

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) Explain the scope of soil engineering. 05
  - b) Write a short note on Atterberg's limits. 05
  - c) Derive the expression for average co-efficient of permeability for flow of water normal to the plane of stratification of soil. 05
  - d) Write a short note on quick sand condition. 05
  - e) Explain the factors affecting compaction. 05
2. a) Derive the expression for the relationship between void's ratio, water content, specific gravity and degree of saturation. 05
- b) A soil has liquid limit and plastic limit of 45% and 30% respectively. If the volumetric shrinkage at liquid limit and plastic limit are 40% and 25%, determine the shrinkage limit. 10
- c) Classify the following soil as per IS classification system systematically with justifications: % passing 75 micron sieve = 8%, retained on 4.75 mm sieve = 35, coefficient of curvature = 2.5, uniformity coefficient = 7, liquid limit = 15, plasticity index = 3. 05
3. a) In a site reclamation project 2.5 m of graded soil with  $\gamma = 22\text{kN/m}^3$  was laid in compacted layers over existing layers of silty clay with  $\gamma = 18\text{kN/m}^3$  which was 3m thick. This was above a 2 m thick layer of gravel ( $\gamma = 20\text{kN/m}^3$ ). Assuming that the water table remains at the surface of the silty clay, draw the effective stress profile for the soil profile i) before the fill is place and ii) after the fill has been placed 10
- b) The following results were obtained from a standard proctor test on a sample of soil 10
- |                       |      |      |      |      |      |      |
|-----------------------|------|------|------|------|------|------|
| Water content (%)     | 0.12 | 0.14 | 0.16 | 0.18 | 0.20 | 0.22 |
| Mass of wet soil (kg) | 1.68 | 1.85 | 1.91 | 1.87 | 1.86 | 1.85 |
- The volume of the mould used was 1000 ml. Find optimum moisture content and maximum dry density. Also, plot the zero air voids line if  $G = 2.70$ .
4. a) Explain the role of Montmorillonite, Illite mineral in producing the plastic behaviour of soil. 05
- b) There are two borrow areas A and B which have soils with void ratios of 0.80 and 0.70 respectively. The in-place water content is 20% and 15% respectively. The fill at the end of construction will have a total volume of  $10,000\text{ m}^3$ , bulk density  $2.0\text{ gm/cc}$  and placement water of 22%. Determine the volume of the soil required to be excavate from both areas. Take  $G = 2.65$ , If the cost of excavation of soil and transportation is Rs. 200 per  $100\text{ m}^3$  for area A and 220 per  $100\text{ m}^3$  for area B, state which borrow pit is economical. 10
- c) Write the uses of particular size distribution curve 05

5. a) A test well of 0.5m in diameter penetrates through saturated aquifer of 10 m thick overlaying an impervious layer. The steady discharge of well is 20 m<sup>3</sup>/hr. The drawdown at the distance of R<sub>1</sub> = 25m, from the centre of test well is found to be 1.9m. What will be the drawdown at the distance of 50m? If the permeability of soil is 3.8 x10<sup>-4</sup> m/s. Estimate approximate drawdown of centre well also. 10
- b) In a falling head permeability test on a soil sample of length 100 mm, the head of water in the stand pipe takes 10 seconds to fall from 850 mm to 175 mm above the tail-water level. Then another soil of length 60 mm is placed on top of the first soil. The time taken for the head to fall between the same limit is 18 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
6. Write a short note on:
- a) Thixotropy of clay 05
- b) Uses of flow nets 05
- c) Types of boring 05
- d) Borehole logs 05

