

(3 Hours)

Total Marks 80

- Note: 1. Q.No.1 is compulsory.  
 2. Attempt any three questions out of remaining five questions.  
 3. Assume any data if required stating clearly.

- Q.No.1 Attempt any four questions **20**
- Draw the neat sketch of Layout of hydroelectric power plant
  - Define specific speed of centrifugal pump and derive its expression
  - Explain briefly various types of surface profiles in open channel
  - Derive conditions for most economical rectangular channel section.
  - Classify the jumps based of Froude No.
- Q.No.2.(a) (a) A jet of water of diameter 25 mm strikes a 200 mm x 200 mm square plate of uniform thickness with a velocity of 10 m/s at the centre of the plate which is suspended vertically by a hinge on its top horizontal edge. The weight of plate is 100 N. The jet strikes normal to the plate. What force must be applied at the lower edge of the plate to keep it vertical ? What will be inclination of plate with vertical due to force exerted by jet of water, if plate is allowed to deflect freely **10**
- (b) A jet of water of diameter 60 mm moving vertically with a velocity 28 m/s impinges on a fixed curved plate tangentially at one end at an angle of  $30^\circ$  to the horizontal. Calculate the resultant force of the jet on the plate if the jet is deflected through an angle of  $50^\circ$ . **10**
- Q.No.3 (a) Determine the power given by the jet of water to the runner of a Pelton Wheel which is having tangential 25 m/s . The net head on the turbine is 60 mt and discharge through the jet of water is  $0.025 \text{ m}^3/\text{s}$ . The side clearance angle is  $15^\circ$  and take  $C_v=0.97$  **10**
- (b) An inward flow reaction turbine has external and internal diameters as 1.2 m and 0.6 m respectively. The hydraulic efficiency of turbine is 88% when the head on the turbine is 40 mt. The velocity of flow at outlet is 3 m/s and discharge at outlet is radial. If the vane angle at outlet is  $15^\circ$  and the width of the wheel is 90 mm at inlet and outlet, determine (i) the guide blade angle (ii) speed of turbine (iii) vane angle of the runner at inlet (iv) Volume flow rate of turbine **10**
- Q.No.4 (a) The outer diameter of an impeller of a centrifugal pump is 380 mm and outlet width is 50 mm. The pump is running at 780 rpm and is working against head of 16 m. The vanes angle at outlet is  $40^\circ$  and manometric efficiency is 78 % Determine (i) velocity of flow at outlet (ii) velocity of water leaving the vane (iii) angle made by absolute velocity at outlet (iv) discharge **10**

- (b) (i) Explain Hydraulic Crane **05**  
(ii) Write short notes on Hydraulic accumulator **05**
- Q.No.5(a) Calculate the quantity of water that will be discharged at an uniform depth of 1.0 mt in a 1.4 mt diameter circular channel (pipe) which is laid at a slope of 1 in 1200. Assume Chezy's  $C=60$ . **10**
- (b) A trapezoidal channel section with side slope 1H : 1V has to be designed to carry a discharge of  $12 \text{ m}^3/\text{sec}$  at a velocity of  $2.5 \text{ m/s}$  so that the amount of lining for the bed and sides is to be most economical. Calculate the area of lining required for one mt length of canal. **10**
- Q.No.6 (a) Derive the expression for depth of hydraulic jump. **10**
- (b) (i) Explain briefly specific energy curve with neat sketch. **10**  
(ii) The specific energy for a 4 mt wide rectangular channel is to be  $4 \text{ Nm/m}$ . If the rate of flow of water through channel is  $16 \text{ m/s}$ , determine the alternate depth of flow

Time: 3 Hours

Marks: 80

- NB: 1) Question No. 1 is compulsory  
 2) Attempt any 3 of the remaining 5 questions  
 3) Assume suitable data wherever necessary  
 4) Numbers to right indicate full marks.

