and detail an isolated footing for a column (400mm x 500mm) reinforced with 8-20Φ bar and carrying a service load of 2500kN. Assume safe bearing capacity of soil 250kN/m^2 at a depth of 1.2m below the ground. Assume M25 concrete and Fe415 steel both for column and footing. Use Limit State Method. Show all necessary checks.	22