

## CIVIL ENGINEERING (Optional)

### स्थापत्य अभियांत्रिकी ( वैकल्पिक )

Time : 3 hours

Maximum Marks : 200

**Note :**

- (i) In all attempt Five questions.
- (ii) Question No. 1 is **compulsory**.
- (iii) Of the remaining Questions, Attempt Any four by selecting one Question from each section.
- (iv) Numbers of optional questions upto the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.
- (v) Non programmable calculator is allowed to use.
- (vi) Candidate should not write roll number, any names (including his/her own), signature, address or any indication of his/her identity anywhere inside the answer book otherwise he/she will be penalised.

**1. Attempt any four of the following :**

- (a) Attempt **any five** of the following (2 marks each) : 10
  - (i) Write and explain various forms of equations of equilibrium for general forces in a plane.
  - (ii) State and explain D'alemberts principle.
  - (iii) State and explain various assumptions made in the theory of bending.
  - (iv) Why do we need theories of failure for designing a structural element when we know the strength of material from laboratory tests ?
  - (v) Distinguish between a determinate and an indeterminate structure.
  - (vi) Draw stress strain curve for a Mild steel specimen in tension and show salient points in the curve.
  
- (b) Attempt **any five** of the following (2 marks each) : 10
  - (i) What is a member stiffness matrix ? What are its properties ?
  - (ii) Why we need to calculate deflections in structures ?
  - (iii) Explain the procedure for consistency and setting time test on cement
  - (iv) Explain different reasons for termination of contract.
  - (v) Explain procedure for designing a welded joint in a plane truss using gusset plate.
  - (vi) Explain different causes of loss in pre-stress.

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- (c) What is meant by waterlogging ? What are the major causes of waterlogging ? Enlist various measures adopted for controlling waterlogging. **10**
- (d) What is meant by 'optimistic Time', 'most likely Time' and 'Expected time' in PERT technique ? Differentiate between CPM and PERT. **10**
- (e) An industry is planning to expand its production operation. It has identified three different technologies for meeting this goal. The initial outlay and annual revenues with respect to each of the technologies are given in the table. Suggest the best technology which is to be implemented based on Present Worth method of comparison assuming interest rate 20% compounded annually. **10**

Technology	Initial Outlay Rs.	Annual Revenue Rs.	Life years
Technology 1	12,00,000	4,00,000	10
Technology 2	20,00,000	6,00,000	10
Technology 3	18,00,000	5,00,000	10

**SECTION A**

- 2. (a) A block sliding down an inclined plane (25 degrees to horizontal) leaves the end of the plane at a velocity of 5 m/sec and the point of its leaving the inclined plane is 8 m above Ground. Calculate the position of the point where it will hit the ground. **10**
- (b) A cantilever beam has (horizontal) span of 3 m. The beam carries a vertical point load of 5 kN at 1.5 m from support. The Young's modulus is  $200000 \text{ N/mm}^2$ , and moment of inertia about the axis of bending is  $10000000 \text{ mm}^4$ . Calculate deflection at the tip of the cantilever. Neglect effect of self wt of beam. **10**
- (c) A simply supported beam of span 6m has cross section 300 mm wide x 600 mm deep. The beam carries a load of 10 kN/m including self wt. Calculate the total strain energy stored in the beam due to bending only. **10**
- (d) A flywheel at rest, of mass moment of inertia  $10 \text{ kg-m}^2$  (about its axis of rotation) is mounted on a mass-less and frictionless axis and is subjected to the action of a continuously acting moment of 1 kN-m. Calculate the time in seconds when it reaches a circular rotational speed of 100 RPM. **10**

9. Answer the following sub-questions :

- (a) Distinguish between local shear failure and general shear failure in relation to design of foundations. Where would you expect each to occur. Differentiate between immediate settlement and consolidation settlement indicating clearly where do you expect each of them to occur. 15
- (b) Discuss briefly the factors influencing the design of road intersections. Describe any two types of road intersections with neat sketches and mark on them the locations of different islands used for channelization of traffic. 15
- (c) What is meant by 'cycle time' of an earthwork equipment ? Discuss the various factors which affect the cycle time of 'hoe'. Discuss the important aspects of preventive maintenance of earthwork equipment. 10

