(3Hours) **Max Marks=80**

Note 1. Question 1 is compulsory
2. Attempt any 4 out of six questions
3. Assume any suitable data where ever required

Q.1 Attempt any **four**

a. The mass of a chunk of moist soil is 20kg and its volume is 0.011m3. After drying in an oven the mass reduces to 16.5kg. Determine the water content, the density of moist soil, the dry density, void ratio and degree of saturation. **05**

b. Write a note hydrometer method of analysis. **05**

c. A horizontal stratified soil deposit consists of three uniform layers of thickness 6, 4, and 12m respectively. The permeabilities of these layers are $8x10^{-4}$ cm/sec, $52x10^{-4}$ cm/sec, and $6x\ 10^{-4}$ cm/sec. Find the effective average permeability of the deposit in the horizontal and vertical direction. **05**

d. Explain light compaction with a neat diagram. **05**

e. Compute the area ratio of a sampling tube given the outside diameter = 100mm and inside diameter = 94mm. In what types of soil can this tube be used for sampling. **05**

Q.2 **a.** What are different types of clay soil minerals? Describe in brief. **05**

b. Write a note on soil borelog. **05**

c. The following are the results of standard compaction test performed on a sample of soil: **10**

Water content, %	12	14	16	18	20	22
Bulk density, gm/cc	1.77	1.95	2.01	1.97	1.97	1.95

Plot compaction curve and obtain maximum dry density and optimum moisture content. Calculate the water content necessary to completely saturate the sample at its maximum density, assuming no change in the volume. Take G = 2.7 and volume of mould 950ml.

Q.3 **a.** A soil has a liquid limit of 25% and a flow index of 12.5%. If the plastic limit is 15% determine the plasticity index and the toughness index. **05**

b. How would you determine permeability of a soil deposit consisting of layers of fine grained soil. Discuss in detail with neat diagram. **05**

c. A sand deposit is 10m thick and overlies a bed of soft clay. The ground water table is 3m below the ground surface. If the sand above the ground water table has a degree of saturation of 45%, determine and construct pressure distribution diagram of total pressure, pore water pressure and effective pressure. The void ratio of sand is 0.70 and take G = 2.65. **10**

Q.4 **a.** Explain various methods to determine water content of the soil. **05**

b. Explain Casagrande method of determination of liquid limit of soil. **05**

c. Define soil thixotropy. A soil has Liquid limit= 55%, Plastic limit=20%, natural moisture content= 15%. Calculate and comment on the Plasticity index, Consistency index, Liquidity Index. **10**

Q.5 **a.** Define soil transmissibility. The falling head permeability test was conducted on a soil sample of 4cm diameter and 18cm length. The head fell from 1.0m to 0.40m in 20minutes. If the cross-sectional area of the stand pipe was 1cm2, determine the coefficient of permeability. **10**

b. A sand deposit consists of two layers. The top layer is 2.5m thick with density 11.71 gm/cc and the bottom layer is 3.5m thick with saturated density of 2.06 gm/cc. The water table is at a depth of 3.5m from the surface and the zone of capillary saturation **10**

is 1m above the water table. Draw the diagram showing the variation of total stress, neutral stress and effective stress.

Q.6 **a.** What are the purposes of site exploration. A sample of clay has liquid limit of 63% and plasticity index 30%. (a) What is the state of consistency of the soil if the soil has its natural water content of 34%. (b) Calculate the shrinkage limit if the void ratio of the sample at the shrinkage limit is 0.70. Assume G = 2.70 **10**

b. The soil has a following characteristics % passing 75micron = 8%, percentage retained on 4.75mm sieve = 35, coefficient of curvature = 2.5 coefficient of uniformity = 7. The fine fraction gave the following results Plasticity index = 3, liquid limit = 15%. Classify the soil. **10**

Time : 3 Hrs. **Total Marks : 80**

Note: Question no. 1 is compulsory.
Solve any 3 questions out of remaining questions.
Assume suitable data, if required.
Draw neat sketches wherever required.

