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Candidate should write his/her Roll No. here.

Total No. of Questions : 5

No. of Printed Pages : 10

SEM-2014(01)
CIVIL ENGINEERING
Paper – I

Time : 3 Hours]

[Total Marks : 300

Instructions to the candidates :

Please read each of the following instructions carefully before attempting questions.

Candidates should attempt all the FIVE questions.

All questions carry equal marks. The number of marks carried by a part of a question is indicated against it.

Answers must be written in ENGLISH only.

Unless otherwise mentioned, symbols and notations have their usual standard meanings.

Assume suitable data, if necessary and indicate the same clearly.

Neat sketches may be drawn, wherever required.

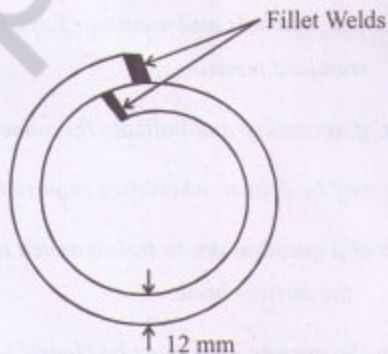
All parts and sub-parts of a question are to be attempted together in the answer book.

Any pages left blank in the answer book must be clearly struck out.

1. All parts carry **equal** marks.

$10 \times 6 = 60$

- (a) What do you mean by kinematically indeterminate structure and degree of freedom ?
- (b) Derive the expression for horizontal reaction in a two hinged arch using Castigliano's first theorem.
- (c) Define shape factor and determine shape factor for a diamond section.
- (d) A post tensioned concrete beam 200 mm wide and 450 mm deep is prestressed by a circular cable ($A = 800 \text{ mm}^2$) with zero eccentricity at the ends and 150 mm at the centre of span. The span of beam is 10 m. The cable is stressed from one end such that an initial stress of 850 MPa is available in the unjacked end immediately. Determine the stress in the wire at the jacking end and percentage loss. Take $\mu = 0.60$ and $k = 0.003/\text{m}$.
- (e) Define efficiency of a rivetted joint. A circular penstock of 1 m diameter is made out of 12 mm thick plate, lapping it and securing it by transverse fillet welds of 10 mm size provided on inside and outside as shown in the figure below. What safe internal pressure can be allowed in the penstock ? Take $p_q = 110 \text{ MPa}$.



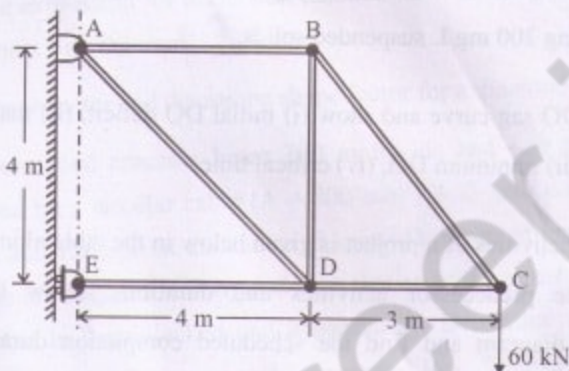
- (f) Draw design stress-strain curve for concrete and describe its salient features. 6
- (g) List four important coagulation mechanisms. Also identify coagulation mechanism for the case when 20 mg/L alum is added in pH3 solution for coagulating 200 mg/L suspended solids. 6
- (h) Draw a DO sag curve and show (i) initial DO deficit, (ii) maximum DO deficit, (iii) minimum DO, (iv) critical time. 6
- (i) A list of activities of a project is given below in the table along with their immediate predecessor activities and durations. Draw the activity network diagram and find the scheduled completion duration of the project. 6

Table : Activity list, IPA and Durations

Activity	IPA	Duration (days)
A	-	7
B	-	10
C	A	15
D	A, B	8
E	C, D	4

- (j) Explain "Earnest Money", "Security Deposit" and "Performance Guarantee". 6

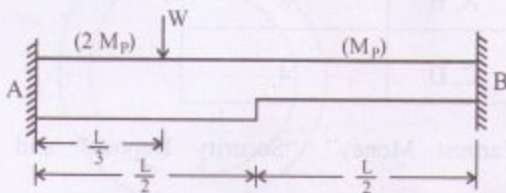
2. (a) Determine the vertical deflection of point D in the truss shown in figure below. The cross-sectional areas of members AD and DE are 1500 mm^2 , while those of the other members are 1000 mm^2 . Take $E = 200 \text{ GPa}$ for all members.



- (b) A simply supported beam is of span 15 m. A u.d.l. of 40 kN/m and 5 m long crosses the beam from left to right. Draw the influence line diagrams for shear force and bending moment at a section 6 m from left end. Use these diagrams and calculate maximum shear force and bending moment at this section.

