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Candidate should write his/her Roll No. here.

Total No. of Questions : 5

No. of Printed Pages : 11

**SEM-2016(01)-I**  
**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.*

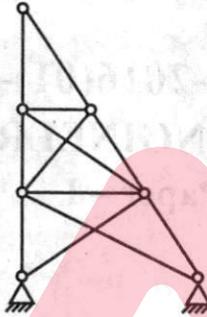
*Only non-programmable scientific calculator is allowed.*

*No codes/special publications/Tables published by BIS or otherwise are allowed.*

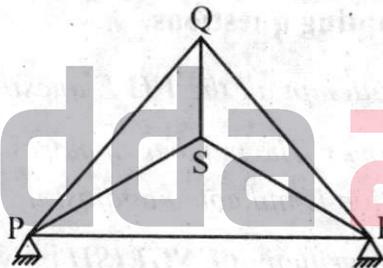
1. All parts carry **equal** marks.

$10 \times 6 = 60$

- (a) For the pin-jointed frame shown below, determine the degree of static indeterminacy and the number of degree of freedom. 6



- (b) What is meant by a redundant frame? Assess whether the frame shown below is redundant or not. 6

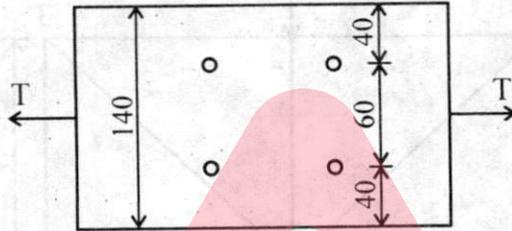


- (c) A simply-supported rectangular concrete beam of  $150 \text{ mm} \times 300 \text{ mm}$  with length of  $8 \text{ m}$  is prestressed by a straight cable carrying an effective prestressing force of  $450 \text{ kN}$  located at an eccentricity of  $50 \text{ mm}$ . The beam is subjected to an external sagging bending moment of  $20 \text{ kN-m}$  inclusive of self-weight and live load. Determine the resultant stress distribution at the mid-span section of the beam. 6

- (d) Write any six different types of losses in the post-tensioned prestressed concrete structures. 6

- (e) Determine the design strength in yielding of a gross-section of a plate  $140 \text{ mm} \times 12 \text{ mm}$ . The plate has holes of  $16 \text{ mm}$  diameter, as shown in the following figure. The yield strength of the plate is  $250 \text{ N/mm}^2$ . Partial safety factor for failure at yield stress is 1.1

6



- (f) A  $16 \text{ mm}$  thick plate is connected to a  $16 \text{ mm}$  thick plate by butt weld having effective length of  $300 \text{ mm}$ , determine the strength of the joint if single V butt weld is used. The grade of steel is Fe410 and shop welding is used for fabrication.

6

- (g) What is yield coefficient for microorganisms in biological processes? How does it influence the requirement for land for managing bacterial sludge from biological wastewater treatment?

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- (h) Why is organic matter removed first than killing pathogens in disinfection unit process?

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- (i) What is resource levelling in a project? Discuss its two key elements.

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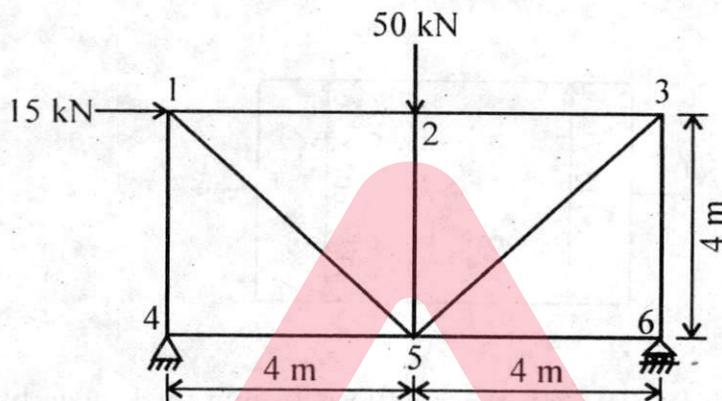
- (j) Differentiate among the terms : negotiation, conciliation and arbitration in dispute resolution of a construction contract.