1. Answer any 4:
- a) Write a short note on methods of borehole logs. 05
  - b) What are the effects of permeability on various properties of soil? 05
  - c) Explain the factors affecting compaction of soil. 05
  - d) What are the uses of particle size distribution curve. 05
  - e) Write a short note on Atterberg limits. 05

2. a) Using three phase diagram, derive the expression for submerged density in terms of porosity. 05  
 b) For the construction of an embankment, the soil is transported from the borrow area using a truck which can carry  $8 \text{ m}^3$  soil at a time. Determine i) the volume of soil to be excavated from the borrow pit and ii) the number of truck loads required to obtain  $120 \text{ m}^3$  compacted earth fill from the following details: 10

Property	Borrow Area	Truck	Field
Bulk Unit Wt.	$20 \text{ kN/m}^3$	$15 \text{ kN/m}^3$	$22 \text{ kN/m}^3$
Water Content	10.5%	8.5%	16.5%

- c) Write a short note on thixotropy of clays. 05
3. a) The following observations were recorded in a liquid limit test: 10

No. of blows N	w %
28	68
22	70
36	67
19	75
16	77

Determine liquid limit & flow index. If  $w_p = 46\%$ , find plasticity index

- b) Enlist the limitations of sedimentation analysis. 05
- c) Two clays A and B have the following properties:

	Clay A	Clay B
Liquid limit $W_L$ %	45	56
Plastic limit $W_P$ %	21	36
Natural water content $W_N$ %	31	51

Which of the clays, A or B, would experience larger settlement under identical loads? Which of the soil is more plastic? Which of them is softer in consistency?

4. a) Write a short note on relative density. 05  
 b) In a falling head permeability test on a soil sample of length 120 mm, the head of water in the stand pipe takes 15 seconds to fall from 950 mm to 200 mm above the tail-water level. Then another soil of length 80 mm is placed on top of the first soil. The time taken for the head to fall between the same limit is 20 seconds. The permeameter has a cross-sectional area of 5000 mm<sup>2</sup> and a stand pipe area of 150 mm<sup>2</sup>. Calculate the permeability of the 2<sup>nd</sup> soil. 10  
 c) For a homogeneous earth dam 30 m high and 2 m free board, a flow net was constructed with four flow channels. The number of potential drops was 20. The dam has a horizontal filter at the base near the toe. The coefficient of permeability of the soil was  $9 \times 10^{-2}$  mm/s. Determine the anticipated seepage, if the length of the dam is 110 metres. 05
5. a) A test well 0.6 m in diameter penetrates through a saturated aquifer 11 m thick overlying an impervious layer. The steady discharge of the well is 20.72 m<sup>3</sup>/hr. The drawdown at a distance of  $R_1 = 25$  m from the centre of test well is found to be 2 m. What will be the drawdown at a distance of  $R_2 = 55$  m, if the permeability of soil is  $4 \times 10^{-4}$  m/sec? Estimate approximate drawdown at the test well also. 10  
 b) In a site reclamation project 3.5 m of graded soil with  $\gamma = 23\text{kN/m}^3$  were laid in compacted layers over existing layers of silty clay with  $\gamma = 19\text{kN/m}^3$  which was 4m thick. This was underlain by a 3 m thick layer of gravel ( $\gamma = 21\text{kN/m}^3$ ). Assuming that the water table remains at the surface of the silty clay, draw the effective stress profile for the soil profile:  
 a) before the fill is placed and b) after the fill has been placed. 10
6. a) The results of an IS Standard Proctor Test are as follows: 10

Trial No.	1	2	3	4	5	6
Moisture content (%)	6.02	7.81	12.25	14.05	15.40	20.25
Weight of container and compacted soil (N)	35.8	37.3	39.3	40.0	40.1	39.1

The specific gravity of soil particle is 2.65. Plot the following: a) moisture content - dry density curve, b) zero air voids curve and c) 10% air content curve. Determine the optimum moisture content and the corresponding maximum dry density. Assume suitable data, if required.