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**Duration: 3hrs**

**[Max 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. Differentiate between surface and subsurface drainage.
  - b. Explain Q-K-V curve.
  - c. Write a note on the use of geosynthetics in highways.
  - d. What is a grade-separated intersection? What are its advantages?
  - e. What is sight distance? How is intersection sight distance calculated?
  - f. Calculate the actual ruling gradient on a curve of  $3^\circ$  in a BG track, if the ruling gradient of that section of railway is 1 in 200
2. a. What is the function of a taxiway? Calculate the turning radius of a taxiway for operating Boeing airplanes having a wheelbase of 17.70m, tread of main landing gear as 6.62 m, and turning speed of 37 kmph. Consider coefficient of friction as 0.13? [10]  
b. Why is extra widening required at curves? Estimate the extra widening required for a pavement of width 7m on a horizontal curve of radius 255 m, if the longest wheelbase of vehicle expected is 6.8 m and design speed is 75 kmph. [10]
3. a. What is the purpose of joints in concrete pavements? Briefly explain the different types of joints in concrete pavements. [10]  
b. What is meant by Cant deficiency? Calculate the cant deficiency and permissible speed for a  $4^\circ$  curve on a BG track [10]
4. a. Enlist the tests on aggregates used in highway construction. Explain any one test in detail. [10]  
b. What is a breakwater? Give a note on different types of breakwaters. [10]
5. a. With the help of a neat diagram explain in detail, the different layers of a flexible pavement. [10]  
b. What are the corrections to be applied to basic runway length? Given that the basic runway length for a proposed airport is 1150 m. What will be the corrected length of the runway, if the airport is at an elevation of 400 m? The airport reference temperature is  $26^\circ\text{C}$  and the effective runway gradient is 0.38 percent. [10]
6. Write short notes on any four of the following [20]
  - (a) Critical stress combination on rigid pavements
  - (b) O&D studies
  - (c) Equivalent single wheel load
  - (d) Methods for Strengthening of existing pavement
  - (e) Steps for the design of a rigid pavement
  - (f) Spot speed and its types

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Time: 3 Hours

Total Marks: 80

Note:

1. Question number 1 is compulsory;
2. Attempt any three out of the remaining five questions.
3. Draw neat sketches wherever necessary.
4. Figure to the right indicates full marks.

Q1	Attempt <b>any four</b>	20
	a) Explain working principles of lift.	
	b) Compare single phase and three phase electric supply.	
	c) Explain fire preventions in buildings.	
	d) Write a note on corrosion resistant steel.	
	e) Write a note on water meter.	
	f) Write a note on polymer concrete.	
Q2	a) Explain in detail modern lighting with examples.	10
	b) Explain in detail septic tank.	10
Q3	a) Explain the causes of deterioration of concrete.	10
	b) Discuss in details the types and causes of cracks in structures.	10
Q4	a) Write a note on destructive and nondestructive tests	10
	b) Explain grouting and discuss in detail about injection grouting.	10
Q5	a) Explain in detail the causes of accidents on construction sites.	10
	b) Draw and explain water supply system of a residential building	10
Q6	Write notes on the following ( <b>any four</b> )	20
	a) Tender documents	
	b) Cathodic protection	
	c) Causes of fire in building	
	d) Factors affecting visual task	
	e) Causes of seepage in structures	

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.
- iv) Assume suitable data if required.

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- Q.1 Write notes on any four of the following questions. 20
- i.- Geopolymers
  - ii.-Carbon credits
  - iii-Alternatives building blocks for walls
  - iv- Nanotechnology for sustainable development
  - v- Renewable and nonrenewable energy
- Q.2 A) Discuss in detail about the requirements for environmental and cost-effective building for different climatic regions in India. 10
- B) What do you mean by sustainable development? What are the measures of sustainable development. Mention the challenges to such developments. 10
- Q.3 A) Describe the requirements and classifications of mortar. 10
- B) Explain any five supplementary cementitious materials and their effect on fresh and hardened concrete. 10
- Q.4 A) Discuss about different types of curing methods used in construction. 10
- B) Explain the matrix materials, types of polymers used and application of Fibre reinforced polymer composites. 10
- Q.5 A) Explain the materials used, construction methods and application of ferrocement. 10
- B) Explain the various roof alternatives available in construction and its application.? 10
- Q.6 A) What are the various industrial waste materials used in construction industry with its merits and demerits. 10
- B) Discuss the details of Water and Air Act in India. 10

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(Time: 3 Hours)

(Total Marks: 80)

- Note:** 1. **Question number 1 is compulsory**; attempt **any three** out of the remaining five questions.  
 2. Assume suitable **data** if **required** and mention it clearly.  
 3. Draw neat sketches wherever necessary. Figure to the right indicates full marks.  
 4. IS 10262:2019 is not allowed. Graphs & tables are provided in the QP.

