Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2019

CE3CO14 Design of Steel Structures

Programme: B.Tech. Branch/Specialisation: CE

Duration: 3 Hrs. **Maximum Marks: 60**

Note: (a) All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.
(b) Use of IS: 800- 2007, IS 875 and steel table is permitted.
(c) Assume suitable data if required.

Q.1 i. Which of the following has zero eccentricity with respect to load line? **1**
(a) Single cover butt joint (b) Double cover butt joint
(c) Lap joint (d) None of these.

ii. Prying action is associated with- **1**
(a) Additional compressive force on bolts due to flexibility of connecting members
(b) Reduction in flexural force on bolts
(c) Additional shear force on rivets
(d) Additional tensile force on bolts due to flexibility of connecting members

iii. The problem of web crippling in beams is significant when- **1**
(a) Web is weak under concentrated loads
(b) There is too much flexural moment
(c) Compression flange is weak
(d) None of these

iv. Economical depth of plate girder corresponding to- **1**
(a) Minimum weight
(b) Minimum depth
(c) Minimum thickness of web
(d) Maximum weight

v. Battening is preferred when the- **1**
(a) Column carries axial load
(b) Column is eccentrically loaded
(c) Space between the two main component is not large
(d) Both (a) and (c)

P.T.O.

vi. The block shear failure of tension member involves failure planes which are- **1**
(a) Two mutually perpendicular tension planes
(b) two mutually perpendicular shear plane
(c) Tension on one plane and shear on other perpendicular plane
(d) Tension on one plane and compression on another perpendicular plane

vii. In the plastic method of base plate design the pressure from the concrete below is assumed to be equal to **1**
(a) 0.55 fck (b) 0.45 fck (c) 0.6 fck (d) 0.65 fck

viii. Splice plates in columns are designed as **1**
(a) Short column (b) Intermediate column
(c) Long column (d) None of these

ix. The maximum slenderness ratio limit for truss members under loads other than wind / earthquake load is **1**
(a) 180 (b) 80 (c) 10 (d) 400

x. In general, purlins are designed as- **1**
(a) Continuous beams (b) Simply supported beams
(c) Cantilever beams (d) None of these.

Q.2 i. Specify different structural steel sections. **2**
ii. Compare between welded and bolted / riveted joints. **3**
iii. Two plates of thickness 16 mm and 14 mm are required to be joined by buttweld. The plates are subjected to a factored tensile load of 400 kN. The effective weld length is limited to 180 mm. Calculate that which type of weld out of single / double v butt weld is to be provided. **5**
OR iv. Two plates 10 mm x 60 mm are connected in a lap joint with 5 M 16 bolts (arranged longitudinally in linear pattern) of grade 4.6 and 4 10 grade plates. calculate the strength of joint. **5**

Q.3 i. Define plastic section modulus. **2**
ii. Explain lateral stability of beams. What are the mechanisms through which it is ensured? **3**
iii. A simply supported steel joist of 5 M span has to support a load of 60 kN / metre (inclusive of self wt.). The beam compression flange is restrained against buckling. **5**

(a) Design beam section using ISWB section and Fe 410 steel grade for flexure.
(b) Check the section for shear. also specify the case of shear.
OR iv. What are the different components of plate girder. Specify functions of components also. **5**

Q.4 i. Based on area, how design of tension member is different than design of compression member? **2**
ii. What are lug angles? When are they used? **3**
iii. Illustrate the procedure for the design of tension member. **5**
OR iv. Write the procedure for the design of laced / battened column. **5**

Q.5 i. How beam columns are different than columns? **2**
ii. Explain following types of column bases through labelled diagrams **3**
(a) Slab base (b) Gusseted base.
iii. Determine the size and thickness of simple base plate type slab base for an ISHB 300 @ 618 N / m. Column to carry a factored load of 1000 kN. Assume Fe 410 grade steel and M25 grade concrete. **5**
OR iv. Write down the procedure for designing gusseted base type of column base. **5**

Q.6 i. What are different types of trusses? **2**
ii. Specify different loads and their combinations used in truss design. **3**
iii. Design bottom chord member of truss for following details- **5**
(a) Length = 2.8 m (b) Compressive force 75 kN
(c) Tensile force 95 kN.
Use two unequal angle sections with longer legs back to back as section.
OR iv. Design basic purlin section for the truss for the following details- **5**
(a) Span of purlins 6 m.
(b) Spacing of purlins 1.25 m
(c) Angle of truss 11.3°
(c) live load 0.35 kN / m^2
(e) Dead load 0.21 kN / m^2 including self-weight
(f) Wind pressure 1.45 k N / m^2.
Calculation for checks are not required.