1. Solve **any four** questions out of following **20**
   a. Write note on multistage centrifugal pumps
   b. Find the force of impact of jet when it strikes a flat plate at right angles.
   c. Write short note on Hydraulic Ram
   d. Explain with neat sketch Hydraulic Accumulator
   e. Derive the condition for most economical rectangular channel section
   f. Write a note on Characteristic curves of Turbine

2. a. A jet of water is moving at 60 m/s and is deflected by a vane moving at 25 m/s in a direction at 30° to the direction of the jet. The water leaves the blades with no velocity component in the direction of motion of the vane. Determine the inlet and outlet angles of the vanes for no shock at entry or exit. Take the outlet velocity of water relative to the blades to be 0.85 of the relative velocity at entry. **10**
   b. Derive the equation for loss of energy due to hydraulic jump. **10**

3. a. The inlet & outlet diameters of an inward flow reaction turbine are 3.50 m and 2.50 m, the width at inlet as well as outlet being 550 mm. The guide blade angle is 22°. The inlet vane angle is 94°. The turbine runs at 160 rpm. Find the discharge of the turbine, the runner power developed and the vane angle at outlet. Assume that the turbine is discharging radially at outlet **10**
   b. Determine the dimensions of a trapezoidal channel of best section whose sides have a slope of 3H to 2 V. The proposed lining for the channel has a roughness coefficient N = 0.012. The bed slope of the channel is 1 in 5000, and the channel must discharge 10 m^3/s of water. **10**

4. a. Find the slope of the free water surface in a rectangular channel of width 20 m, having depth of flow 5 m. the discharge through the channel is 50 m^3/s. The bed of the channel is having a slope of 1 in 4000. Take the value of Chezy's constant C=60. **10**
   b. A 100 mm diameter jet discharging 0.45 m^3/s impinges on a series of curved vanes moving at 20 m/s. The direction of the jet and the direction of motion of the vane are the same at inlet. Each vane is so shaped that if stationary it would deflect the jet by 165°. Calculate (a) The force exerted in the direction of motion of the vane, (b) The power developed and (c) The hydraulic efficiency. **10**

5. a. The turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90%, determine (a) specific speed of the turbine, (b) power generated, (c) Unit speed, unit discharge and unit power when working under a head of 20 m. **10**

   b. The draft tube fixed to a Francis turbine has an inlet diameter of 3.25 m and an outlet area of 25 m^2. The inlet of the draft tube is 5.5 m above the tail water level. The outlet level of the draft tube is at tail water level. Velocity of water at inlet to the draft tube is 5 m/s. the loss of head in the draft tube may be taken as 0.5 times the kinetic head at outlet. Find (a) Pressure head at inlet of the draft tube, (b) Total head at the inlet of draft tube, (c) Power at outlet of runner, (d) Power at outlet of draft tube (e) Power lost in draft tube. **10**

6. a. Derive the condition for most economical Circular section for condition of maximum velocity **10**

   b. A centrifugal pump running at 100 rpm has an outlet vane angle of 60^o. The velocity of flow through the impeller is constant at 3 m/s. the manometric head is 24 m and the manometric efficiency is 75 %. The diameter is twice the inlet diameter. Assuming that water enters without whirl, find (a) the inlet & outlet diameter of the impeller (b) Inlet vane angle **10**

(3 Hours) **[Total Marks: 80**

Note: **i. Q. No. 1 is compulsory**
ii. Attempt any 3 out of remaining 5
iii. Support all theory and numerical with neat sketch

1. Solve any **four** (20 M)
   A. Compare various modes of transportation.
   B. Explain the basic requirements of ideal Highway Alignment.
   C. Write note on Passenger Car Unit (PCU).
   D. Discuss on Lane distribution factor.
   E. Discuss on highway drainage.
   F. Explain various rigid pavement failures.

2. A. What is safe stopping distance? find out the SSD required for a single lane 2-way road on a leveled ground, if the design speed is 50 kmph when gradient is 5% and break efficiency is 50%. (10 M)
   B. Discuss on Negative Super-elevation. Also, if 8^0 curve track diverges from main curve of 5^0 in an opposite direction in a layout of B.G yard, calculate Super-elevation and speed on branch line if maximum speed permitted on main line is 55kmph. (10 M)

3. A. Find msa for construction of new bypass for single lane having initial traffic 250 cvpd in both directions. Rate of growth is 6.5 %, VDF is 2.5, CBR is 4 %, construction period is 2 years & 'n' is 15 years. (10 M)
   B. Draw and show all the pavement layers of flexible pavement with their function (10 M)

4. A. Explain any one test performed on Aggregate in laboratory in detail. (10 M)
   B. The runway length required at sea level in standard atmospheric condition is1620 m. the airport has an elevation of 270m. ART is 32.94^0 C. If effective gradient is 0.20 percent, find corrected runway length. (10 M)

5. A. Design a rigid pavement for wheel load of 7000 kg, tyre pressure 7.5 kg/cm^2, spacing between longitudinal joints is 3.75 m & spacing between contraction joints is 4.2 m. Take E = 3 x 10^5 kg/cm^2, μ = 0.15, e = 1 x 10^{-5}, k = 30 kg/cm^3, flexural strength = 45 kg/cm^2. (10 M)