**1. Attempt any five.**

- (a) What is the effect of viscosity modifying admixtures in the fresh concrete? [04]  
 (b) What is non - destructive testing of concrete? Enlist the various tests involved. [04]  
 (c) What is hot weather concreting? What are the harmful effects of hot weather? [04]  
 (d) Draw the schematic diagram of pull-out test procedure. [04]  
 (e) A sample of concrete is prepared by using 500 g of cement with water cement ratio of 0.55 and  $240 \text{ N/mm}^2$  intrinsic strength of gel. What is the theoretical strength of concrete on full hydration? [04]  
 (f) Explain the concept behind statistical quality control of the concrete with a sketch. [04]  
 (g) Following statement is true or false. If false, rewrite the correct statement. [04]  
 i. Compressive strength is an intrinsic property of concrete.  
 ii. Rate of hydration is on the order of  $\text{C}_3\text{A} > \text{C}_2\text{S} > \text{C}_3\text{S} > \text{C}_4\text{AF}$   
 iii. Theoretically, 0.23 g of bound water is required to completely hydrate 1 g of cement.  
 iv. Cold weather is defined as a period when the average daily temperature falls below  $-4^\circ\text{C}$  for more than three successive days.
2. (a) State the relationship between depth of carbonation and grade of concrete. Draw a suitable diagram highlighting the depth of carbonation in concrete. [05]  
 (b) Explain the acceptance criteria of concrete according to IS 456. [05]  
 (c) What is the difference between the concrete mixture design by IS 10262 and ACI method and which concrete mixture design gives economy? Explain in detail. [10]
3. (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 = M 35  
 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 = 3.15  
 xi. Specific gravity of C.A = 2.75  
 xii. Specific gravity of F.A = 2.65  
 xiii. Aggregates are assumed to be in saturated surface dry condition.  
 F.A belongs to Zone II  
 Refer tables and graph given at the end for the mixture design.

- (b) 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) Enlist different light weight aggregates used in concrete as ingredients, and explain any one in detail. [05]  
 (b) Explain in detail corrosion monitoring techniques of reinforcement and preventive measures. [05]  
 (c) Define coarse aggregate. Classify coarse aggregates on the basis of surface texture. How does surface texture influences on the properties of fresh as well as hardened concrete? [05]  
 (d) State the salient features of self-compacting concrete. [05]
5. (a) Explain problems associated with the presence of fluids in the pores of concrete. [05]  
 (b) Write a short note on the importance of using optimum water cement ratio for heat of hydration. [05]  
 (c) State the problems associated with mass concreting. Suggest remedies to overcome these problems. [05]  
 (d) Define gel space ratio. How is it calculated? What is the effect of gel-space ratio on concrete? [05]
6. (a) What is pervious concrete? What are the advantages of pervious concrete? [05]  
 (b) Explain the maturity concept of concrete. Also calculate the strength of concrete at the age of 10 days when cured at an average temperature during day time at 35°C and night time 18°C, if the strength of fully matured identical concrete is found to be 30 MPa. [05]  
 (c) Explain theories of failure of cement paste and aggregates in concrete for freezing and thawing? [05]  
 (d) What is the purpose of the core test? State the guidelines to be followed for core sampling in concrete? [05]

**Plowman's Coefficients for Maturity Equation**

Strength after 28 days at 18°C (Maturity of 19,800°C·h): MPa	Coefficient	
	A	B
Less than 17.5	10	68
17.5 – 35.0	21	61
35.0 – 52.5	32	54
52.5 – 70.0	42	46.5