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**SECTION C**

6. Answer the following sub-questions :
- (a) Define boundary layer. Discuss the various factors affecting boundary layer thickness. Describe the methods of controlling the boundary layer. **15**
  - (b) What do you understand by the term per capita demand ? What are the various factors which affect the per capita demand of a town ? Explain any three methods of forecasting the future population of a town and comment on their relative merits. **15**
  - (c) Discuss the necessity and methods of foundation treatment of dams. Explain how uplift considerations affect design of gravity dams. **10**
7. Answer the following sub-questions :
- (a) Differentiate between (i) Steady and Unsteady flow. (ii) Uniform and non-uniform flow in open channels and show that for a trapezoidal channel of given area of flow, the condition of maximum flow requires that hydraulic mean depth is equal to one half of the depth of flow. **15**
  - (b) What is meant by 'activated sludge process' ? With the help of neat sketch explain the activated sludge process. What are the advantages and disadvantages of activated sludge process ? **15**
  - (c) What are the principal components of hydropower plant ? What is surge tank ? What are its types and uses ? **10**

**SECTION D**

8. Answer the following sub-questions :
- (a) Define effective stress. What do you understand by the term 'permeability of soil' ? State the variables on which permeability of soil depend. Differentiate between compressibility, compaction and consolidation in reference to soil strata. **15**
  - (b) Describe the causes and effects of any two major defects that appear in cement concrete roads. Describe the major features of construction which affect the riding quality of cement concrete roads. **15**
  - (c) What do you understand by term 'slipform'. Discuss the suitability of slipform. Draw the neat sketch of slipform indicating the major components and explain the working Enlist the difficulties encountered in underwater concreting. **10**

**P.T.O.**

3. (a) Straight column of length  $L$  simply supported at both ends has flexural rigidity  $EI$ . The column carries an axial load  $P$  and a transverse load  $W$  at its center. Calculate central deflection of the column and hence determine its buckling load. 10
- (b) What is Rate Analysis ? How will you scientifically determine rate of concrete per cubic meter to be poured in a RCC slab at 4 m above ground level ? 10
- (c) A Three hinged circular arch has span of 20m and rise 8m. The arch carries a UDL of 20 kN/m (measured horizontally). The hinges are at supports (same level) and at crown. Determine support reactions and draw SFD and BMD for the arch. 10
- (d) Calculate shape factor for a thin hollow circular section of outside diameter 60.3 mm and wall thickness of 3.25mm. The section is made of Mild steel with usual stress strain characteristics. 10

### SECTION B

4. (a) A continuous beam ABCD has spans  $AB=4m$ ,  $BC=8m$ ,  $CD=6m$ .  $EI$  is same throughout. The beam carries a UDL of 20 kN/m on AB and 25 kN/m on BC. Analyse the beam by moment distribution method and determine support reactions. 10
- (b) A column made up of 2 ISMC200 spaced 500 apart (face to face, out to out) carries an axial load of 600 kN and a moment of 10 kN-m about its major axis. The column is to be supported on a concrete pedestal. Design gusseted base plate for the column and also design the foundation bolts for the base. Allowable bearing pressure of concrete is 4 N/mm<sup>2</sup> and permissible bending stress in plate is 180 N/mm<sup>2</sup>. All connections to be made using 6 mm fillet welds. 20
- (c) Design a RCC slab simply supported on all edges. Size of slab is 3.5m x 8m, Use HYSD steel bars of grade Fe 415. The slab is to carry a total superimposed load of 4 kN/m excluding self wt. 10
5. (a) A portal frame ABCD has fixed supports at A and D. Columns AB and DC are 6 m high and beam BC has 8m span. Flexural rigidity of all members is 828000000 N-m<sup>2</sup>. If the support A frame settles down by 30 mm, analyze the frame and draw BMD of the frame. 20
- (b) A concrete beam of section 400 mm wide x 750 mm deep carries a total BM of 400 kN-m Determine magnitude and eccentricity of the force so that stresses at transfer are limited to 12 N/mm<sup>2</sup> in compression and 1 N/mm<sup>2</sup> in tension. 20