2012

CIVIL ENGINEERING (Optional)   100101
स्थापत्य अभियांत्रिकी (वैकल्पिक)

Time : 3 hours   **Maximum Marks : 200**

Note :

(i)   Answers must be written in English.

*(ii)   Question No. 1 is **compulsory**. Of the remaining questions, attempt **any Four** selecting one question from **each section**.*

*(iii)   Figure to the **RIGHT** indicates marks of the respective question.*

(iv)   Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.

(v)   Only Non-Programmable calculator is permitted.

(vi)   Candidates should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise they will be penalised.

1. Answer *any four* of the following :

   (a) Explain the following types of bond in brick masonry with sketches showing its elevation, plan for 1, 3, 5 course and plan for 2, 4, 6 course.
      (i)   Stretcher bond   5
      (ii) One brickwall English bond   5

   (b) Attempt any five of the following (2 marks each) :   2x5=10
      (i)   What do you mean by Principal Planes and Principle Stresses.
      (ii) What is the value of maximum stress induced in a body when the load is applied suddenly.
      (iii) What do you mean by point of inflection ?
      (iv) What assumptions are taken in the analysis of shear stress in beams ?
      (v)   What is strut ? How does it differ from column ?
      (vi) What is the difference between crushing and buckling failure of a column ?

   (c) State and discuss assumptions and limitations of Dupuit's Theory. Derive an   10
       expression for discharge from a well fully penetrating in unconfined aquifer and confined aquifer.

   (d) Draw the network diagram for the following project and identify the critical   10
       path. Calculate total free and independent floats for each of the activities.

Activity	A	B	C	D	E	F	G	H	I	J	K
Time (d)	20	10	12	8	15	16	15	5	10	12	20
Immediately following Activities	D, J	C, F	D, J	-	C, F, G	H, I, K	H, I, K	D, J	J	-	-

P.T.O.

(e) A new water pipeline is to be laid from an existing pumping station to a nearby 10 reservoir. The cost estimates for three possible pipe sizes are given below :

Pipe size (mm)	Cost of pumping ₹/hr.	First cost of construction ₹
250	200	35000
300	175	60000
450	100	75000

The annual cost is to be computed assuming a life of 15 years with no salvage value and an interest rate of 10%.

(i) Which is the most economical pipe size for pumping 5000 hrs per year ?

(ii) How many hrs of pumping per year would be required to make 250 mm and 300 mm pipes equally economical ?

SECTION - A

2. Answer the following sub-questions : 15

(a) What is the difference between statics and dynamics. Find the magnitude and direction of the resultant force of the following forces acting at a point.

(i) 20 N inclined at 30° towards North of East

(ii) 25 N towards North

(iii) 30 N towards North - West and

(iv) 35 N inclined at 40° towards South of West

(b) With necessary sketches explain the following methods of finding out the reduced levels of points :

(i) Plane of collimation method 5

(ii) Rise and fall method 5

And find the height of a chhajja from the ground level from the following data : 5

Reduced level of the ground = 100.00

Staff reading on the ground = 1.835

Reading on the staff held upside down against the bottom of chhajja = 0.975

(c) What is an estimate in connection with a civil engineering structure ? Enlist 10 different types of estimates and give difference between revised estimate and supplementary estimate in a tabular form.

3. Answer the following sub-questions : 15

(a) Define coefficient of restitution in connection with collision of elastic bodies. A ball of mass 1.0 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2.0 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution.

(b)   In a tacheometric survey following were the observations :   **15**

   The staff intercept on a staff held vertically at distance of 50 m and 150 m from a theodolite station were 0.550 and 1.60 respectively when the line of sight of the instrument was horizontal. The instrument was then shifted and set up over a station A and the staff readings on a staff held vertically over station B were 1.50, 1.70, 1.90 and the vertical angle was - 10°45'. The RL of station A was 100.00 and HI at station was 1.75 m. Calculate the distance AB and reduced level of station B.

(c)   Enlist types of engineering contracts. Explain in brief any two of them giving   **10**
their advantages and disadvantages.

SECTION - B

4.   Answer the following sub-questions :   **10**

(a)   A continuous Beam ABCD having support A as fixed support and span CD is over hung. It is continuous over support B and C having span AB=4 m, BC=6 m, and CD=1.2 m, Span AB is loaded with U.D.L 6 kN/m, span BC is acted upon by central point load of 24 kN and there is point load of 5 kN at point D, using the Slope Deflection method analyse the Beam and Draw the B.M.D.

(b)   A beam of span 6 m carries U.D.L of 30 kN/m over the entire span. Design the   **15**
beam assuming that the compression flange is laterally restrained throughout the length. Take σ_b=165 N/mm². Sections available are as under.
Take f_y=250 MPa.

Section	Zxx (cm³)	t_w (mm)	t_f (mm)	h_1 (mm)	h_2 (mm)
ISMB 350	778.9	8.1	8.9	332.2	27.5
ISWB 350	887.00	8.0	11.4	327.2	27.25
ISHB 300	863.3	9.4	10.6	278.8	28.50
ISMB 400	1022.9	8.9	16.0	368.00	30.50

(c)   Derive the Design Constants as per Limit State design philosophy for material   **15**
M 20 and Fe 415 and M 25 and Fe 500.

