No. of Printed Pages : 6 **BCE-041**

Diploma in Civil Engineering (DCLEVI)

Term-End Examination

December, 2011 00742

BCE-041 : THEORY OF STRUCTURES II

Time : 2 hours *Maximum Marks : 70*

Note : *Question number 1 is* ***compulsory.*** *Attempt any other* ***four*** *questions. In all, solve* ***five*** *questions. All questions carry* ***equal*** *marks. Assume suitable data wherever necessary and mention it clearly. Use of scientific calculator is* ***allowed.***

1. Choose the most appropriate answer from the given alternatives. **7x2=14**

(a) In Limit-State method of design the characteristic compressive strength of concrete is fck. What is the design strength of concrete f_d at collapse ?

(i) 0.36 fck (ii) 0.87 fck

(iii) 0.67 fck (iv) 0.45 fck

(b) In Limit-State method of design for the flexural members, the maximum depth of neutral axis $X_{u(max)}$ for steel of grade Fe 250 is :

(i) 0.48 d (ii) 0.43 d

(iii) 0.53 d (iv) 0.45 d

(c) In Limit-State method of design for the flexural members the basic value of the ratio of span to depth (for spans upto 10 m) to control deflection in case of simply supported beams is :

(i) 7 (ii) 26 (iii) 20 (iv) 10

(d) The maximum compression reinforcement in a beam is provided as a percentage of the gross sectional area of the beam. This percentage is :

(i) 2.0 (ii) 4.0

(iii) 6.0 (iv) 1.0

(e) The maximum compressive strain in concrete in axial compression is taken as :

(i) 0.35% (ii) 0.30%

(iii) 0.25% (iv) 0.2%

(f) The minimum reinforcement in a slab is provided as a percentage of the gross sectional area of the slab. This percentage for steel of grade Fe 415 is :

(i) 0.15 (ii) 0.20

(iii) 0.12 (iv) 0.34

(g) The maximum spacing of shear reinforcement in the form of vertical stirrups in a beam is taken to be equal to :

(i) effective depth of the beam 'd'

(ii) 0.75 d

(iii) 300 mm

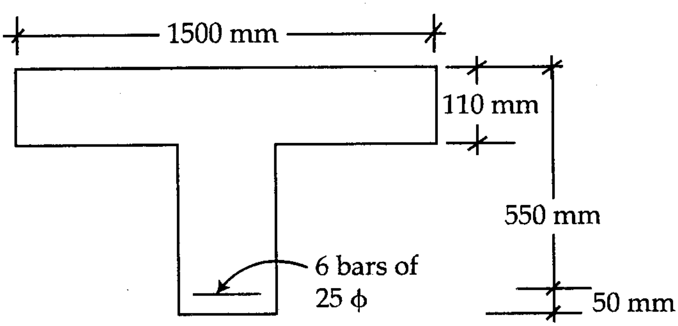
(iv) least of (i), (ii) and (iii).

2. A rectangular beam of clear span 6 m is simply supported on 300 mm wide supports. This beam has to carry a uniformly distributed load of 15 kN/m including its self weight. Design the beam using M_{20} grade of concrete and Fe 415 grade of steel for both tension and shear reinforcement. **14**

3. (a) Mention the basic assumptions made in the theory for the design of reinforced concrete flexural members by Limit-State method. **7**

   (b) Draw the strain and stress diagrams for singly reinforced rectangular sections to be designed by Limit-State method. Determine the maximum depth of neutral axis for a balanced section using the grade of steel as Fe 415. **7**

4. Determine the permissible U.D.L inclusive of its self weight for a T-beam section shown below. This beam has an effective span of 7.5 m and is simply supported on both ends. Adopt M_{25} grade of concrete and Fe 415 grade of steel. **14**



5. Design the longitudinal as well as the transverse reinforcement for a rectangular reinforced concrete column of size 300 mm × 600 mm. The column has an unsupported length of 3.0 m. Both ends of the column are effectively hold in position but not restrained against rotation. This column carries a factored axial load of 2000 kN. Adopt M_{20} grade of concrete and Fe 415 grade of steel. **14**

6. Design strip footing for a concrete wall of 300 mm thickness carrying a load of 700 kN/m. Adopt safe bearing capacity of soil as 180 kN/m^2, M_{20} grade of concrete and steel of grade Fe 415. **14**

7. (a) Discuss how would you check safety of a retaining wall against overturning and sliding. 7

   (b) Show the detailing of reinforcement by means of neat sketches in plan and sections for a simply supported one way slab. 7

8. Write short notes on *any four* of the following : **4x3½=14**

   (a) Development length for reinforcement.
   (b) Effective flange width of T-beams
   (c) Limit state of collapse
   (d) Under reinforced, balanced or over reinforced sections
   (e) Shear reinforcement in beams.
   (f) Fire resistance of concrete.

Note : The following design data may be used wherever required :

(a) Design Shear strength τ_c of concrete in N/mm^2 (Limit-State method) :

100 A_{st} / bd	Concrete M20	Concrete M25
0.15	0.28	0.29
0.25	0.36	0.36
0.50	0.48	0.49
0.75	0.56	0.57
1.00	0.62	0.64
0.25	0.67	0.70
1.50	0.72	0.74
1.75	0.75	0.78
2.00	0.79	0.82
2.25	0.81	0.85
2.50	0.82	0.88
2.75	0.82	0.90

(b) Design Bond stress τ_{bd} N/mm^2 (Limit-state method) for bars in tension.

	Steel Fe 250	Steel Fe 415
Concrete M20	1.20	1.92
Concrete M25	1.40	2.24

(c) Design shear strength of concrete τ_c max. N/mm^2 (Limit-State method).

Concrete M20 2.8

Concrete M25 3.1

(d) For solid slabs, design shear strength of concrete shall be taken as $K\tau_c$. The values of K are as below :

Overall depth of slab (mm)	**K**
300 or more	1.00
275	1.105
250	1.10
225	1.15
200	1.20
175	1.25
150 or less	1.30

(e) Modification factor K_2 for different percentages of tension reinforcement A_{st} in flexural RCC members for stress in steel at service loads, $f_s = 240\ N/mm^2$, may be taken as below :

100 A_{st} / bd	**K_2**
0.2	1.7
0.4	1.32
0.6	1.15
0.8	1.05
1.0	1.0
1.2	0.95
1.4	0.90
1.6	0.88
1.8	0.86
2.0	0.84
2.2	0.82
2.4	0.80
2.6	0.79
2.8	0.78