PART-A

GENERAL ENGINEERING (Civil and Structural)

1. (a) What are the chief chemical ingredients and their percentage used in the manufacturing of Portland cement ? Also briefly explain the Bogue components and their properties in the cement. **20**

(b) Explain *any four* of the following thermal insulation : **5×4=20**

(i) Slab or block insulation

(ii) Blanket insulation

(iii) Bat insulating materials

(iv) Insulating boards

(c) Explain Whole Circle Bearing system. The following bearings were observed with a compass. Calculate the interior angles. **20**

LINE	FORE BEARINGS
AB	60° 30′
BC	122° 00′
CD	46° 00′
DE	205° 30′
EA	300° 00′

2. (a) What is superelevation ? Derive the relation between superelevation and speed of vehicle on horizontal curve. Design the rate of superelevation for a horizontal curve of a radius 500 m and speed 100 km/hr. **5+15**

(b) Describe the terms - True and Magnetic bearings ; local attraction ; back bearings and magnetic declination. **20**

(c) Explain the term Base period and Crop period. After how many days will you order irrigation in order to ensure healthy growth of crops if : **20**

(i) Field capacity of soil = 29%

(ii) Permanent wilting point = 11%

(iii) Density of soil = 1300 kg/m^3

(iv) Effective depth of root zone = 700 mm

(v) Daily consumptive use of water of the given crop = 12 mm

Consider moisture content must not be less than 25% of the water holding capacity between the field capacity and permanent wilting point.

3. (a) What do you mean by "Viscosity" ? Velocity distribution of a fluid of dynamic viscosity is 8.63 poise is $U = 2/3y - y^2$ in which **U** is the velocity in m/sec at a distance y meter above the plate, determine the shear stress at $y = 0$ and $y = 0.15$. Take dynamic viscosity of fluid is 8.63 poise. **20**

(b) Define air pollution. Enlist natural and man made air pollution. What are the effects of air pollution on human, plants and materials ? **5+5+10=20**

(c) Define the term BOD, COD and TDS. The 5 days 30°C BOD of sewage sample is 110 mg/*l*. Calculate its 5 days 20°C BOD. Assume the deoxygenation constant at 20°C k_{20} as 0.1 ? **3x3+11=20**

4. (a) Two plates 6 mm thick are joined by 14 mm diameter rivets in a triple staggered riveted lap joint as shown in fig 1. In what way will the joint fail if allowable tensile stress for plate = 150 MPa ; allowable shear stresses for rivets = 90 MPa and allowable bearing stress for rivets = 270 MPa. Also find the efficiency of the joint. **20**

