Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020**

**Subject Code:3150612 Date:01/02/2021**

**Subject Name:Design of Structures**

**Time:10:30 AM TO 12:30 PM Total Marks: 56**

**Instructions:**

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of IS:456(2000), IS:800 (2007) and Steel table is permitted**
5. **Assume M20 grade concrete and Fe415 steel for RCC element, if not provided.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Differentiate between working stress method and limit state method of reinforced concrete. | **03** |
| | **(b)** | Write down the value of partial safety factors applied to Dead Load (DL), Imposed Load (IL) and Wind Load (WL) for the DL + IL + WL load combination considered for limit state of collapse, as per IS:456(2000). What will be the partial safety factors value for DL + WL load combination for limit states of serviceability, as per IS:456(2000)? | **04** |
| | **(c)** | AnRCC beam of a rectangular section 300 mm × 450 mm is reinforced with tensile reinforcement of 3 nos. 16mm Fe415 bars. The clear cover is 25 mm and the grade of concrete used is M25. State whether the section is under reinforced. Also, calculate moment of resistance of the section. | **07** |
| **Q.2** | **(a)** | Calculate the area of tension reinforcement needed with regard to the limit state method for a rectangular reinforced concrete beam of width, 250 mm and effective depth of 315 mm. The concrete grade is M20 and the grade of reinforcing steel is Fe415. Consider the section to be a balanced section. | **03** |
| | **(b)** | State and explain in brief types of limit states in the design of reinforced concrete structures. | **04** |
| | **(c)** | A rectangular reinforced concrete beam of width 300 mm and effective depth 565 mm is subjected to the design shear force of 250 kN. The beam is reinforced with tensile reinforcement of 0.90 %. Design for 2-legged shear reinforcement of 8 mm diameter having grade Fe415. Use concrete grade M20. | **07** |
| **Q.3** | **(a)** | Discuss the assumptions made in the limit state design of reinforced concrete compression members. | **03** |
| | **(b)** | Design lateral and longitudinal reinforcement for the short axially loaded square column, 500 mm × 500 mm subjected to the design axial load of 3000 kN. Use M20 grade concrete and Fe415 steel. Take minimum eccentricity of 20 mm. | **04** |
| | **(c)** | A simply supported reinforced concrete slab of effective dimension 4.5m × 6.0m is carrying a characteristic load of 15 KN/m$^2$, inclusive of the dead load, live load and floor finish load. Assuming M25 grade of concrete and Fe415 grade of steel, overall thickness of the slab being 180 mm and 20 mm cover, what is the required area of steel in the shorter span, if 12 mm diameter bars are used? | **07** |
| **Q.4** | **(a)** | Plot neat sketch of stress-strain curve of concrete and stress block parameters adopted by IS:456(2000). | **03** |
| | **(b)** | A square isolated footing of dimension 1.5m × 1.5m is subjected to a | **04** |

characteristic load, P=660kN (including the self weight of the footing) to the ground, through a column of 350mm × 350mm. The load factor is taken as 1.5. The overall depth of footing is 350mm. The clear cover is 40mm. The diameter of reinforcement provided is 12mm. Calculate the one-way shear force, per meter width, due to soil reaction at the critical section for design.Consider SBC value 150 KN/$M^2$

**(c)** Design an interior slab panel of effective dimensions 4.2m × 6.25m subjected to a factored load of 15 kN/$m^2$ inclusive of self-weight and floor finish load. The slab is provided with main reinforcement bar diameter as 10 mm, and has overall thickness of 150mm. Clear cover is 20 mm, grade of concrete is M20, grade of steel Fe415. **07**

**Q.5** **(a)** State advantages and disadvantages of welded connections. **03**

**(b)** Two plates having thickness 6 mm and 8 mm made up of Fe 410 grade steel are joined together by 16 mm diameter bolts of grade 4.6. Calculate nominal bearing strength of bolt. (Take $k_b$ = 1). **04**

**(c)** In a truss a compression strut 3 m long consists of two angles ISA 100×100×6 mm. Find the strength of the member if the angels are connected on both sides of 12 mm gusset plate usingSingle bolt. Take yield and ultimate stress as 250 MPa and 410 MPa, respectively and Modulus of Elasticity as 200000 MPa. **07**

**Q.6** **(a)** State advantages and disadvantages of Steel structures over reinforced structures. **03**

**(b)** How the design bending strength of a beam section is calculated as per IS:800 (2007), if shear force on the beam exceeds 60% of design shear strength of the section? **04**

**(c)** A tie member of a roof truss consists of single ISA 100×75×8 of Fe410 grade, is welded to a 10 mm thick gusset plate. Design the welded connection to transmit a tensile load of 300kN. Assume connection are made in the workshop **07**

**Q.7** **(a)** Draw neat sketch of different lacing systems. **03**

**(b)** Draw neat sketch of gusseted based foundation. **04**

**(c)** Determine the design axial load on the column section ISMB 400, if the height of the column is 3.5 m and the column is pin-ended at both ends. Take: $f_y$= 250 N/$mm^2$, $f_u$=410 N/$mm^2$; E = $2\times10^5$ N/$mm^2$. **07**

**Q.8** **(a)** Draw neat sketch of battening system. **03**

**(b)** Draw neat sketch of slab based foundation. **04**

**(c)** Design a laterally supported beam of effective span 5 m for the following data. **07**

Grade of steel: Fe 410
Factored maximum B.M. = 180 kN-m
Factored maximum S. F. = 200 kN
Check for deflection is not required.

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