5.   Answer the following sub-questions :   **10**

(a)   A two hinged parabolic Arch of span 20 m, and rise 4 m carried U.D.L. of 50 kN per meter over the left half of the span. Find the reactions at support and the position and amount of Maximum Bending Moment.

(b)   An ISHB 250@54.7 kg/m with cover plates 300 mm × 20 mm are used as a column   **15**
for supporting all inclusive load of 1600 kN. Design a gussetted base plate for column and also find no. of rivets required for the connection. Adopt following working stresses.

   (i)   Bearing strength of concrete=4 N/mm²
   (ii)   Bending stress for base plate=185 Mpa
   (iii)   Use P.D.S rivets of 18 mm Dia
   (iv)   Shearing stress for rivet = 100 N/mm²
   (v)   Bearing stress for rivet = 300 N/mm²

(c) A singly Reinforced beam has to resist ultimate moment of resistance of 36 kNm. **15** Design the section by using 0.45% steel. Assume b=230 mm, use material M 20 and Fe 250. Also Design the Shear Reinforcement for the beam if

$\tau_c = 0.42$ N/mm^2 and span of Beam = 4 m.

SECTION - C

6. Answer the following sub-questions : **15**

(a) Prove that the velocity distribution for viscous flow between two parallel plates when both plates are fixed across a section is parabolic in nature and maximum velocity is equal to one and half times the average velocity. Also derive equation for drop of pressure head for a given length and shear stress for the same case.

(b) Answer the following : **3x5=15**

   (i) Define potable and palatable water. Explain why drinking water should be both potable and palatable.

   (ii) Two clarifiers operate in parallel. The total flow to the two clarifiers is 0.12 m^3/s. The depth of each clarifier is 2.25 m and each has detention time of 4 hours. What is the surface overflow rate of each clarifier ?

   (iii) Why and how do you maintain water distribution system ?

(c) Explain with the help of diagram, the various component parts, along with their **10** functions of diversion headwork.

7. Answer the following sub-questions : **15**

(a) Obtain an expression for the work done per second by water on the runner of pelton wheel. Hence derive an expression for maximum efficiency of pelton wheel giving relationship between jet speed and bucket speed.

Draw inlet and outlet velocity triangles for a pelton wheel and indicate directions of various velocities.

(b) Answer the following : **3x5=15**

   (i) A wastewater is being discharged into a river that has a temperature of 15°C. What fraction of the maximum oxygen consumption has occurred in five days if the BOD rate constant determined in the laboratory at 20°C is 0.115 d^{-1} (base e) ?

   (ii) Explain the purification mechanisms in an oxidation pond with a neat sketch.

   (iii) How do you determine stability of atmosphere from vertical temperature readings ?

(c) Explain in brief various forces acting on a gravity dam and also explain how you **10** account for earthquake effects in the design of a gravity dam.

SECTION - D

8. Answer the following sub-questions :
    (a) (i)   Define following terms and explain the significance of each :   5
              (A) Shrinkage limit   (B) Sensitivity of the soil
        (ii) A 5.0 m high retaining wall with vertical face retains cohesionless soil   10
              backfill with unit weight of 17.8 kN/m^3, cohesion C = 0 and angle of internal
              friction of 21 degrees. The top surface of the retained soil is horizontal. It
              carries a surcharge pressure of 45 kN/m^2 on the top of the retained soil.
              Calculate the total thrust exerted on the retaining wall per meter length
              under active state. Also locate the point of its application from the base of
              the retaining wall.
    (b) (i)   Explain the concept of minimum and maximum superelevation. Design   10
              the rate of superelevation for a horizontal highway curve of radius 600 m
              and speed 120 kmph.
        (ii) Explain the relationship between speed and maximum capacity of a traffic   5
              lane.
    (c)   What are the functions of a tractor pulled scraper ? What are the advantages of   10
              a scraper over shovels and trucks ? Also determine the total scraper time for a
              scraper to haul earth from a pit to a fill, 610 m distant under average fixed time
              conditions, with an average haul speed of 19.31 km/hr and an average return
              speed of 38.62 km/hr, if the fixed time is 2.3 minutes.

9. Answer the following sub-questions :
    (a) (i)   Write Terzaghi's equation for the analysis of bearing capacity of strip footing.   5
              With suitable sketch, explain the nomenclature used in the equation.
        (ii) Explain the following terms :   5
              (A) RQD
              (B) Taylor's Stability Number
        (iii) A square foundation 2 m × 2 m size is constructed on sand stratum. The   5
              sand has properties as follows :
              (A) Modulus of Elasticity E = 7.8 × 10^3 kN/m^2
              (B) Poisson's ratio = 0.4
              (C) influence factor = 1.12. If the immediate settlement of the foundation
                  shall not exceed 40 mm, what maximum load (in kN) can be placed
                  on the foundation ?
    (b) (i)   Show the conflict points at the intersection of the cross roads having one   5
              way regulation on both roads.
        (ii) Classify bridges. Discuss the factors governing the selection of type of a   10
              bridge.
    (c)   What are the objectives of providing joints in concrete construction ? Briefly   10
              elucidate the three types of joints used in concrete construction.

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