1. For a concrete of M30 grade, explain the characteristic compressive strength compliance requirement as per IS 456:2000 (5 Marks)

2. Explain with diagram, the law which depicts the relationship between water cement ratio and strength of concrete. (5 Marks)

3. For the data given in the table, complete the missing details on earliest finish time, latest start time and total float. (5 Marks)

Activity	Duration	Earliest Start time	Earliest Finish time	Latest Start time	Latest finish time	Total float
A	3	0	—	—	3	—
B	5	0	—	—	13	—
C	8	0	—	—	17	—
D	1	3	—	—	10	—
E	4	3	—	—	8	—

4. Prepare a rough estimate for a proposed commercial complex for a municipal corporation for the following data using cubical content method. Plinth Area = 1000 m^2/floor, Number of storeys = G+3,

   Height of each storey = 3.6 m, Cubical content rate = Rs. 2000/m^3, provided for the following

   (a) Water supply & sanitary arrangement = 10% (b) Electrification = 5% (c) Fluctuation of rates = 5% (d) Contractors profit = 10% (e) Petty Supervision & contingencies = 2.5%.

   Report the final answer in crores of rupees. (5 Marks)

5. A high-precision surveying instrument, acquired today for Rs. 1,00,000 is projected for nonstop operation across 10 years in civil engineering field tests. Its end-of-life scrap value is Rs. 10,000 Calculate the remaining book value right at the onset of its 5^{th} operational year, applying straight-line depreciation. (5 Marks)

6. A canal cross section has offsets from baseline at 10 m intervals. Compute the area using Simpson's rule. (5 Marks)

Station (m)	0	10	20	30	40	50	60
Offset (m)	0	4.0	5.2	8.1	7.8	4.9	0

7. A Highway fill has to be compacted to 90% of Standard Proctor test density. A burrow area available near the site has a dry density of 1.7 g/cc at 100% compaction and a natural void ratio of 0.705.The specific gravity of the soil solids is 2.61. Compute the volume of borrow material needed to construct a highway fill of height 5 m and length 1km with side slopes 1:1.5 The top width of the fill is 8 m. (5 Marks)

8. The time to reach 60% consolidation is 30 seconds for a sample of 10 mm thick, tested in laboratory under the conditions of double drainage. How many years will be the corresponding layer in nature requires to reach the same degree of consolidation if it is 10 m thick and drained one side only. (5 Marks)

9. A pile is driven in a uniform clay of large depth. The clay has unconfined compression strength of 90 kN/m^2. The pile is 45 cm diameter and 6 m long. Determine the safe frictional resistance of the pile. Assume a factor of safety of 3. Assume the adhesion factor = 0.7 (5 Marks)

10. A concentrated load of 22.5 kN acts on the surface of a homogenous soil mass. of large extent. Find the stress intensity at a depth of 15 meters and (a) directly under the load (b) at a horizontal distance of 7.5 m. Use Boussinesq's equations. (5 Marks)

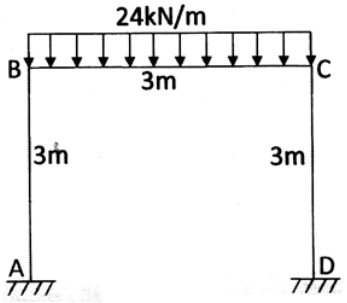
11. Derive the relation between void ratio (e) in terms of G (Specific gravity of soil solids), water content (w), and degree of saturation (S) with the help of a three phase diagram. For a fully saturated soil how will you modify the equation of void ratio. (5 Marks)

12. Discuss the procedure for conducting standard penetration test as per Indian standard. What are the corrections to be done after observing N values? (5 Marks)

13. A simply supported beam of span 4 m supports a uniformly distributed load of 4 kN/m over the entire span along with a point load 2 kN at the midspan. Draw the bending stress distribution in the midspan cross section. The cross section is rectangular with width 60 mm and depth 100 mm. (5 Marks)