- b) Explain static cone penetration test. 05  
 c) Write a short note on number, spacing and depth of boreholes. 05

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Time: 3 Hours

Maximum Marks - 80

**Note** Question No. 01 is compulsory, attempt any **three** out of the remaining five questions  
Use of IS 456:2000 is permitted  
Assume suitable data if required and state it clearly

**Q.1 Attempt ANY FOUR from following**

- a) Explain balanced, under-reinforced and over-reinforced design with respect to Working stress method philosophy. **05**
- b) Draw the Reinforcement Detailing of Two-way slab 4m x 5m clear span for the following details. **05**  
Ast in the shorter direction =  $376.15 \text{ mm}^2$  and Ast in the longer direction =  $261.93 \text{ mm}^2$ . Assume diameter of the bars and also show bent up bars in both the directions.
- c) Calculate Reinforcement in the Central band for the Total Area of Reinforcement  $2500 \text{ mm}^2$ . Size of the Footing is 4m x 2.5m. **05**
- d) A Square column 450 mm x 450 mm is reinforced with 4 no. of bars 16mm diameters using M20 grade concrete and Fe415 steel. Find the Load carrying capacity of the column if it is axially loaded short column. **05**
- d) Explain Characteristic strength of Materials, Characteristic Load and partial safety factors. **05**
- e) What do you mean by side face reinforcement? When it is provided in the beam. Draw reinforcement detailing showing side face reinforcement. Assume suitable data. **05**
- f) Explain the condition when the beam shall be designed as a doubly reinforced beam. **05**

- Q.2** a) A simply supported beam of size 230 mm x 600 mm overall depth is reinforced with 4 no of bars of 12 mm diameter. Find the safe uniformly distributed load on the beam in addition to its self weight on a span of 4.5 m. The materials are M20 grade concrete and Fe415 steel. Adopt Working Stress Method. **10**
- b) A Singly reinforced rectangular beam 230 mm x 600 mm effective depth with 3 no. 25 mm diameter bars. Find out the factored moment of resistance of the section. The Materials are M20 grade concrete and mild steel reinforcement. Also find out moment of resistance if the materials are M20 grade concrete and Fe415 steel. Adopt Limit State Method. **10**

- Q.3** a) Determine the position of the neutral axis of a reinforced concrete beam 250 mm wide x 360 mm effective depth. If the stresses developed in concrete and steel are  $6.5 \text{ N/mm}^2$  and  $174 \text{ N/mm}^2$  respectively. The materials are M20 grade concrete and Fe 415 steel. Also determine the type of beam. Adopt working Stress Method. **07**
- b) A T Beam of effective flange width 1100 mm, thickness of the slab is 110 mm, width of the rib is 230 mm and effective depth is 560 mm. The T beam is reinforced with 3 no. of bars 25 mm diameters at the bottom of the beam. Calculate the factored moment of resistance. The Materials are M25 concrete and Fe415 steel. Adopt LSM. **08**
- c) Calculate Minimum and Maximum Percentage of Reinforcement as per IS 456:2000 for the following details. **5**
- 1) Tension Reinforcement in Beam,  $b= 230 \text{ mm}$ ,  $d= 460 \text{ mm}$ ,  $D = 500 \text{ mm}$ , Fe415 steel.
  - 2) Slab of Overall Depth = 150 mm, Fe 415 steel.
  - 3) Column of size, 450 mm x 450 mm
- Q.4** a) Design a shear reinforcement for a beam of 230 mm x 450 mm effective depth carrying a factored shear force of 200 kN. It is reinforced with 3 no of bars of 16 mm diameter. Use M20 grade concrete and Fe415 steel. Adopt Limit State Method. **10**
- b) Design a simply supported slab for a room size of 8m x 3.5 m clear span, Live Load =  $4 \text{ kN/m}^2$ , Floor finish =  $1.5 \text{ kN/m}^2$ . Slab is resting on wall of 230 mm width. Use M25 grade concrete and Fe415 steel. Draw Reinforcement Details. **10**
- Q.5** a) Design a column, 4 m long, restrained in position and direction at both ends, to carry axial load of 1500 kN. Use M20 grade concrete and Fe415 steel. Draw Reinforcement Details. **10**
- b) Write down with neat sketch, where exactly you find the critical section in the design of isolated footing for Bending moment, one way shear and Two way shear. **05**
- c) Write and Explain any two assumptions that are used in limit state of collapse due to flexure. **05**
- Q.6** a) Design a Square footing for a axially loaded column of size 400 mm x 400 mm, carrying a working load of 800 kN. Use M20 concrete and Fe415 steel. Safe bearing capacity of the soil is  $200 \text{ kN/m}^2$ . Draw reinforcement details. **12**
- b) Write down the steps to design circular column with helical reinforcement. Also write different formulas that are used in the design. Assume suitable data to draw reinforcement detailing of the Circular column with helical reinforcement. **08**