6

2. Solve any **two** of the following :

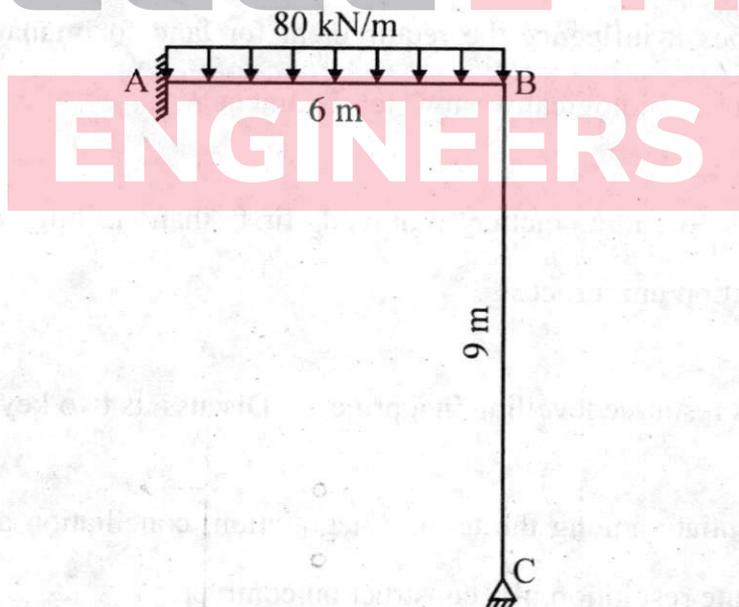
- (a) Determine member forces and support reactions of the truss shown below by using method of joints.

30

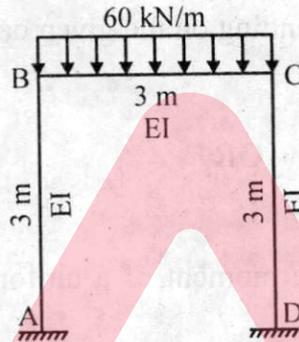


- (b) Analyze the frame shown below using moment distribution method. Flexural rigidity of all the frame members is unity. Determine the support reactions and draw labeled bending moment diagram.

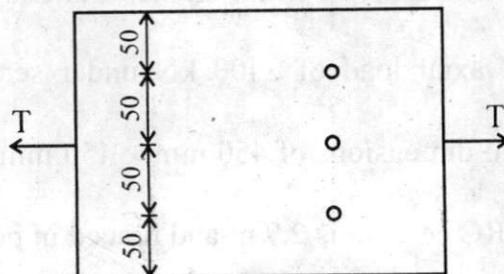
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- (c) For the portal frame having uniform elastic modulus ( $E$ ) and moment of inertia ( $I$ ) for all the members shown below, draw labeled shear force and bending moment diagrams by adopting stiffness matrix method. 30



3. (a) (i) Determine the design tensile strength of a  $200 \text{ mm} \times 10 \text{ mm}$  steel plate with three  $16 \text{ mm}$  diameter bolts as shown in the figure below. Partial safety factor for failure at yield stress is 1.1, partial safety factor for failure at ultimate stress is 1.25, yield strength of steel is  $250 \text{ N/mm}^2$  and ultimate strength of steel is  $410 \text{ N/mm}^2$ . 15



- (ii) Design a reinforced concrete (RC) beam of width 400 mm to carry bending moment of 120 kN/M. Take the permissible compressive in concrete due bending as  $7.0 \text{ N/mm}^2$ , permissible tensile stress in steel as  $230 \text{ N/mm}^2$  and modular ratio as 13.33. Use appropriate design approach depending on the given data.

15

OR

- (b) (i) Determine the plastic moment of a uniform fixed beam shown in the figure below subjected to concentrated ultimate load of 10 kN. Use kinematic method.

