GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2024

Subject Code:3150612   **Date:02-12-2024**

Subject Name:Design of Structures

Time:10:30 AM TO 01:00 PM   **Total Marks:70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**
5. **Use of IS: 456-2000, IS: 800-2007, IS 875 and Steel Table is permitted.**
6. **Steel hand book (SP-6) allowed.**

			Marks
Q.1	**(a)**	Explain the limit state method for deign of reinforced concrete and steel structures.	**03**
	(b)	Differentiate between (1) Pitch and Gauge distance (2) End and Edge Distance and (3) Bolt diameter and Hole Diameter of Bolted Connection	**04**
	(c)	Calculate the design moment capacity of a beam section 300 mm X 450 mm effective depth reinforced with 942 mm^2 tension reinforcement. Justify your answer with suitable section check whether it is balanced, under-reinforced or over-reinforced section. Use grade M25 and 415.	**07**
Q.2	**(a)**	Why the balanced sections are most preferred over Under-reinforced section and Over-reinforced section. Also mention which type of section is avoided in design of singly reinforced beam with suitable reason.	**03**
	(b)	Explain the different types of failures observed in bolted connection with neat sketches.	**04**
	(c)	Design the following joints using the ordinary black bolts between two plates of width 200 mm and thicknesses of 10 mm and 18 mm respectively to transmit a factored load of 160 kN. (i) Lap Joint (ii) Double cover butt joint with 8 mm cover plates. Use plates made by Fe 410 grade steel and 16 mm diameter bolt of grade 4.6.	**07**

OR

	(c)	For a rectangular beam of width 300 mm and effective depth 600 mm with 25 mm cover, the tensile reinforcements are provided by 5 Nos. 25 mm diameter bars for a design shear force of 200 kN. Check whether the nominal shear stress lies between the critical shear stress and maximum permitted shear stress for M20 grade of concrete, i.e. $\tau_v < \tau_c < \tau_{c, max}$.	**07**
Q.3	**(a)**	A balanced reinforced concrete beam of M25 grade and width 450 mm is having a factored limiting moment of 110 kN-m. The grade of steel is of Fe 415. Calculate the effective depth (to nearest multiple of 10) of the section.	**04**

(b) Design a laced column 10.5m long to carry factored axial load of 1000 kN. The column is restrained in position but not restrained at both the ends. Provide single lacing system. Use two Channel Section placed back-to-back. Assume steel of grade 410 and bolts of grade 4.6. Design the lacing system with bolted connection. Use ISMC 300 with spacing 184mm center to center. Take L/r= 93.35.   **10**

OR

Q.3 **(a)** Define (i) Characteristic Strength of concrete (ii) classification of long and short column on basis of slenderness ratio   **04**

(b) Following are the details of a simply supported roof slab: **10**
Inside dimension 7.5 m X 3.5 m, supported on bearing of 200 mm; Carries a imposed load of 4 kN/m^2 and floor finish of 1 kN.m^2; Grade of concrete M20 and steel grade Fe 415; provide 10mm bars in tension side with a clear cover of 20 mm. Assume a modification factor of 1.25 for the calculation of effective depth. Calculate the overall depth, effective span, Design Loads, Factored Moment and Shear, Effective depth required, area of tensile reinforcement. Also provide Check for Shear and deflection for safer design.

Q.4 **(a)** State advantages and disadvantages of welded connections.   **03**
(b) Determine the development for 16 mm diameter bar, Fe 415 grade steel in compression and M 25 grade of concrete.   **04**
(c) A perfectly axially loaded concrete column of gross dimension 400 mm X 400 mm is reinforced with 4 bars of 20 mm diameter. Determine the design axial load carrying capacity of column. Consider M25 grade concrete and Fe 415 grade steel.   **07**

OR

Q.4 **(a)** Why are the end returns provided in fillet welds?   **03**
(b) Why are four different buckling curves prescribed to evaluate column strength?   **04**

(c) Explain the design procedure for laterally supported and unsupported steel beam.   **07**

Q.5 **(a)** If a short column having overall dimension of 300 mm X 500 mm and 16 mm diameter of longitudinal bars, Estimate the maximum spacing between two lateral ties.   **03**
(b) The main reinforcement of RC slab consists of 10 mm bars at 10 cm spacing. If it is desired to replace 10 mm bars by 12 mm bars, then estimate the revised spacing of 12 mm bars.   **04**
(c) Design a laterally supported beam of effective span 5 m for the following data: **07**
Grade of Steel: Fe 410;
Factored Maximum Bending Moment 180 kN-m, and maximum Shear Force 220 kN.
Only provide safety check for buckling.

OR

Q.5 **(a)** Draw neat sketch of battening system.   **03**
(b) Enlist the various failure modes of axially loaded tensile member along with sketch (line diagram only).   **04**

(c) An ISA 110 mm X 110 mm X 10 mm carries a factored tensile force of 150 kN. It is to be jointed with a 10 mm thick gusset plate. Design the joint using HSFG bolt when (i) no Slip is permitted (ii) When slip is permitted. Assume steel id of Fe 410 grade. **07**

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