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Time: 3hrs

Total Marks:80

- N.B. : (1) Question No 1 is Compulsory.  
(2) Attempt any 3 questions out of the remaining 5.  
(3) All questions carry equal marks.  
(4) Assume suitable data, and support all theory with neat sketch, wherever required.

1. Attempt any FOUR [20]
  - a. What is grade compensation? Where is it provided on a highway?
  - b. Describe the term 'Equivalent Wheel Load Factor'. How does an increase in wheel load affect the damaging factor?
  - c. Explain how PIEV theory is used to evaluate reaction time.
  - d. What are the types of failures in flexible pavement?
  - e. Sketch the layout of an Airport, properly marking all the components.
  - f. Why is soil stabilization required? What are its different methods?
2.
  - a. Enlist the different types of traffic studies and explain any one in detail. [10]
  - b. What is stopping sight distance? Calculate the safe stopping sight distance for a design speed of 70 kmph for two-way traffic on a single-lane road, if the coefficient of friction is given as 0.37 [10]
3.
  - a. Mention any one test for determining the grade of bitumen. Explain the test. [10]
  - b.
    - (i) What are the basic requirements of a highway alignment? [10]
    - (ii) The design speed on a highway is 80 kmph, the pavement width is 10m and the length of the wheelbase is assumed as 6m. If a horizontal curve of radius 480m is to be provided on this highway, design the geometric features – (i) super elevation, (ii) Extra widening
4.
  - a.
    - (i) What is the significance of CBR value and modulus of subgrade reaction on the design of pavements? [10]
    - (ii) Explain the term 'cumulative standard axle'? Write down the formula for CSA and explain all the terms
  - b. Define Equilibrium cant. [10]  
Calculate the value of equilibrium cant for a  $3^\circ$  curve on a BG track having a design speed of 95 kmph. What is the maximum permissible speed on the track, allowing maximum cant deficiency?

5. a. (i) Explain BBD for structural evaluation of pavements [10]  
(ii) Write a note on drainage systems in pavements.
- b. Using Westergaard's equations, calculate the wheel load stresses at (i) interior, [10]  
(ii) edge and (iii) corner regions of a rigid pavement, from the given data.  
Determine the location where a crack is likely to develop due to corner loading.  
Given,  $P = 6500 \text{ kg}$ ,  $E = 3 \times 10^5 \text{ kg/cm}^2$ ,  $\mu = 0.15$ ,  $K = 6 \text{ kg/cm}^3$ , radius of contact  
area,  $a = 15 \text{ cm}$  and pavement thickness,  $h = 18 \text{ cm}$
6. a. Explain QVK curve and LOS (level of service) with suitable figures. [10]
- b. Find out the corrected length of runway for an airport at an elevation of 200m [10]  
RL, if the basic runway length is 600m. The airport reference temperature is  $27^\circ\text{C}$   
and the maximum elevation difference along the profile of the runway is 5.6 m.

(Time: 3 Hours)

(Total Marks: 80)

- Note:** 1. **Question number 1** is **compulsory**; attempt **any three** out of the remaining questions.  
2. Assume suitable **data** if **required** and mention it clearly.  
3. Draw neat sketches wherever necessary. Figure to the right indicates full marks.