14. The extension of a bar specimen when subjected to an axial pull of 100 kN was measured to be 0.08 mm on a gauge length of 20 cm. The initial diameter of the bar was 40 mm which was reduced by 0.004 mm under the axial pull. Determine the Young's modulus, rigidity modulus, bulk modulus and Poisson's ratio of the material of the bar. Take cross sectional area = 1250 mm^2. (5 Marks)

15. Analyse the frame shown in figure using slope deflection method and draw the bending moment diagram. The frame is fixed at A and D and has rigid joints at B and C. Take EI as constant. (5 Marks)



16. A reinforced concrete beam of effective span 6 m is singly reinforced with steel bars of area 792 mm^2 at effective cover of 50 mm. Cross section of the beam is rectangular 250 mm 500 mm. Determine whether the beam is under reinforced as per limit state method. Assume M20 concrete and Fe 250 steel. (5 Marks)

17. Determine the design tensile strength of the plate 160 8 mm with holes for 16 mm diameter bolts as shown in figure, considering gross section yielding and net section rupture only. Plates are of steel grade Fe 410.

(5 Marks)

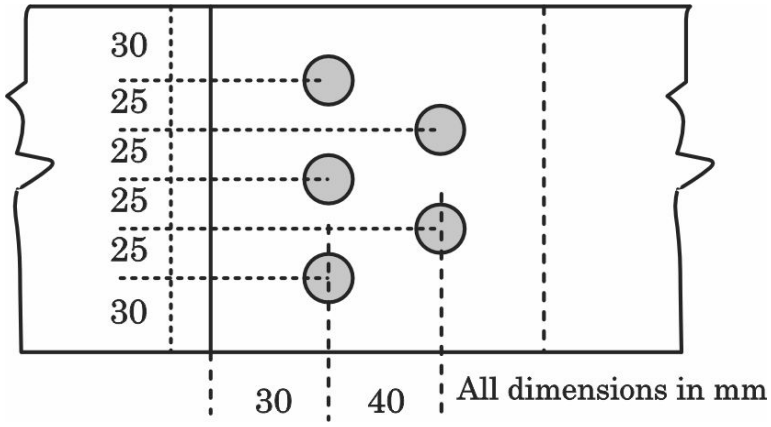
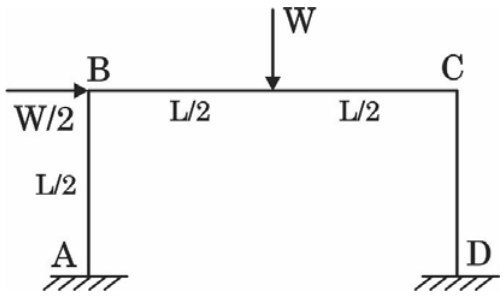


Table 5 Partial Safety Factor for Materials, γ_m

(*Clause* 5.4.1)

Sl.No.	Definition		Partial Safety Factor	
(i)	Resistance governed by yielding, γ_{m0}		1.10	
(ii)	Resistance of member to buckling γ_{m0}		1.10	
(iii)	Resistance, governed by ultimate stress γ_{m1}		1.25	
(iv)	Resistance of connection :		Shop Fabrications	Field Fabrications
	(a)	Bolts-Friction Type, γ_{mf}	1.25	1.25
	(b)	Bolts-Bearing Type, γ_{mb}	1.25	1.25
	(c)	Rivet, γ_{mr}	1.25	1.25
	(d)	Welds, γ_{mw}	1.25	1.50

18. Determine the value of W at which the frame in figure will collapse. Frame is fixed at A and D; joints B and C are rigid and all the members are of the same section with plastic moment capacity of Mp. (5 Marks)



19. The following tacheometric observations were made on two points P and Q from a station A. The height of the tacheometer at A above the ground was 1.55 m. Determine the elevations of P and Q if the elevation of A is 75.500 m. The stadia constant k and c are respectively 100 and 0.00 m. Assuming that the standard error in stadia reading is +/– 1.6 mm and of vertical angle +/– 1.5'. (5 Marks)

