Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160607 **Date: 08/05/2017**

Subject Name: Elementary Structural Design

Time: 10:30 AM to 01:30 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Is:456,IS:800 and steel table is permitted.**
5. **Assume M20 grade concrete and Fe415 steel for RCC element and Yield stress of 250 MPa for the structural steel if not given.**

MARKS

Q.1 Select most appropriate option for the following **14**

1 If a design moment exceeds limiting moment of resistance of a RCC rectangular beam section, the section is generally design as a..
(A) Singly over-reinforced section
(B) Doubly over-reinforced section
(C) Singly under-reinforced section
(D) Doubly under-reinforced section

2 For a RCC flanged beam section design, which statement is true?
(A) There must be flange on both the sides of web
(B) Flange must be on tension face of the web
(C) Flange must be on compression face of the web
(D) There must be flanges on both top and bottom of the web

3 Grade 4.6 bolt has nominal ultimate stress of
(A) 406 MPa
(B) 460 MPa
(C) 4.6 MPa
(D) 400 MPa

4 Maximum longitudinal pitch in a bolted compression member shall be
(A) 12t or 200 mm whichever is less
(B) 16t or 200 mm whichever is less
(C) 12t or 200 mm whichever is more
(D) 16t or 200 mm whichever is more

5 If all other parameters are same, slenderness ratio of a given compression member is maximum when..
(A) Both ends are fixed
(B) One end is fixed and other end is free
(C) Both ends are hinged
(D) One end is fixed and other end is hinged

6 Among following cross sections, shape factor is maximum for…
(A) Circular section
(B) Square with diagonal horizontal
(C) Rectangular section
(D) I - section

7 At plastic stage, neutral axis location is such that,
(A) It divides the section at mid height
(B) It divides the section at 1/3 height from bottom
(C) It divides the section in equal area
(D) It divides the section at 1/3 height from top

8 Which of the following is not corresponding to a limit state of serviceability?
(A) Fatigue
(B) Deflection
(C) Fire resistance
(D) Vibrations

9 In which structural steel section, section fails before reaching yield stress?
(A) Plastic section
(B) Slender section
(C) Compact section
(D) Semi-compact section

10 In a two way simply supported rectangular slab panel loaded with UDL, which statement is true for the sagging moment at middle of the panel?
(A) It is maximum along longer span
(B) Maximum along shorter span
(C) Equal along both the span
(D) None of the above

11 Nominal cover for reinforcement to meet durability requirement wherein concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe shall be minimum.
(A) 45 mm
(B) 25 mm
(C) 20 mm
(D) 100 mm

12 Basic value of span to depth ratio for limit of deflection for a simply supported beam having span 20m shall be
(A) 20
(B) 7
(C) 26
(D) 10

13 Actual curtailment of a bar beyond theoretical cut off point shall be ..... or..... times the diameter of a bar whichever is more.
(A) Effective depth,24
(B) Over all depth,12
(C) Effective depth,12
(D) Effective depth,16

14 Minimum amount of secondary HYSD bar reinforcement for a building slab shall be ..... of gross cross section
(A) 0.12%
(B) 0.8%
(C) 0.15%
(D) 0.2%

Q.2 (a) Give functions of following **03**
(i) Stirrups in a beam (ii) Ties in a column
(iii) Secondary reinforcement in a slab

	(b)	Find the moment of resistance of a beam section 250 mm wide x 450 mm effective depth, reinforced with 3-20# at tension face.	**04**
	(c)	Design doubly reinforced beam section 300x500 mm to carry factored bending moment 300 kNm. Consider M25 concrete and fe415 steel. Furnish reinforcement details.	**07**
		OR	
	(c)	Design and detail a one-way simply supported slab of 3.5 m clear span supported on 300 mm thick walls. Consider 3 kN/m^2 live load and 1 kN/m^2 floor finish.	**07**
Q.3	**(a)**	Sketch reinforcement detail of a rectangular combined footing to be provided for two columns. Sketch plan, longitudinal and cross section.	**03**
	(b)	Design and detail RCC square column section to carry ultimate axial load 1800 kN. The effective length of column is 2.5m.	**04**
	(c)	Find moment of resistance of a flanged T beam having 150 mm flange thickness,1500 mm effective flange width, 300 mm web thickness,450 mm effective depth reinforced using 6 nos.#20 bars at tension face	**07**
		OR	
Q.3	**(a)**	Sketch reinforcement detail for a simply supported two-way square slab showing all required details including torsion reinforcement.	**03**
	(b)	Design and detail shear R/F for a rectangular beam 230x450mm effective depth subjected to working UDL 50 kN/m over an effective span of 5m.Main RF at support is 600 mm^2.Consider M25 concrete and fe415 steel.	**04**
	(c)	Design and detail isolated footing for an axially loaded column 400 x 400 mm in c/s and carrying 1500 kN working load. Take SBC of soil as 200 kN/m^2.	**07**
Q.4	**(a)**	Find bolt value of 20 mm diameter 4.6 grade bolt, connecting 410 grade 10 mm thick plate, in single shear and double shear. Consider area of bolt=245 mm^2.	**03**
	(b)	Two steel plates 200x8 mm of grade 410 are to be connected by 20 mm bolts of grade 4.6 using butt joint. Design the connection to transmit a pull equal to the strength of the plate.	**04**
	(c)	Design a slab base footing for an ISHB450 column carrying 2000kN axial compressive load.	**07**
		OR	
Q.4	**(a)**	Sketch the typical bolted connection using lug angle.	**03**
	(b)	Deign lap joint to connect two plates 100x16 mm and 100x12mm to transfer 100 kN axial factored load. Use single row of 4.6 grade bolts. Plates are of steel grade 410.	**04**
	(c)	Design a single angle 2.0 m long steel tension member of a truss to carry an ultimate tensile force of 200 kN. Consider bolted connection.	**07**
Q.5	**(a)**	Sketch the details of gusseted base footing.	**03**
	(b)	Design and detail the weld connection to be done at site for a single angle ISA 75 x 75 x 6 mm to develop its full strength, connected to a gusset plate of 8 mm thickness.	**04**
	(c)	Design a simply supported steel beam of 6 m effective span to carry 20 kN/m working dead load and 10 kN/m working live load. Compression flanges are restrained laterally throughout the span.	**07**
		OR	
Q.5	**(a)**	Sketch the details of slab base footing.	**03**
	(b)	Explain beam-column design with illustrative sketches.	**04**
	(c)	Determine the compressive strength of a discontinuous strut which is formed by tack bolting 2-ISA 90X90X8 mm placed on the same side of 10 mm thick gusset plate. The strut is hinged at both ends and has 3.0 m length.	**07**