Diploma in Civil Engineering

Term-End Examination

December, 2006

BCE-041 : THEORY OF STRUCTURES II

Time : 2 hours *Maximum Marks : 70*

Note : *Attempt Q. No. 1 which is **compulsory** and 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 calculator is permitted.*

1. Choose the most appropriate answer from the given alternatives : *7×2=14*

(i) In limit state method of design of RCC flexural members the stress-strain relationship for concrete is assumed to be a parabolic curve upto a strain of 0·002 in concrete, thereafter it is constant upto collapse. The height of this point of the stress block from the neutral axis is

(a) 4/7 the depth of neutral axis

(b) 3/7 the depth of neutral axis

(c) 5/7 the depth of neutral axis

(d) None of these

(ii) In Limit State method of design of RCC flexural members the centre of gravity of the compressive forces acting on the section from the topmost fibre of concrete is at a distance of

(a) 0·57 the depth of neutral axis

(b) 0·36 the depth of neutral axis

(c) 0·42 the depth of neutral axis

(d) None of these

(iii) In Limit State method of design of RCC flexural members the vertical deflection limit is deemed to have been satisfied if the ratio of the basic value K_B of the effective span to effective depth of the member in case of a continuous beam is

(a) 7

(b) 20

(c) 26

(d) 30

(iv) The minimum reinforcement in a slab is provided as a percentage of the gross area of the section. This percentage for grade of steel Fe 250 is

(a) 0·15

(b) 0·20

(c) 0·25

(d) 0·10

3. A reinforced concrete beam of width 250 mm and overall depth of 550 mm is reinforced with 4 bars of 20 mm diameter of grade Fe 415. Check whether the section is under-reinforced or over-reinforced. Also, determine the safe moment of resistance of the section. Use concrete of grade M 20 and an effective cover of 50 mm. The permissible stress in steel σ_{st} is 230 N/mm^2 and in concrete σ_{cbc} is 7 N/mm^2. *14*

4. Design the longitudinal as well as transverse reinforcement for a rectangular beam of width 300 mm and overall depth of 500 mm. Use concrete of grade M 25, steel of grade Fe 415 and an effective cover of 50 mm.
Ultimate Bending Moment M_u = 100 kNm
Ultimate Shear Force V_u = 100 kN
Ultimate Torsional Moment T_u = 9 kNm *14*

5. Design a simply supported beam of 5 m clear span loaded with a uniformly distributed load of 15 kN/m including its self weight. Assume support width 250 mm, grade of concrete M 20, grade of steel Fe 415 for main tension reinforcement and Fe 250 for shear reinforcement. *14*

6. Design a two way reinforced slab for an office floor of effective size 3·5 m × 4·5 m simply supported on all its four edges with the corners prevented from lifting. Live load on the slab is 4 kN/m^2. Grade of concrete M 20 and steel Fe 415 moment coefficients are as under : *14*

Type of panel Four edge discont.	Short span coefficients α_x values of l_y / l_x								Long span coefficients α_y fo all values of l_y / l
	1·0	1·1	1·2	1·3	1·4	1·5	1·75	2·0	
+ive moment at mid span	0·056	0·064	0·072	0·079	0·085	0·089	0·100	0·107	0·056

7. Design longitudinal reinforcement for the circular column of diameter 350 mm for a factored load of 1800 kN and effective length of 2·75 metres with helical ties of 8 mm diameter at a pitch of 45 mm c/c with a nominal cover of 40 mm. Adopt grade of concrete M 20 and steel Fe 415. *14*

8. Write short notes on any ***four*** of the following : $3\frac{1}{2}\times4=14$

(a) Basic Assumptions for Design of Sections

(b) Limit State of Collapse

(c) Stirrups

(d) Retaining Wall

(e) Type of Staircases

(f) Development Length

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

A. Design Shear Strength of Concrete τ_c, N/mm^2 (Limit – State Method)

100 A_{st} / bd	0·15	0·25	0·50	0·75	1·00	1·25	1·50	1·75	2·00	2·25	2·50	2·75
Concrete M 20	0·28	0·36	0·48	0·56	0·62	0·67	0·72	0·75	0·79	0·81	0·82	0·82
Concrete M 25	0·29	0·36	0·49	0·57	0·64	0·70	0·74	0·78	0·82	0·85	0·88	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 M 20	1·20	1·92
Concrete M 25	1·40	2·24

C. Design Shear Strength of Concrete $\tau_{c\ max.}$ N/mm^2
(Limit-State Method)

Concrete M 20 2·8

Concrete M 25 3·1

D. For solid slabs, design shear strength of concrete shall be taken as K τ_c. Values of K are as below :

Overall depth of slab (mm)	300 or more	275	250	225	200	175	150 or less
K	1·00	1·05	1·10	1·15	1·20	1·25	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	0·88
2·6	0·79
2·8	0·78