Thickness (cm)	22	24	26	30
Temp. Difference	14.8	15.6	16.2	16.8

   FOS = 1.1 to 1.2. take Cx = Cy = 1.
   B. Compare different types of road signs. Draw three examples of each. (10 M)

6. A. Determine characteristic deflection for the following readings taken on a road having traffic 1800 cvpd. 1.48, 1.62, 1.40, 1.28, 1.32, 1.71, 1.63, 1.22, 1.13, 1.53. (10 M)
   Also, if temperature of pavement = 29°C, and the moisture correction factor is 1.2, find the corrected Dc.
   B. Explain Superelevation. Also, design Superelevation for a curve having radius 500 m & speed is 100 kmph. (10 M)

Time: 3-hour **Max. Marks: 80**

Please Note:

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

Q1 Attempt any four of the following. **20**

a) What is doubly reinforced beam. Under what conditions doubly reinforced beam is provided.

b) Design a singly reinforced beam 5 m span and carrying a udl of 25 kN/m. Take width of the section two third of the effective depth. **(USE LSM)**
(Materials: M20 concrete and Mild steel)

c) Write a short note on 'Slab Beam Type of Footing'. Draw a neat sketch.

d) A short RCC column of 500 mm × 500 mm is reinforced with 4 bars of 16 mm diameter. The effective length of the column is 2.9 m. find the ultimate load for the column. (Materials: M20 concrete and Mild steel) **(USE LSM)**

e) Draw neat sketches of following reinforcements in RC members.
   i. Longitudinal steel and Lateral tie in circular column
   ii. Reinforcement in two way slab
   iii. Reinforcement in singly reinforced beam

f) Explain various limit states.

Q2 a) A simply supported one way slab of a room has clear span of 2.8 m. Design the slab and check for shear. (other checks not needed) Live load = 3 kN/m^2. **10**
(Materials: M20 concrete and Fe 415 steel)
Show the reinforcement details. **(USE LSM)**

b) Design a singly reinforced beam 6 m span and carrying a udl of 30 kN/m. Take width of the section two third of the effective depth. **(USE WSM)** **05**
(Materials: M20 concrete and Fe 415 steel)

c) Explain the terms: Axial Bending, Uniaxial Bending and Biaxial Bending. **05**

Q3 a) A column of 600 mm* 600 mm is carrying an axial load of 1000 kN. Design the square footing for the column. The safe bearing capacity of the soil is 150 kN /m^2. (check for two way shear not required) (Materials: M20 concrete and Fe 415 steel) Show the reinforcement details. **(USE LSM)** **10**

b) Design a rectangular beam subjected to bending moment of 50 kNm, a shear force of 30 KN and a torsion of 25 kNm. Use M20 concrete and Fe 415 steel. (Materials: M20 concrete and Fe 415 steel) **(USE LSM)** **10**

Q4 a) A reinforced concrete beam is 300 mm wide. Effective depth of the beam is 450 mm. It is reinforced with four bars of 16 mm diameter as compression steel and four bars of 25 mm as tension steel. Cover to centre of compression steel is 50 mm. Determine moment of resistance of beam using **Working Stress Method** (Materials: M20 concrete and Fe 415 steel) **10**

b) Design a cantilever slab to carry a live load of 2 kN/m^2. The overhang of the slab is 0.8 m. (Materials: M25 concrete and Fe 415 steel) Draw reinforcement details.**(USE LSM)** **10**

Q5 a) A simply supported RC beam is 250mm wide and 500 mm effective depth is reinforced with 4 bars of 16 mm diameter. Design the shear reinforcement if the beam is subjected to factored shear force of 150 kN. Provide bent up bar to resist shear. Draw reinforcement details. (Materials: M20 concrete and Fe 415 steel)**(USE LSM)** **12**

b) Write a note on 'Raft Foundations'. **04**

c) Explain balanced section in WSM and LSM. **04**

Q6 a) A reinforced concrete column has an effective length of 2.75 m. it carries an axial load of 1500 kN. Design the column and draw reinforcement details. (Materials: M25 concrete and Fe 415 steel)**(USE LSM)** **14**

b) A simply supported two way slab of size 4m*6 m is provided 10 mm bars@ 200 mm c/c in both directions. Design torsion reinforcement at corner and draw a neat sketch. (Materials: M20 concrete and Fe 415 steel)**(USE LSM)** **06**