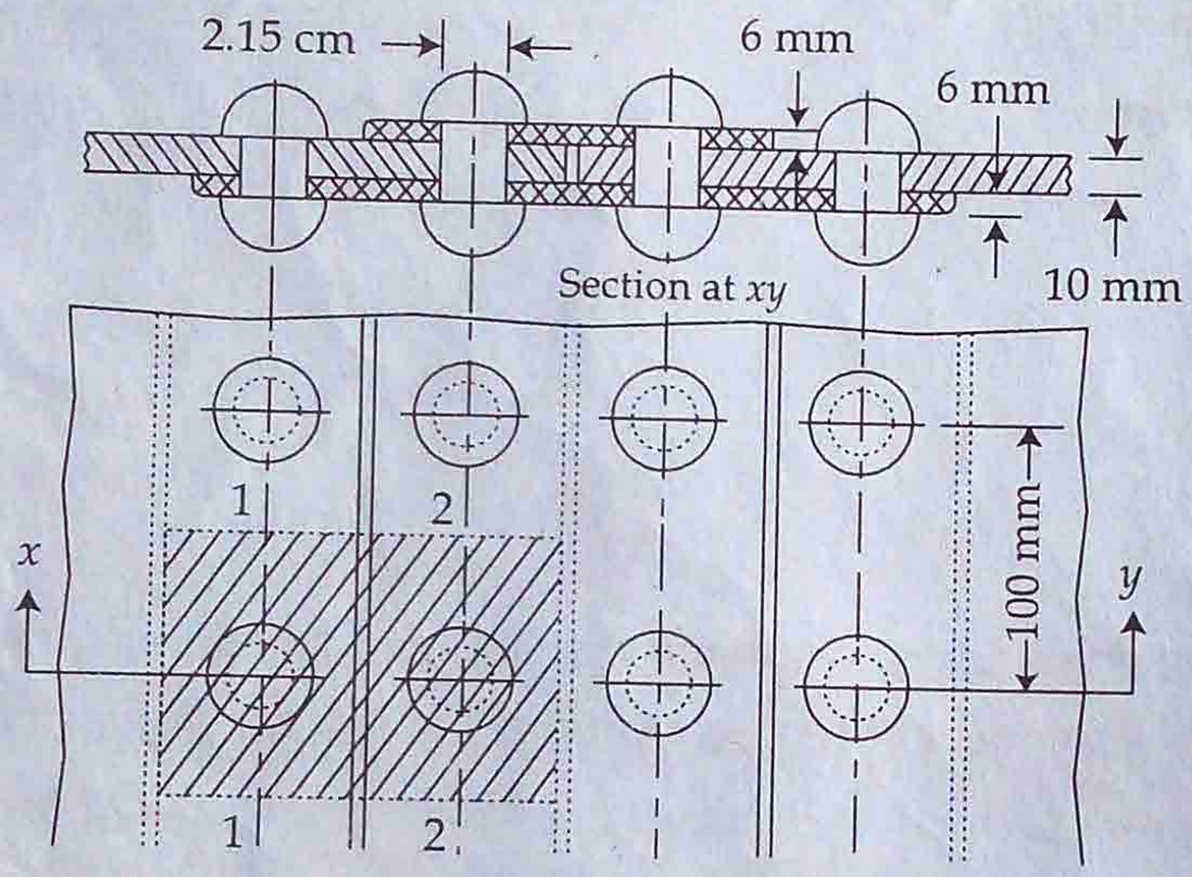

Fig. 1

(b) A sand deposit is 10 m thick and overlies a bed of soft clay. The ground water table is 3 m below the surface. If the sand above the ground water table has a degree of saturation of 45%, plot the diagram showing the variation of the total stress, pore water pressure and the effective stress. The void of the sand is 0.70. Take G = 2.65. **20**

(c) Draw the shear force and bending moment diagrams for the beam shown in fig : 2. **20**

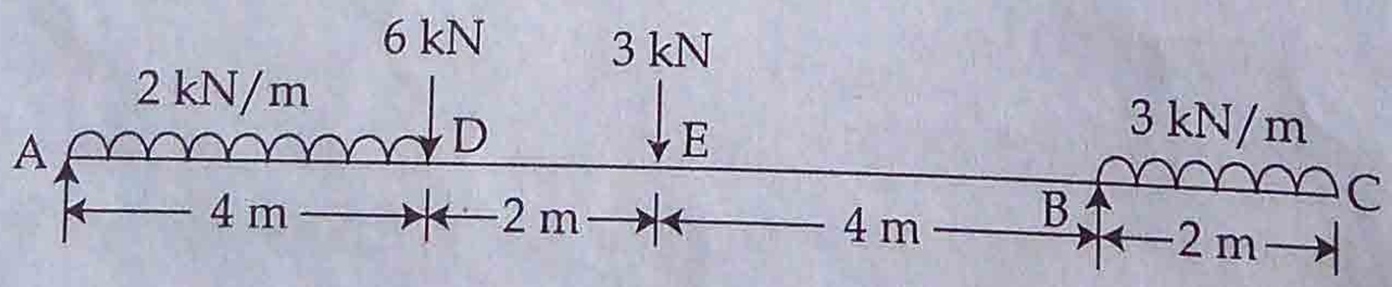

Fig. 2

5. (a) The cross - section of a joist is a T-section, 120 mm × 200 mm × 12 mm, with 120 mm side horizontal. Sketch the shear stress distribution and hence find the maximum shear stress if it has to resist a shear force of 200 kN. 25

(b) For the I section shown in fig : 3 determine the position of centroid and moment of inertia about the base flange (I_{KL}). 10+10=20