OR

Determine the Collapse load for the fixed beam as shown in figure below.



3. (a) (i) Check the suitability of a channel section ISLC 400 @ 45.7 kg/m of E250 grade for a column to carry an axial load of 345 kN. The column is 4 m long and restrained against both rotation and translation at one end and restrained against only translation at the other end. Section properties are $A = 5825 \text{ mm}^2$ and $r_{\min} = r_{yy} = 28.1 \text{ mm}$. For the given buckling class of cross-section and KL/r , the design compressive stress, f_{cd} (MPa) are given in the table below.

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Table : Design Compressive Stress, f_{cd} (MPa)

KL/r	90	100	110	120	130	140	150	160	170	180
f_{cd}	121	107	94.6	83.7	74.3	66.2	59.2	53.3	48.1	43.6

- (ii) A rectangular plate made of steel is having yield stress, $f_y = 250 \text{ MPa}$ and ultimate stress, $f_u = 410 \text{ MPa}$. This plate of 200 mm width and 10 mm thickness is drilled with a hole of 4 mm diameter at its mid-width. Calculate tensile strengths, neglecting shear lag of the steel plate, in yielding and in rupture.

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OR

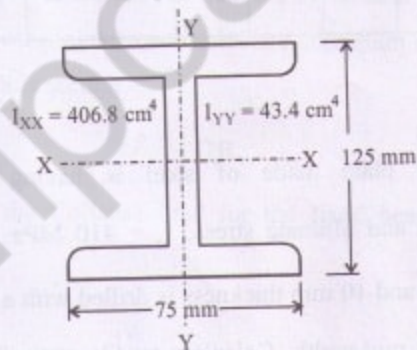
(i) Calculate buckling load for a 5 m long rectangular steel column of cross-section $0.1 \text{ m} \times 0.2 \text{ m}$ hinged at both ends about its major and minor axes.

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(ii) A pitches roof is to be provided for a workshop of effective span 18. The trusses are spaced at 4 m centre to centre and purlins at 1.6 m centre to centre. The pitch of the roof is 28° . The weight of roofing material is 16.2 kg/m^2 and the normal wind pressure is 120 kg/m^2 . If ISLB 125 @ 11.9 kg/m section is used for purlins. Check the adequacy of the section, if permissible bending stress is 165 MPa .

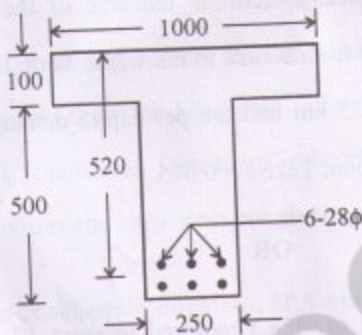
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The detail of I-section is shown in figure.



- (b) Determine the ultimate moment of resistance of an isolated T-beam of span 6 m. Sectional detail of the T-beam is shown in the figure. Take M 20 concrete and Fe 250 steel.

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(All dimensions are in mm.)

4. (a) A rectangular sedimentation tank $17.5 \text{ m} \times 5.5 \text{ m} \times 3.5 \text{ m}$ is treating water 2.5×10^6 litres/day. If 80 ppm suspended solids are present in the water, assuming 75% removal in the basin and the average specific gravity as 2.0, determine the following :
- Average flow of water through tank.
 - Detention time.
 - Deposition of the solids in the tank.
 - Overflow rate.

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P.T.O.

- (b) (i) What are the requirements of a good distribution system of water? 10
- (ii) Water is to be supplied to a town of population of 1.5 lakh. If the water work is situated at a lower elevation of 50 m than the water level in the source. Determine the size of the gravity main to convey the water from source to the water work, if the length of the gravity main is 25 km and the per capita demand of the town is 150 litres/day/capita. Take $f = 0.075$. 20

OR

- (i) Calculate amount of HOCl required to react 17 g/L ammonia to produce nitrogen trichloride. Show reactions also. 5+5
- (ii) Define Ct in disinfection process. Calculate times required to obtain 99% inactivation of 3 pathogens by chlorine. Ct values for pathogens A, B, C are given below :
- Ct = 0.1 for A; Ct = 0.2 for B; Ct = 0.01 for C. Use 1 mg/L chlorine dose. 4 + 6 = 10
- (iii) Consider biodegradation of 180 mg/L glucose. Calculate theoretical oxygen demand and theoretical CO₂ production. Also determine electron donor and electron acceptor in this reaction.

$$(2.5 + 2.5 + 2.5 + 2.5) = 10$$

5. (a) A toll road is constructed at a cost of ₹ 68 crore for an expected traffic of 5000 vehicles per day. How much toll to be charged per vehicle if the developer expects 12 percent rate of return annually on the investment over a period of 20 years ?