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

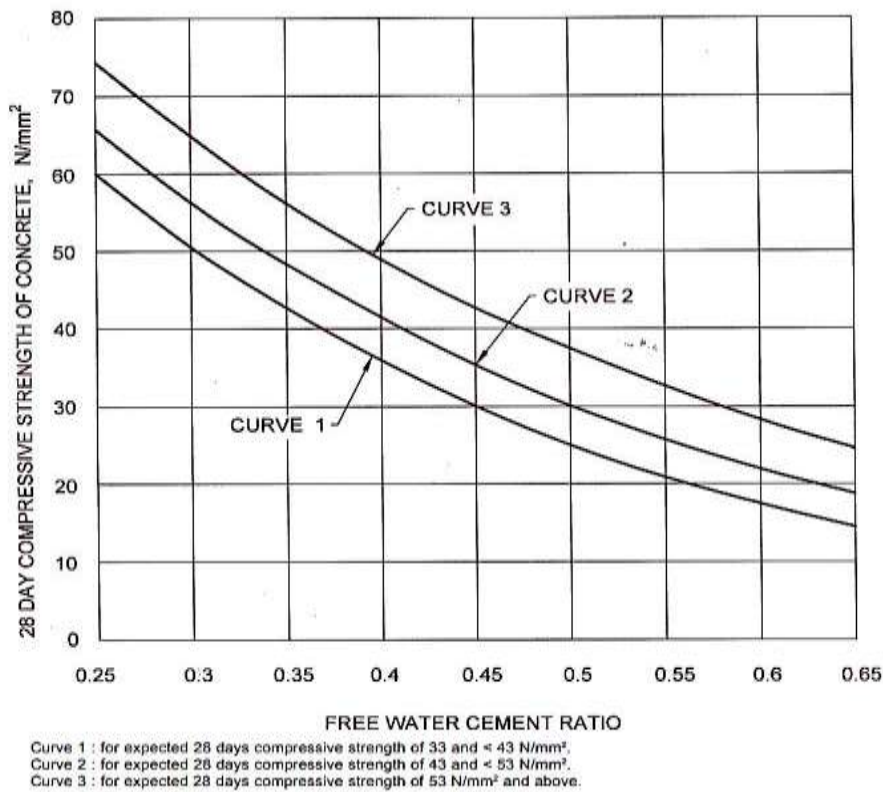
Table 1: Maximum Water Content per Cubic meter of Concrete for Nominal Maximum Size of Aggregate

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



**FIG 1. RELATIONSHIP BETWEEN FREE WATER CEMENT RATIO AND 28 DAYS COMPRESSIVE STRENGTHS OF CONCRETE FOR CEMENTS OF VARIOUS EXPECTED 28 DAYS COMPRESSIVE STRENGTHS**



**Duration: 3hrs**

**[Max Marks: 80]**

- Instructions.: (1) Question No.1 is **Compulsory**.  
(2) Attempt any **three** questions out of the remaining five.  
(3) **Each** full question carries **20** marks.

**Q.1** Answer any **FOUR**

- a Explain the role of infrastructure in the economic growth of the nation. (05 M)
- b Distinguish between apron and hangar. (05 M)
- c Write short note on Rapid Mass Transit System. (05 M)
- d Explain zoning near airports. (05 M)
- e What are the applications of drone surveys? (05 M)

- Q.2**
- a Discuss the various factors to be considered for the selection of a suitable site for a major airport. (10 M)
  - b Explain the classification of harbours based on utility. (05M)
  - c Differentiate between social infrastructure and physical infrastructure. (05M)

- Q.3**
- a Explain the classification of bridges based on (i) structural behaviour (ii) structural materials (10 M)
  - b Write a note on Air Traffic Control and its functioning. (05 M)
  - c Discuss what steps should be taken to achieve uninterrupted traffic system in urban areas. (05 M)

- Q.4**
- a Briefly explain the different methods of tunneling in hard rock? (10 M)
  - b List out the advantages and disadvantages of water transportation compared to other modes of transport. (05 M)
  - c Write short note on EDM instruments. (05 M)

- Q.5**
- a Explain the working of the following construction equipment with the help of neat sketches (10 M)
    - (i) Power shovel
    - (ii) Drag line
  - b What are the factors controlling the design of a taxiway? (05 M)
  - c Briefly explain the basic components of GPS. (05 M)

**Q.6** Write short notes on:

- a Amphibians and hovercrafts (05 M)
- b Pile driving machine (05 M)
- c Slip forms (05 M)
- d Guided transport system (05 M)

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(3 HRS)

(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 **5x4=20**

- (a) Derive the equation of impact of jets on flat stationary vanes  
(b) Draw the neat sketch of velocity triangle for tangential flow turbine.  
(c) Define with neat sketch Centrifugal Pump. What are its main parts.  
(d) Differentiate between (i) Uniform & Non-Uniform flow (ii) Steady & Unsteady flow  
(e) Derive conditions for most economical rectangular channel section.