**1. Attempt any four.**

- (a) What is rheology? Why it is essential? Where is it used? [05]  
(b) Explain the concept behind statistical quality control of the concrete with a sketch. [05]  
(c) Explain the process and significance of hydration of cement. [05]  
(d) What do you understand by destructive, non-destructive, and partial destructive tests on concrete? Give an example in each test. [05]  
(e) What is the relationship between cube strength and cylinder strength? and in which mixture design cube strength and cylinder strength are preferred. [05]  
(f) Explain the mechanism of carbonation with its effect on concrete and the method of determination of carbonation? [05]

**2. (a) Design a concrete mix by IS 10262: 2019 for the following data: [12]**

- i. Characteristic compressive strength required in the field at 28 days grade designation = M 40
- ii. Standard Deviation = 5.0
- iii. Value of X = 6.5
- iv. For durability criteria, w/c is restricted to 0.45
- v. Nominal maximum size of aggregate = 20 mm
- vi. Shape of C.A aggregate = Angular
- vii. Degree of workability required at site = 100 mm slump
- viii. Type of exposure = mild
- ix. Method of concrete placing = Pumpable concrete
- x. Specific gravity of cement = 3.14
- xi. Specific gravity of C.A = 2.7
- xii. Specific gravity of F.A = 2.6
- xiii. Aggregates are assumed to be in saturated surface dry condition.

F.A belongs to Zone II

Refer following tables for the mixture design.

**(b) Method of Road Note No. 4**

**[08]**

Design a Concrete Mix to suite the Following Data Using the Method of Road Note No. 4  
Specified works cube strength: 30 N/mm<sup>2</sup> at 28 days.

Degree of control: Very good with weigh batching and constant supervision (minimum strength as a 75 percent of average strength)

Degree of workability: Medium

Grading curve number: 03

Type of cement: Ordinary Portland

(Specific gravity= 3.15)

Type of fine aggregate: Natural sand

(Specific gravity= 2.60)

Type of coarse aggregate: Irregular aggregate of 20 mm size (Specific gravity= 2.60)

The aggregates available at the works site have the following grading:

Design the concrete mix & set out field mix proportions for 1 cubic meter of concrete by weigh batching. What is the density of fresh concrete? Also refer following graphs and tables for the mixture design.

Aggregate to cement ratio	
w/c	Medium degree of workability
0.4	3.5
0.45	4.2
0.5	4.8

IS Sieve Size		20 mm	10 mm	4.75 mm	2.36 mm	1.18 mm	600 μ	300 μ	150 μ
Cumulative Percentage passing	Fine Aggregate	-	-	100	92	76	48	20	3
	Coarse Aggregate	100	31	7	0	-	-	-	-

3. (a) Explain the transport mechanism of fluids and gases in concrete. **[04]**
- (b) Explain the alkali-aggregate reaction. **[04]**
- (c) Explain the effects of chemical admixture on the fresh and hardened properties of concrete. **[04]**
- (d) What is cold weather concreting? What are the harmful effects of cold weather? Explain the various precautionary measures taken during cold weather. **[08]**
4. (a) Write a short note on infrared thermography. Explain how the result is interpreted to check the quality of concrete. **[05]**
- (b) You are going to construct concrete sewer pipes under the ground where the soil is rich in sulphate content. Which type of cement you will prefer and why? **[03]**
- (c) Explain how Maturity method is used for determining the strength of concrete with suitable sketch. **[06]**
- (d) How is self-compacting concrete distinguished from conventional concrete? And enlist the tests which qualify the self-compacting concrete. **[06]**
5. (a) What is the purpose of the core test? How do you calculate the compressive strength of concrete by core test? **[05]**
- (b) Why ITZ is the weakest link in the concrete? What is effect of gel-space ratio on concrete? **[05]**
- (c) What is Vacuum concrete? What are the advantages of it? **[05]**
- (d) Write step by step procedure of concrete mix design by American Concrete Institute 211.1 **[05]**

6. (a) Write following statements are true or false. If false, rewrite the correct statement. [04]
- Durability of reinforced concrete structures depends primarily on the quality of the cover concrete.
  - Aerobic bacteria in the slime under flowing sewage convert sulphates in the sewage into sulphides.
  - When phenolphthalein indicator is used in concrete, the pink colour indicates the acidic nature of the concrete.
  - The ratio of  $Ca^{2+}/alkali (Na^+, K^+)$  in the ASR gel determines its expansive nature.
- (b) Distinguish between stiffening, setting and hardening of concrete. [06]
- (c) Explain in detail Corrosion monitoring techniques of reinforcement and preventive measures. [05]
- (d) Enlist different waste which will be used in concrete as ingredients, and explain any one in detail with their advantages and disadvantages. [05]