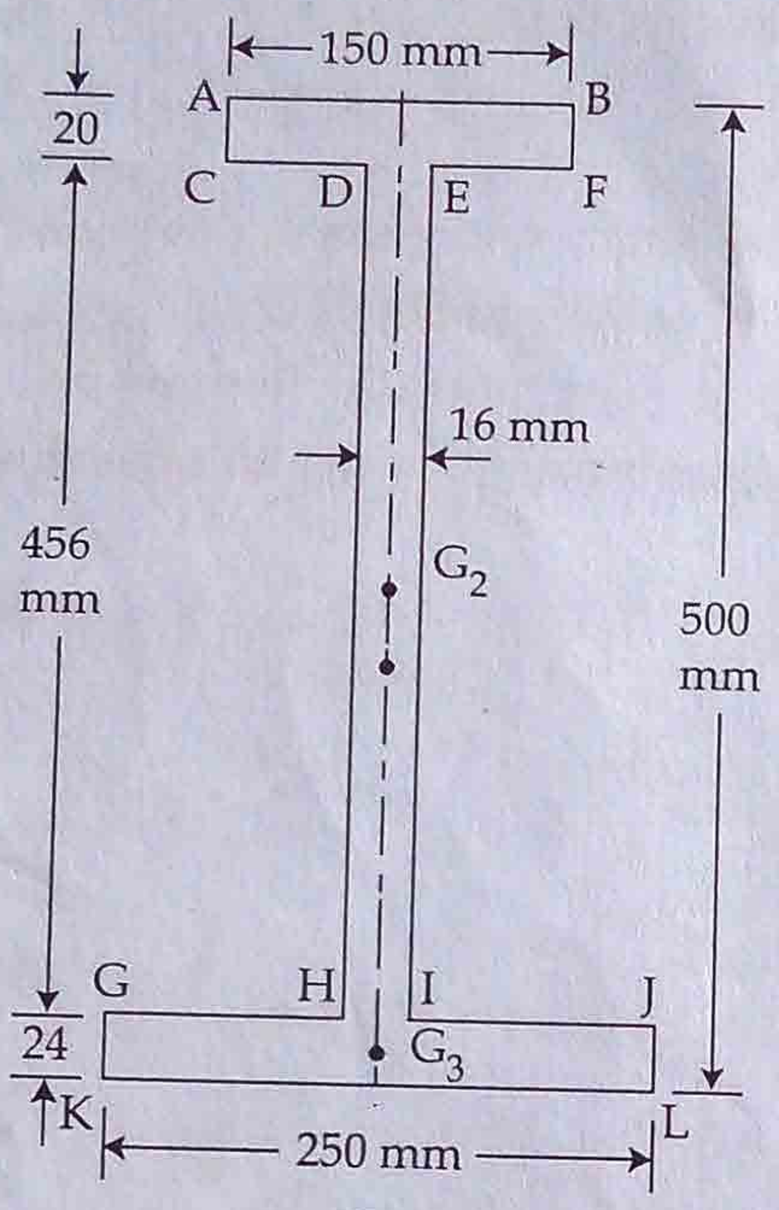

Fig. 3

(c) (i) What is bond ? Explain flexural and anchorage bond. 6

(ii) What is development length ? Write its significance in RCC design. 4+5=9

6. (a) A singly reinforced beam having a width of 250 mm is reinforced with 3 bars of 16 mm diameter at an effective depth of 400 mm. If M20 grade concrete and Fe415 HYSD bars are used, compute for the section. 15+15

(i) Working moment of resistance

(ii) Ultimate moment of resistance.

(b) Design a square column section subjected to concentrated load of 1000 kN at service. Consider concrete grade of M25 and steel grade Fe 415. 10

(c) Design a built - up column composed of two channel sections placed back to back, carrying an axial load of 1345 kN. Effective length of column is 4.95 m. Take $f_y = 250\ kN/mm^2$. 20

26.2.1.1 Design bond stress in limit state method for plain bars in tension shall be as below :

Grade of concrete	M 20	M 25	M 30	M 35	M 40 and above
Design bond stress, τ_{bd}, N/mm^2	1.2	1.4	1.5	1.7	1.9

Table 16 : Nominal Cover to Meet Durability Requirements

(Clause 26.4.2)

Exposure	*Nominal Concrete Cover in mm Not Less Than*
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

Notes :

1. For main reinforcement upto 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.

2. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by $^{+10}_{0}$ mm.

3. For exposure condition 'severe' and 'very severe', reduction of 5 mm may be made, where concrete grade is M 35 and above.