15



- (ii) Using M20 grade of concrete and Fe500 grade of steel, design a reinforced concrete (RC) column made of main reinforcement of 20 mm diameter bars with 8 mm diameter lateral ties and subjected to a factored axial load of 2400 kN under service loads having cross-sectional dimensions of  $450 \text{ mm} \times 450 \text{ mm}$ . The unsupported length of the RC column is 2.7 m and braced in both directions.

15

- (c) A column of cross-section 450 mm × 450 mm carries un-factored axial load of 1500 kN. Design an isolated box footing for it, if the bearing capacity of soil is 150 kN/m<sup>2</sup>. Use M20 grade of concrete and Fe500 grade of steel, load factor of 1.5 and 12 mm diameter steel bars for reinforcement to design the footing. The percentage of steel ( $p_t$ ) and the corresponding design shear strength of concrete ( $\tau_{c.lim}$ ) are given in the following table.

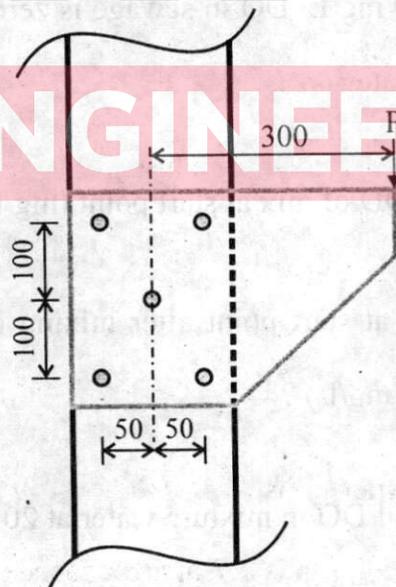
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$p_t(\%)$	0.19	0.20	0.21
$\tau_{c.lim}(\text{N/mm}^2)$	0.312	0.32	0.328

OR

A 12 mm thick steel bracket, bolted to a rolled steel column flange of thickness 7.6 mm, is loaded as shown in the figure below. If group of five M20 bolts of grade 4.6 are used, determine the maximum value of the eccentric factored load  $P$  that the assembly can safely carry. Take the nominal strength factor,  $k_b = 1.0$ , and neglect the effect of shear lag.

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4. (a) The ABC campus sewage is flowing at the rate of 1 million liters/day from a primary clarifier to a standard rate trickling filter. The 5-d BOD of influent is 300 mg/L. The value of adopted organic loading is to be 200 gm/m<sup>3</sup>/day and the surface loading is 1000 litres/m<sup>2</sup>/d. Answer the following :

- (i) Efficiency of the filtration unit (%)
- (ii) Amount of BOD remaining (mg/L) and
- (iii) Revised efficiency of filtration unit for recirculation ratio = 10

$$10 + 10 + 10 = 30$$

(b) (i) A city discharges 2000 litre/sec of sewage into a stream (minimum stream flow rate = 6000 litres/sec). Temperature of sewage and water are 20 °C. The ultimate BOD of sewage is 1000 mg/L and that of river is 10 mg/L. DO in sewage is zero. DO of stream water is 7 mg/L. Calculate :

- (i) Ultimate BOD of mix at start point (mg/L), and
- (ii) DO of mix at start point after mixing of sewage water with river water (mg/L) ?

Saturation value of DO in mixture water at 20 °C = 9.17 mg/L.

$$5 + 5 = 10$$

- (ii) A rectangular grit chamber (water depth = 0.8 m) is designed to remove particles [diameter = 0.1 mm; specific gravity = 2.65; settling velocity = 0.02 m/sec.; flow rate = 1000 m<sup>3</sup>/d]. A flow through velocity of 0.2 m/sec will be maintained by weir.