Staff at	Vertical angle	Staff reading		
		Upper	Middle	Lower
P	–5°12'	1.388	0.978	0.610
Q	+27°35'	1.604	1.286	0.997

20. To measure a line AB, a theodolite was set up at A and a subtense bar of length 2 m was set up at B. The horizontal angle measured at A for the subtense bar targets was 4°02'26.4". Determine the length of AB, the fractional error in length AB if the horizontal angle was measured with an accuracy of +/– 1.5", and the error in AB if the subtense bar was out by 1° from being normal to AB. (5 Marks)

21. To determine the sea level distance between two stations A and B, A being lower than B, the measured slope distance between A and B corrected for meteorological conditions, is 32015.65 m. The measured vertical angles at A and B are +3°40'15" and –3°51'32", respectively. The elevation of point A is 410.22 m. Determine the sea level distance between the points. Take mean earth's radius as 6370 m. (5 Marks)

22. What are the duties of a surveyor? Write short notes on types of errors in surveying. (5 Marks)

23. The two velocity components of a three-dimensional fluid flow are $u = (2x^2 + 2xy)$ and $w = (z^3 - 4xz - 2yz)$. Determine the third component of velocity(v), such that they satisfy the continuity equation. (5 Marks)

24. The velocity distribution for laminar flow of real fluid in a pipe is given as $v = V_{max}\left[1 - \left(\frac{r^2}{R^2}\right)\right]$, where V_{max} is the velocity at the centre of the pipe, R is the pipe radius, and v is the velocity at radius r from the centre of the pipe. Determine the kinetic energy correction factor. (5 Marks)

25. If y_1 and y_2 are the alternate depths in a rectangular channel, prove that $\frac{2y_1^2 y_2^2}{(y_1 + y_2)} = y_c^3$. Here y_c is the critical depth. (5 Marks)

26. Show by Rayleigh's method of dimensional analysis that the resistance R to the motion of sphere of diameter D moving with uniform velocity V through a fluid having density ρ and viscosity μ may be expressed as $R = (\rho D^2 V^2)\phi\left(\frac{\mu}{\rho DV}\right)$. (5 Marks)

27. The rates of rainfall for successive 20 minutes storm in mm/hour are 22, 22, 95, 72, 12.5, 12.5 and 50. Taking the value of ϕ-index as 31 mm/hour, find out the net runoff and total rainfall in mm. (5 Marks)

28. Explain the classification of cross drainage works. (5 Marks)

29. Design speed is considered the controlling factor in geometric design of highways. Justify this statement by explaining its influence on horizontal and vertical alignments and sight distance. (5 Marks)

30. Explain the desirable properties of road aggregates and bitumen used in pavement construction. (5 Marks)

31. Explain the types of joints provided in rigid pavements. State their functions and importance. (5 Marks)

32. State the requirements of an ideal rail fastening system. Explain why elastic fastenings are preferred over rigid fastenings. (5 Marks)

33. Define free-flow speed, jam density and critical density. Explain their significance in traffic engineering. (5 Marks)

34. Explain the concept of intersection control hierarchy. (5 Marks)

35. Define Biological Oxygen Demand (BOD). Explain the significance of BOD in assessing wastewater quality. (5 Marks)

36. What is Dissolved Oxygen (DO)? Explain its importance in water quality and aquatic life. (5 Marks)

37. A residential colony has a population of 10,000 people. The average water supply is 200 litres per capita per day. Calculate the quantity of domestic waste water generated. Assume that 80% of the supplied water appears as domestic wastewater. (5 Marks)

38. 'List the major emissions from automobiles causing air pollution. What are the technological measures for controlling automobile air pollution? (5 Marks)

39. What is Air Quality Index (AQI)? List the major air pollutants considered in calculating AQI. (5 Marks)

40. Explain the environmental impacts of open dumping of municipal solid waste. (5 Marks)

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