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- (b) Level the daily labour requirement for the schedule to not more than 6 workers per day and draw the histogram for your solution and also for your ES and LS patterns. Details of schedule duration, immediate predecessor activities and crew sizes are given in the table below.

Table : Details of schedule duration, IPA and crew sizes for various activities.

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Activity	IPA	Normal Duration (days)	Crew Size (No.)	
			Normal	Minimum
A	-	4	4	2
B	-	4	3	1
C	A	2	3	2
D	A	4	3	1
E	C, D	4	2	1
F	B, C, D	3	4	2

OR

- (a) Construction of a house costs ₹ 36 lac. It is expected to have an annual maintenance cost of ₹ 60,000. It has been now leased out for a monthly rent of ₹ 60,000. Assuming house owner's expected rate of return being 15 percent per annum and no intermediate compounding of house rents within a year, calculate in how many months would the house owner be able to recover the costs. 20
- (b) Completely crash the following activity schedule given in table below and find the optimal time and least cost. Details of immediate predecessor activities (IPA); normal and crash durations and costs are given in the table. Consider overhead cost = ₹ 100 per day. 40

Table : Activities schedule and cost details.

Activity	IPA	Duration		Cost (₹)	
		Normal	Crash	Normal	Crash
A	-	6	4	600	780
B	A	10	7	500	875
C	A	12	8	600	900
D	B, C	8	4	800	940
E	C	6	6	600	725
F	D, E	4	2	800	850

Roll No.

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Total No. of Questions : 5

No. of Printed Pages : 7

SEM-2014(01)
CIVIL ENGINEERING
Paper – II

Time : 3 Hours]

[Total Marks : 300

Instructions to the candidates :

1. All questions carry equal marks.
2. Answer all questions. Question No. 1 does not have internal choice, while questions no. 2-5 have internal choice.
3. Marks of different parts of questions are given along side of the parts.
4. Answers must be written in **English** only.
5. Unless otherwise mentioned, symbols and notations have their usual standard meanings.
6. Assume suitable data (if necessary) and indicate the same clearly.
7. Neat sketches may be drawn at appropriate places.
8. All parts and sub-parts of a question must be answered together.
9. Any pages left blank in answer book must be clearly struck out.

1. Answer all the questions :

(10×6=60 Marks)

- (A) Draw a neat sketch of storage cum diversion scheme and label all the components. 6
- (B) What is a unit hydrograph ? List the assumptions of unit hydrograph theory. 6
- (C) List any three types of canal linings and its specific applications. 6
- (D) Discuss the advantages of gravity dam over earthen dam. 6
- (E) With the help of neat sketch, identify the components of railway track. 6
- (F) Discuss the applications of wind rose diagram with neat sketch. 6
- (G) A soil sample has a saturation moisture content of 20% and specific gravity of 2.6. Determine (i) Void ratio, (ii) Porosity and (iii) Saturated unit weight. 6
- (H) List the factors affecting stopping sight distance. 6
- (I) Standard penetration test conducted at a depth of 10 m resulted in the values : 6, 12 and 15 for each 15 cm penetration respectively. Assuming the water table at surface, soil as fine sand and correction factor for overburden as 1.0, Determine corrected 'N' value of the soil. 6
- (J) What is the need of ground improvement ? List the major methods of ground improvement based on its principle. 6

2. Answer any **three** questions out of **four**. 60
- (A) (i) Derive the relationship between duty, delta and base period. 5
- (ii) A water course has a CCA of 1500 ha. The intensity of Crop A is 40% and of Crop B is 40%. Both the crops being Rabi crops. Crop A has a kar period of 18 days while Crop B has Kar period of 16 days. Calculate the discharge of the water course in Kar depth of A and B is 11 cm and 18 cm, respectively. 15
- (B) Table below gives the recorded annual 24 h maximum rainfall data at a certain location, for period of 15 years, Determine 75%, 90% and 95% dependable rainfall through interpolation. 20
- | | |
|-----------------------|--|
| Year | 1961, 1962, 1963, 1964, 1965, 1966, 67, 68, 69, 70, 71, 72, 73, 74, 75 |
| Rain fall (mm) | 116, 126, 142, 88, 82, 66, 76, 86, 68, 65, 95, 108, 71, 80, 65 |
- (C) Derive the expression of discharge in terms of radius of influence and radius of wells for an unconfined aquifer. 20
- (D) Given a 6 hr unit hydrograph in following table, derive a 9 hour unit hydrograph. 20