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Marking Scheme
CE3CO14 Design of Steel Structures

Q.1	i.	Which of the following has zero eccentricity with respect to load line? (b) Double cover butt joint	**1**
	ii.	Prying action is associated with- (d) Additional tensile force on bolts due to flexibility of connecting members	**1**
	iii.	The problem of web crippling in beams is significant when- (a) Web is weak under concentrated loads	**1**
	iv.	Economical depth of plate girder corresponding to- (a) Minimum weight	**1**
	v.	Battening is preferred when the- (d) Both (a) and (c)	**1**
	vi.	The block shear failure of tension member involves failure planes which are- (c) Tension on one plane and shear on other perpendicular plane	**1**
	vii.	In the plastic method of base plate design the pressure from the concrete below is assumed to be equal to (b) 0.45 fck	**1**
	viii.	Splice plates in columns are designed as (a) Short column	**1**
	ix.	The maximum slenderness ratio limit for truss members under loads other than wind / earthquake load is (a) 180	**1**
	x.	In general, purlins are designed as- (a) Continuous beams	**1**
Q.2	i.	Structural steel sections. Four types 0.5 mark for each (0.5 mark * 4)	**2**
	ii.	Compare b/w welded and bolted / riveted joints. Three points 1 mark for each (1 mark * 3)	**3**
	iii.	Calculate that which type of weld out of single / double v butt weld is to be provided. For single v butt weld For calculation of effective throat thickness 1 mark Strength of weld (315 kN) 1.5 mark For double v butt weld For calculation of effective throat thickness 1 mark Strength of weld (504 kN) 1.5 mark	**5**
OR	iv.	Calculate the strength of joint. For design shear strength of one bolt (29.72kN) 1 mark For design bearing strength of one bolt (64.28kN) 2 marks For design tensile strength of plate in yielding (136.36kN) 1 mark For design tensile strength of plate in repture (123.98kN) and reporting this as answer 1 mark	**5**
Q.3	i.	Definition plastic section modulus.	**2**
	ii.	Lateral stability of beams 1.5 marks Mechanisms through which it is ensured 1.5 marks	**3**
	iii.	(a) Design beam section using ISWB section and Fe 410 steel grade for flexure. Calculation of factored udl (90kN) 0.5 mark Calculation of factored BM (281.25kNm) 0.5 mark Calculation of factored SF (225kN) 0.5 mark Calculation of plastic section modulus ($1237x10^6 mm^3$) 0.5 mark Recommending ISWB400 (654 N/m) 0.5 mark (b) Check the section for shear. also specify the case of shear. Calculation of design shear strength (451.38 kN) 1.5 marks Verifying and recommending case of low shear 1 mark	**5**
OR	iv.	Components of plate girder 2.5 marks Functions of components 2.5 marks	**5**
Q.4	i.	Based on area, how design of tension member is different than design of compression member? Clear mention of net area and gross area basis	**2**
	ii.	Lug angles 1.5 marks Uses 1.5 marks	**3**
	iii.	Procedure for the design of tension member. 1 mark for each step (1 mark * 5)	**5**
OR	iv.	Procedure for the design of laced / battened column. 1 mark for each step (1 mark * 5)	**5**
Q.5	i.	Beam columns are different than columns	**2**
	ii.	Types of column bases through labelled diagrams (a) Slab base 1.5 marks (b) Gusseted base. 1.5 marks	**3**

	iii.	Determine the size and thickness of simple base plate type slab base		**5**
		Area of base plate (88.89 x 103 Sq mm)	1 mark	
		Actual bearing pressure (7.15 N/mm^2)	1 mark	
		Thickness of base plate (11.75 mm)	2 marks	
		Connection-required length of 8 mm fillet weld (1058 mm)	1 mark	
OR	iv.	Procedure for designing gusseted base type of column base.		**5**
		1 mark for each step	(1 mark * 5)	
Q.6	i.	Any four types of trusses		**2**
		0.5 mark for each type	(0.5 mark * 4)	
	ii.	Different loads	1 mark	**3**
		Their combinations used in truss design.	2 marks	
	iii.	Design bottom chord member of truss for following details-		**5**
		Calculation of cross sectional area (1331.77 mm^2)	1 mark	
		Selection of section (ISA 75x50x6)	1 mark	
		Design compressive strength(188.3kN)	1 mark	
		Check for tensile force (T_{dg}= 325.45 kN)	2 marks	
OR	iv.	Design basic purlin section for the truss for the following details		**5**
		Normal to slope 1.27 kN/m2)		
		Parallel to slope 0.041 kN/M2	2 marks	
		Load Wz= 0.7 kN/M, load Wy = 0.14 kN/M	1 mark	
		Mz=3.78 kNm, My=0.756kNm Factored SF = 3.15 kN	1 mark	
		Plastic section modulus required 16.632 x 103 mm3 and recommendation of section	1 mark	

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