**Q.No.2.(a)** Drive the expression for force exerted by jet on hinged plate **10**

- (b) A jet of water of diameter 75 mm strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of  $165^\circ$ . Assume the plate is smooth. Find (i) Force exerted on the plate in the direction of jet (ii) Power of the jet (iii) Efficiency of the jet **10**

**Q.No.3 (a)** What are types of Draft Tube. Explain Draft tube theory. **10**

- (b) A Kaplan turbine runner is to be designed to develop 9000 kW. The net available head is 6 m. If the speed ratio is 2.0 and flow ration is 0.68, overall efficiency is 86% and the diameter of hub is  $1/3$  the dia of the runner. Find the dia of the runner, its speed and the specific speed of the turbine. **10**

**Q.No.4 (a)** A three stage centrifugal pump has impeller diam 40 cm and 2 cm wide at outlet. The vanes are curved back at the outlet at  $45^\circ$  and reduce the circumferential area by 10%. The manometric efficiency is 90% and overall efficiency is 80% . Determine the head generated by the pump when running at 1000 rpm, delivering 50 lit/sec. What should be the shaft horse power ? **10**

- (b) (i) Explain Hydraulic Press **5x2=10**  
(ii) Write short notes on Hydraulic Ram

**Q.No.5(a)** Derive the conditions for most economical trapezoidal channel **10**

- (b) A sewer line is to be laid at the slope of 1 in 8000 to carry a max discharge of 500 lit/sec, when depth of water is 75% of vertical diameter. Find the dia of this pipe. Take Manning's  $N=0.020$  **10**

**Q.No.6 (a)** Derive the expression for Gradually Varied Flow with assumptions. **10**

- (b) A sluice gate discharges water into a horizontal rectangular channel with a velocity 8 m/s and depth of flow is 0.5 m. The width of the channel is 6 m. Determine whether the hydraulic jump will occur, and if so, find its height and loss of energy per kg. Also determine the horse power lost in the hydraulic jump **10**

Time: 3-hour

Max. Marks: 80

Please Note:

1. All questions carry equal marks
2. Question one is compulsory. Attempt any three out of remaining questions.
3. Use of IS 456:2000 is permitted
4. Assume suitable data if required and state if clearly.

- Q1** Attempt any four **20**
- a) Obtain stress block parameters in limit state method.
  - b) Write a short note on interaction curves used for design of columns.
  - c) Explain how safety of RCC structures is ensured using probability and reliability approach during design.
  - d) Write a short note on raft foundation and draw sketch showing reinforcement.
  - e) State different types of loads acting on structures. How they are calculated.
- Q2** a) A simply supported beam of size 230 mm x 530 mm overall depth is reinforced with 4 no of bars of 16 mm diameter. Find the safe uniformly distributed load on the beam over a span of 5.5 m. Use M20 grade concrete and Fe415 steel. **Adopt Working Stress Method.** **10**
- b) A T Beam of effective flange width 1000 mm, thickness of the slab is 100 mm, width of the rib is 250 mm and effective depth is 500 mm. beam is reinforced with 4 bars of 22 mm diameter. Calculate the factored moment of resistance. The Materials are M20 concrete and Fe250 steel. **10**
- Q3** a) Design a shear reinforcement for a beam of 250 mm x 500 mm effective depth carrying a factored shear force of 140 kN. It is reinforced with 5 no of bars of 16 mm diameter. Use M20 grade concrete and Fe415 steel. Adopt Limit State Method. **10**
- b) Design a simply supported R.C.C slab for an office floor having clear dimensions of 3 m by 9 m with 230 mm walls all- round. Adopt M20 grade concrete and Fe415 steel. Assume suitable data. **10**
- Q4** a) A simply supported beam of size 230 mm x 450 mm overall depth is reinforced with 3 no of bars of 12 mm diameter. Find the safe uniformly distributed load on the beam over a span of 5.0 m. Use M20 grade concrete and Fe415 steel. **Use Limit State Method.** **08**

- b) Determine the safe axial load for a short circular column 425 in diameter, reinforced with 6 bars of 22 mm diameter. It is provided with 8 mm diameter helical reinforcement at a pitch of 40 mm. Use M20 grade concrete and Fe 250 steel. **12**
- Q5**
- a) An RCC column of Size 350 x 350 mm carries a characteristic load of 800 kN. The allowable bearing pressure on soil is 200 kN/m<sup>2</sup>. Design an Isolated Square footing. The materials are M20 concrete and Fe415 steel. **12**
- b) What is T beam. Compare rectangular beam and T beam. **04**
- c) What is doubly reinforced beam. Under what situations doubly reinforced beam is provided. **04**
- Q6**
- a) Compare working stress method and limit state method. **05**
- b) Sketch reinforcement details of slab beam type footing and two-way slab with torsion reinforcement. **05**
- c) Design RC short column 400 mm x 600 mm to carry an axial load of 1500 kN. Use M20 grade concrete and Fe415 steel. Sketch the reinforcement details. **10**
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