Table 19 : Design Shear Strength of Concrete, τ_c, N/mm^2

(Clauses 40.2.1, 40.2.2, 40.3, 40.4, 40.5.3, 41.3.2, 41.3.3 and 41.4.3)

$100\frac{A_s}{bd}$	Concrete Grade					
	M 15	M 20	M 25	M 30	M 35	M 40 and above
(1)	(2)	(3)	(4)	(5)	(6)	(7)
≤0.15	0.28	0.28	0.29	0.29	0.29	0.30
0.25	0.35	0.36	0.36	0.37	0.37	0.38
0.50	0.46	0.48	0.49	0.50	0.50	0.51
0.75	0.54	0.56	0.57	0.59	0.59	0.60
1.00	0.60	0.62	0.64	0.66	0.67	0.68
1.25	0.64	0.67	0.70	0.71	0.73	0.74
1.50	0.68	0.72	0.74	0.76	0.78	0.79
1.75	0.71	0.75	0.78	0.80	0.82	0.84
2.00	0.71	0.79	0.82	0.84	0.86	0.88
2.25	0.71	0.81	0.85	0.88	0.90	0.92
2.50	0.71	0.82	0.88	0.91	0.93	0.95
2.75	0.71	0.82	0.90	0.94	0.96	0.98
3.00 and above	0.71	0.82	0.92	0.96	0.99	1.01

Note : The term A_s is the area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support where the full area of tension reinforcement may be used provided the detailing conforms to 26.2.2 and 26.2.3.

Table 20 : Maximum Shear Stress, $\tau_{c\ max}$, N/mm^2

(Clauses 40.2.3, 40.2.3.1, 40.5.1 and 41.3.1)

Concrete Grade	M 20	M 25	M 30	M 35	M 40 and above
$\tau_{c\ max}$, *N /mm*^{2}	2.8	3.1	3.5	3.7	4.0

Table 21 : Permissible Stresses in Concrete

(Clauses B-1.3, B-2.1, B-2.1.2, B-2.3 and B-4.2)

All values in N/mm^2

Grade of Concrete	*Permissible Stress in Compression*		*Permissible Stress in Bond (Average) for Plain Bars in Tension*
	Bending	*Direct*	
(1)	(2)	(3)	(4)
	σ_{cbc}	σ_{cc}	τ_{bd}
M 10	3.0	2.5	-
M 15	5.0	4.0	0.6
M 20	7.0	5.0	0.8
M 25	8.5	6.0	0.9
M 30	10.0	8.0	1.0
M 35	11.5	9.0	1.1
M 40	13.0	10.0	1.2
M 45	14.5	11.0	1.3
M 50	16.0	12.0	1.4

Notes :

1. The values of permissible shear stress in concrete are given in Table 23.

2. The bond stress given in col. 4 shall be increased by 25 percent for bars in compression.

Table 23 : Permissible Shear Stress in Concrete

(Clauses B-2.1, B-2.3, B-4.2, B-5.2.1, B-5.2.2, B-5.3, B-5.4, B-5.5.1, B-5.5.3, B-6.3.2, B-6.3.3 and B-6.4.3 and Table 21)

$100\frac{A_s}{bd}$	*Permissible Shear Stress in Concrete* τ_c, N/mm^2 *Grade of Concrete*					
	M 15	M 20	M 25	M 30	M 35	M 40 and above
(1)	(2)	(3)	(4)	(5)	(6)	(7)
≤0.15	0.18	0.18	0.19	0.20	0.20	0.20
0.25	0.22	0.22	0.23	0.23	0.23	0.23
0.50	0.29	0.30	0.31	0.31	0.31	0.32
0.75	0.34	0.35	0.36	0.37	0.37	0.38
1.00	0.37	0.39	0.40	0.41	0.42	0.42
1.25	0.40	0.42	0.44	0.45	0.45	0.46
1.50	0.42	0.45	0.46	0.48	0.49	0.49
1.75	0.44	0.47	0.49	0.50	0.52	0.52
2.00	0.44	0.49	0.51	0.53	0.54	0.55
2.25	0.44	0.51	0.53	0.55	0.56	0.57
2.50	0.44	0.51	0.55	0.57	0.58	0.60
2.75	0.44	0.51	0.56	0.58	0.60	0.62
3.00 and above	0.44	0.51	0.57	0.60	0.62	0.63

Note : A_s is the area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support where the full area of tension reinforcement may be used provided the detailing conforms to 26.2.2 and 26.2.3.

Table 24 : Maximum Shear Stress, $\tau_{c\ max}$, N/mm^2

(Clauses B-5.2.3, B-5.2.3.1, B-5.5.1 and B-6.3.1)

Concrete Grade	M 15	M 20	M 25	M 30	M 35	M 40 and above
$\tau_{c\ max}$, N/mm^2	1.6	1.8	1.9	2.2	2.3	2.5