**Data for Mix design from IS 10262:2019**

Table 1: Maximum Water Content per Cubic metre of Concrete for Nominal Maximum Size of Aggregate

Sr. No	Nominal maximum size of the Aggregate (mm)	Maximum Water Content (kg)
1	10	208
2	20	186
3	40	165

Table 2: Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate

Sr. No.	Nominal maximum size of the Aggregate (mm)	Volume of Coarse Aggregate per Unit Volume of Total Aggregate for Different Zones of Fine Aggregate			
		Zone I	Zone II	Zone III	Zone IV
1	10	0.50	0.48	0.46	0.44
2	20	0.66	0.64	0.62	0.60
3	40	0.75	0.73	0.71	0.69



Duration: 3Hours

Total marks: 80

NOTE:

- i) Question No. 1 is compulsory.
- ii) Attempt any three out of the remaining five questions.
- iii) Figure to the right indicates full marks.

- Q.1** Write notes on **any four** of the following questions. **20**
- i.- Filler slab roof.
  - ii.- Embodied energy.
  - iii- Ozone layer depletion.
  - iv- Nanotechnology for sustainable development.
  - v - Carbon capture and storage
  - vi- Geopolymers
- Q.2** A) Define sustainability. Explain the need and pillars of sustainability **10**
- B) What are the raw materials used for stabilized mud block.? Discuss the process and advantages of SMB. **10**
- Q.3** A) Explain any five supplementary cementitious materials and their effect on fresh and hardened concrete. **10**
- B) How LP cement is different from masonry cement.? Discuss its types and applications. **10**
- Q.4** A) Discuss about different types of curing methods used in construction. **10**
- B) Explain the composite materials, construction methods and application of ferrocement. **10**
- Q.5** A) Discuss the matrix materials, different types of reinforcing materials and application of fiber reinforced cement composites. **10**
- B) Explain the various types roof alternatives available in construction and its application.? **10**
- Q.6** A) Explain role construction industry for Global warming? What are the remedial measures to be taken **10**
- B) Discuss in detail about the Water and Air Act in India. **10**

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**Time: 3-hour**

**Max. Marks: 80**

**Note:**

1. All questions carry equal marks
2. Question one is compulsory. Attempt any three out of remaining questions.
3. Assume suitable data if required and state it clearly.

- Q1 Attempt any four 20
- a) What are common problems of lifts and escalators.
  - b) Explain fuse as a protective system.
  - c) Write a note on water meter
  - d) Discuss the causes of seepage & leakage in structures
  - e) Explain applications of Carbon fiber wrapping
  - f) What is role of Project Management Consultant.
- Q2 a) Write a short note on CCTV and LAN system. 10
- b) Explain different components of firefighting system. Draw a neat sketch. 10
- Q3 a) What measures you will suggest for Safety during Repairs. 10
- b) Explain the different water-proofing systems of concrete structures. 10
- Q4 Attempt any four 20
- a) What is the role of building services. List different building services. State important points you will consider while selecting contractor for building services.
  - b) What are the factors affecting selection of artificial lighting
  - c) What is ferro concrete. Explain applications of ferro concrete
  - d) Write a note on motors and generators systems provided in a building.
  - e) Explain cathodic protection.
  - f) Draw water supply and drainage layout of a bungalow. Show pipe sizes and valves.
- Q5 a) Explain the different types of wires and wiring systems. What points you will consider while making choice of wires and wiring systems. 10
- a) What are different repair materials. What are their desirable properties 10
- Q6 a) Discuss causes of deterioration of concrete structures. Suggest the efforts to prevent deterioration. 10
- b) Prepare a list of 'Legal Documentation and Records' during a repair work. Explain any one from this list in detail. 10

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