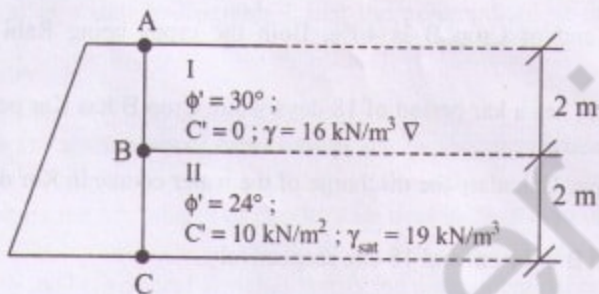
Time (Hour)	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42
Discharge (m³/sec)	0	9	20	35	49	43	35	28	22	17	12	9	6	3	0

3. Answer any **three** questions out of four.

60

- (A) Determine the Rankine passive force per unit length of the wall shown in figure. The water table is at 'B'. Assume $\gamma_w = 10 \text{ kN/m}^3$.

20



- (B) A footing of size 2 m in square shape is laid at a depth of 1.3 m below the surface. Determine the net ultimate bearing capacity using IS code. Take $\gamma = 20 \text{ kN/m}^3$, $\phi' = 30^\circ$, and $C' = 0$. The bearing capacity factors are $N_C = 30.14$, $N_q = 18.4$, and $N_\gamma = 22.4$. The shape factors are $S_c = 1.3$, $S_q = 1.2$, and $S_\gamma = 0.8$.

20

Assume that water table does not affect the bearing capacity.

- (C) A homogeneous earth dam is 21.5 m high and has free board of 1.5 m. A flow net analysis resulted in 12 numbers of potential drops and 3 numbers of flow channels. The dam has horizontal filter of 15 m length. If coefficient of permeability of compacted earth is $2.7 \times 10^{-6} \text{ m/s}$, calculate discharge per unit length of the dam.

20

- (D) Calculate the vertical stress at point 'P' at a depth of 2.5 m directly under the center of the circular footing having radius 2 m, subjected to load of 100 kN/m^2 . Also calculate vertical stress at point 'Q' which is at same depth but 2.5 m away from the center of footing. 20

4. Answer any **three** questions out of four. 60

- (A) Calculate the length of a transition curve and shift using following data :

Design speed = 63 kmph,

Radius of circular curve = 220 m,

Allowable rate of introduction of super elevation = 1 in 150

Pavement width with extra widening = 7.5 m. 20

- (B) The 15 minutes traffic count in cross roads 1 and 2 during peak hour are observed as 185 and 150 vehicles/lane, respectively. Approaching the intersection in the direction of heavier traffic flow. If the amber times required are 3 and 2 seconds respectively for 2 roads based on approach speeds, Design the signal by trial cycle method. Assume average time headway of 2.75 sec during green phase. 20

- (C) On a two way traffic road the speed of overtaking and overtaken vehicles are 60 and 35 kmph, respectively. If the average acceleration of overtaking vehicle is 0.85 m/s^2 , determine

- (i) safe overtaking sight distance,
(ii) minimum length of overtaking zone. 20

(D) (i) Enlist standard tests on bitumen to establish its suitability as per recent IS-73-2013 specifications. Explain significance of any two tests. 10

(ii) State ideal requirements of permanent way with help of neat sketch. 10

5. Answer any six questions out of eight. 60

(A) What is mass inflow curve ? How is it used in determining the storage capacity of a reservoir ? List various yields in a reservoir. 10

(B) Write down (in bullet form) the complete design procedure of an Ogee spillway. 10

(C) (i) Distinguish between taxiway and taxilane. 5

(ii) What will be the effect of Airport code on width of taxilane. 5

(D) List various forms of track junctions. Explain any two with neat sketch. 10

(E) State advantages and disadvantages of a traffic rotary over signalized intersection. 10

(F) The pore pressure parameters of an embankment soil are : $A = 0.5$ and $B = 1.0$. The height of embankment was raised from 2 m to 4 m. Given $\gamma_s = 18 \text{ kN/m}^3$ and lateral pressure at any point is one third of vertical pressure, determine value of change in pore water pressure due to increase in height of embankment. 10

(G) A soil deposit has three layers, having same thickness each, but the permeabilities of the layers are in the ratio of 1 : 2 : 4 from top to bottom.

What is the ratio of equivalent permeability in horizontal direction to vertical direction.

10

(H) A sample of soil was prepared by mixing a quantity of dry soil with 10% of water by mass. Find the mass of the wet mixture required to produce cylindrical compacted specimen of 12.5 cm depth and 15 cm diameter with 6% air content. Find also the void ratio and dry density of the specimen if specific gravity is 2.68.

10