PART A
General Engineering
(CIVIL AND STRUCTURAL)

1. (a) Determine the dissolved oxygen at the end of 2 days for the following data :

Characteristics	Stream water	Waste water
Flow (m^3/sec)	22	3
DO (mg/litre)	10	0
BOD (mg/litre)	3	190

Assume : Deoxygenation constant K = 0·11 per day

Reoxygenation constant R = 0·33 per day

(b) A clay stratum has 2·5 m thickness and has initial overburden pressure of 45 kN/m². The clay is over consolidated with a preconsolidation pressure of 65 kN/m². Find the final settlement due to increment of pressure of 55 kN/m² at the middle of clay layer. Use the following data :

Initial void ratio = 1·2

Compression index = 0·27

Swelling index = 0·06

(c) Discuss the factors affecting duty of water.

(d) Calculate the safe overtaking sight distance for a design speed of 100 km/hr. Assume maximum overtaking acceleration as 1·92 km/hr/sec.

a) What are the requirements of a good ballast in railway engineering ? Explain how the minimum depth of ballast cushion is estimated.

(b) Determine the correct bearings of the lines of a closed traverse PQRSTP. The readings are as follows :

Line	Fore bearing	Back bearing
PQ	195°30′	17°0′
QR	73°30′	250°30′
RS	36°15′	214°30′
ST	266°45′	84°45′
TP	234°15′	57°0′

Identify the stations affected by local attraction.

(c) What are the factors affecting selection of contour interval ?

(d) A trapezoidal dam with a vertical water face is 2·5 m wide at the top and 14 m wide at the base. The height of the dam is 27 m. Find the maximum depth of water so that the dam section is free from tension. Assume unit weight of dam material as 21 kN/m^3 and that of water as 9·81 kN/m^3.

3. (a) Describe plate load test as per IS 1888. Discuss the limitations. What are the effects of size of plate on bearing capacity and settlement ?

(b) A classroom is of the size $8 \cdot 5$ m × $3 \cdot 6$ m. Design a simply supported roof slab for this room. The superimposed load is 5 kN/m^2. Use M 20 grade concrete and HYSD Fe 415 steel. Use limit state method for the design.

| $100\ A_s$ / bd	0·15	0·25	0·50	0·75	1·0
τ_c N/mm^2	0·19	0·36	0·49	0·57	0·64

(c) Explain the steps for the design of column with helical reinforcement in limit state method.

4. (a) What are the characteristics of a good quality timber ?

(b) Derive the condition for the trapezoidal channel of best section. Prove that the hydraulic mean depth for such a channel is one-half the depth of flow.

(c) The discharge of a Pelton wheel turbine is 5 m^3/sec at a head of 300 m at the nozzle. There are two runners and each runner has two jets. The length of the pipeline is 1900 m. The efficiency of the transmission for the pipe is 90%. Assume friction factor f as 0·008. Determine jet diameter, pipe diameter and output of the turbine. The overall efficiency of turbine is 85%.

(d) What is workability of concrete ? Explain slump test and compacting factor test. Discuss the factors affecting workability.

3. (a) Describe plate load test as per IS 1888. Discuss the limitations. What are the effects of size of plate on bearing capacity and settlement ?

(b) A classroom is of the size 8·5 m × 3·6 m. Design a simply supported roof slab for this room. The superimposed load is 5 kN/m². Use M 20 grade concrete and HYSD Fe 415 steel. Use limit state method for the design.

$100\, A_s / bd$	0·15	0·25	0·50	0·75	1·0
τ_c N/mm²	0·19	0·36	0·49	0·57	0·64

(c) Explain the steps for the design of column with helical reinforcement in limit state method.

4. (a) What are the characteristics of a good quality timber ?

(b) Derive the condition for the trapezoidal channel of best section. Prove that the hydraulic mean depth for such a channel is one-half the depth of flow.

(c) The discharge of a Pelton wheel turbine is 5 m³/sec at a head of 300 m at the nozzle. There are two runners and each runner has two jets. The length of the pipeline is 1900 m. The efficiency of the transmission for the pipe is 90%. Assume friction factor f as 0·008. Determine jet diameter, pipe diameter and output of the turbine. The overall efficiency of turbine is 85%.

(d) What is workability of concrete ? Explain slump test and compacting factor test. Discuss the factors affecting workability.

(a) In a roof truss, the member consists of 2 ISA 100 × 75 × 8 mm
angles are connected to either side of a 10 mm gusset plat
member is subjected to a working pull of 280 kN. Desig
welded connection assuming they are made in the workshop
centre of gravity of the section from the top may be conside
31 mm.

(b) Draw the shear force and bending moment diagram for the
as shown below :
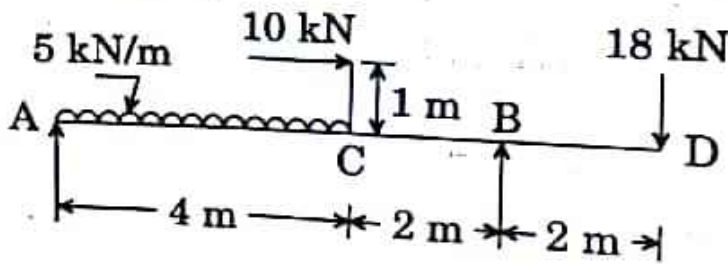
(c) Define the following terms :

Scrap value, Salvage value, Sinking fund and Depreciation

(a) A 6 m high vertical wall supports a saturated cohesive soil with horizontal surface. The top 3·5 m of the backfill has bulk density 18 kN/m^3 and apparent cohesion of 16 kN/m^2. The bulk density and apparent cohesion of the bottom 2·5 m is 19·5 kN/m^3 and 18 kN/m^2 respectively. What will be total active earth pressure on the wall ? Draw the pressure distribution diagram. Assume that tension cracks will develop. Locate the point of application of the resultant pressure.

(b) A direct shear test was conducted on a silty sand. At failure the normal and shear stresses were found to be 66 kPa and 40 kPa respectively. Draw Mohr's circle and determine :
   (i)   Angle of shearing resistance
   (ii) Principal stresses at failure
   (iii) Locate the pole and find orientation of failure plane.

(c) The pump-out test was performed to determine the field permeability of an unconfined aquifer and the following observations were made :

      RL of original water table before pumping = 250·5 m
      RL of water in the well at constant pumping = 245·6 m
      RL of the rock of impervious layer = 220·0 m
      RL of water in observation well = 249·8 m
      The distance of observation well from tubewell = 48 m

Determine
   (i)   Coefficient of permeability of the aquifer (k)
   (ii) Error in k if observations are not taken in the observation well and radius of influence is assumed to be 298 m
   (iii) Actual radius of influence based on the observations of observation well
   (iv) Radius of influence using Sichart equation
The diameter of the well is 20 cm and discharge is 250 m^3/hr.