Answer the following :

- (i) Cross-sectional area (m<sup>2</sup>)  
 (ii) Detention time (sec) and  
 (iii) Channel dimensions

6 + 6 + 8 = 20

OR

- (b) (i) Calculate the minimum size of the particle (micrometer;  $\mu\text{m}$ ) that will be removed with 100% efficiency from a gravitational settling chamber under the following information [density of air = 1000 kg/m<sup>3</sup>; horizontal velocity of air = 0.2 m/sec; temperature = 77 °C; particle specific gravity = 2.0; chamber length = 7 m; chamber height = 1.5 m; correction factor = 2; dynamic viscosity at 77 °C =  $2.1 \times 10^{-5}$  kg/(m.sec)].

6

- (ii) Calculate surface area of disk (m<sup>2</sup>) for an RBC system to treat the wastewater [BOD influent = 130 mg/L; flow rate = 1000 m<sup>3</sup>/d; BOD out = 10 mg/L; hydraulic loading rate = 20 litres/(d × m<sup>2</sup>)]

6

- (iii) Write a balance reaction to show de-nitrification of nitrate ions using methanol. Calculate amounts of methanol (mg/L) required for denitrifying 62 g/L nitrate ions. How much amount of nitrogen gas (mg/L) will be produced ?

6 + 6 + 6 = 18

5. (a) A town built on a river is considering building an additional bridge across the river. Two proposals have been put forward for bridges at different sites. The costs of each proposal are summarized as given below :

	Bridge A	Bridge B
Initial cost of bridge	₹ 65 lakh	₹ 50 lakh
Initial cost of Road works	₹ 35 lakh	₹ 30 lakh
Annual maintenance of bridge	₹ 50,000	₹ 90,000
Annual maintenance of Roads	₹ 30,000	₹ 25,000
Life of bridge	60 years	60 years
Life of Roads	60 years	30 years

With the cost of capital at 9%, which proposal should be adopted ? (Assessment of the proposals to be carried out by a comparison of their net annual cost).

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OR

Data for a small precedence network are given below in Table 1. Draw the network, find out the critical path and the duration of the project.

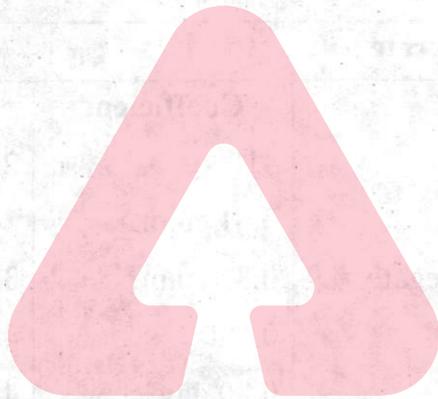
Table 1

Activity	Duration	Depends on
A	2	-
B	6	A
C	4	A
D	9	B, C
E	3	C
F	5	C
G	3	D, E
H	6	E, F
K	4	E, F
L	2	G, H, K

- (b) Analyse rate for a BOQ item of M30 grade concrete (measured in cubic metre) in beams 150 mm × 250 mm deep, including plywood shuttering, finished fair on the sides and at the bottom including three coats of lime wash to these three surfaces for the data given in Table 2 below (reinforcement in concrete to be measured separately under a different item). Assume six uses of wooden plank shuttering in form work before being discarded as waste and reasonable and suitable values for any missing data.

Table 2

For 1 cu.m. of concrete		
Item	Coefficient	Rate, ₹
Cement	410 kg	255 per bag of 50 kg
Sand	0.41 cu.m.	1300 per cu.m.
20 mm graded aggregate	0.82 cu.m.	3500 per cu.m.
Mason	0.6 day	450 per day
Bhisty	0.80 day	415 per day
Beldar	2.30 days	375 per day
Concrete mixer with driver	0.10 day	3000 per day
Vibrator with driver	0.10 day	1000 per day
Others		
Providing & fixing plywood shuttering for sides and soffit of the beam including necessary steel/wooden balli scaffoldings		200 per sq.m.
Three coats of lime wash with blue and gum complete including preparation of surface		35 per sq.m.
Wastage of material		2.5% of respective items
Water & Electricity charges		2%
Overheads & Profit		20%
Labour cess		1%



**adda247**

**ENGINEERS**